Contextual Influences on the Use of Antenatal Care in Nepal

DHS Geographic Studies 2

MEASURE DHS+

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Abstract

This report explores the degree to which contextual factors are determinants of individual behavior, specifically regarding the use of antenatal services. Geographic variation in gender development and empowerment across districts in Nepal suggest that research on women's antenatal care behaviors may be enhanced by incorporating contextual data at the district level with individual and household level data from the 2001 Nepal Demographic and Health Survey (NDHS). This study of antenatal care uses DHS cluster geocodes to link with contextual data at the district level. The analysis focuses on two dichotomous outcome measures associated with antenatal care: (a) whether a woman received any antenatal care, and (b) for those women who made at least one antenatal care visit, whether she made four or more antenatal care visits during the pregnancy.

A renewed focus on women's empowerment and place can help direct attention to the study of social contexts and processes, particularly those relating to maternal health behaviors. Many studies of the use of maternal health services have focused on individual-level or *micro* characteristics. In contrast, this study explores the use of hierarchical models, specifically hierarchical generalized linear models (HGLM), to investigate whether contextual or *macro* characteristics also matter. The macro-micro framework postulates that social forces at the macro level determine micro-level opportunities and constraints and thereby influence individual decisions.

Policies and programs conceived without consideration for local context and place will have limited impact, unless they are informed by data that appreciates the vital connection between women's health and women's status across different spatial scales and analytical levels.

1 Introduction: A Contextual Analysis Framework

Most studies of maternal health outcomes focus on individual-level data from large-scale surveys. Over the last fifteen years, however, demographers and public health researchers have become interested in contextual issues and the use of multilevel modeling techniques (Balk, 1994; Degraff et al., 1997; Diez-Roux, 1998; Diez-Roux, 2001; Duncan et al., 1998; Entwisle et al., 1984; Entwisle et al., 1986; Entwisle et al., 1989; Hermalin, 1985; Hirschman and Guest, 1990; Magadi et al., 2000; Pebley et al., 1996; Sastry, 1996; Smith, 1989). This methodological focus is relevant when examining the effects of macro (or contextual) factors on social behavior played out at a micro (or individual and household) level. It can assess the extent to which individual behavior is influenced by personal characteristics and the attributes of the larger community.

Empirical investigations have examined gender context at the macro level and its impact on the use of antenatal care and reproductive behavior in Bangladesh (Balk, 1994), Nepal (Morgan and Niraula, 1996), India (Chacko, 2001; Stephenson and Tsui, 2002), and Nigeria (Kritz et al., 2000). These studies have found that regional differences in aggregate measures of the position of women produce significant differences in individual behavior. While the status of an individual woman is important, these studies show that the macro-level context of gender equality surrounding an individual also contributes substantially to differences in reproductive and maternal health outcomes. Such work is a motivation for this study.

The context of gender equality contributes substantially to differences in health outcomes.

The specific aim of this study is to investigate whether place (defined as district for the purposes of this research) matters for the use of antenatal health care in Nepal. The study focuses on two contextual measures of women's status and empowerment:

- The *gender development index (GDI)* assesses disparities in basic human capabilities between men and women, specifically regarding life expectancy, educational attainment, and income.
- The *gender empowerment measure (GEM)* assesses gender deprivation based on participation and empowerment; it focuses on women's participation in economic, political, and professional activities.

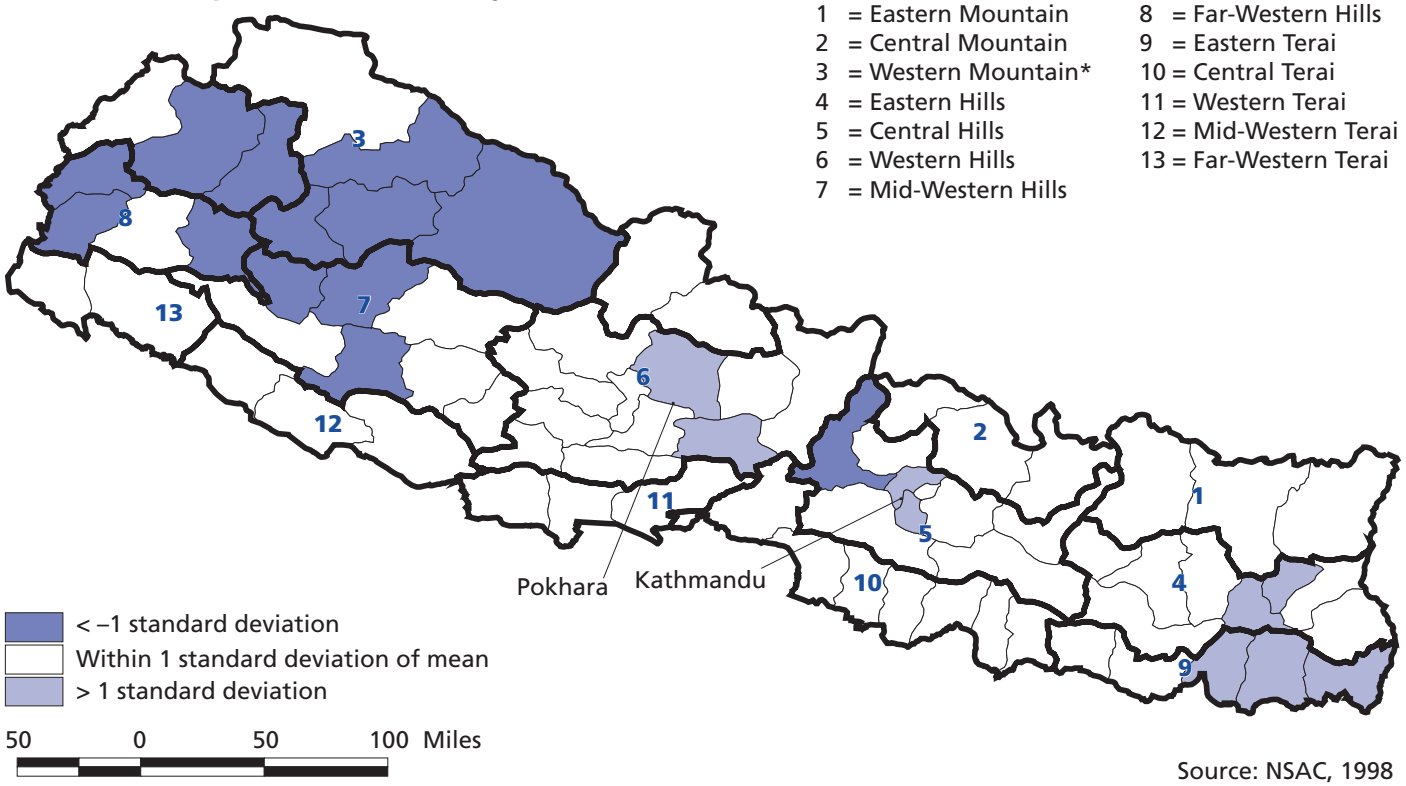
Both of these measures have been derived for the district level in Nepal based on data from the 1998 Nepal Human Development Report (NSAC, 1998).[1]

The use of antenatal care is expected to be lower among women living in districts with low GDI and GEM scores as compared to women living in districts with high GDI and GEM scores. GDI and GEM scores vary widely within Nepal (see Maps 1 and 2).[2] Both measures also exhibit high degrees of spatial autocorrelation (the Moran's

[1] Technical details on the construction of the GDI and GEM can be found in the Nepal Human Development Report (NSAC, 1998), Annex 3.1, pp. 257–260.

[2] It is important to note that at the district level the correlation between GDI and GEM is .725 (significant at .01). Thus this analysis does not include both GDI and GEM in the same model.

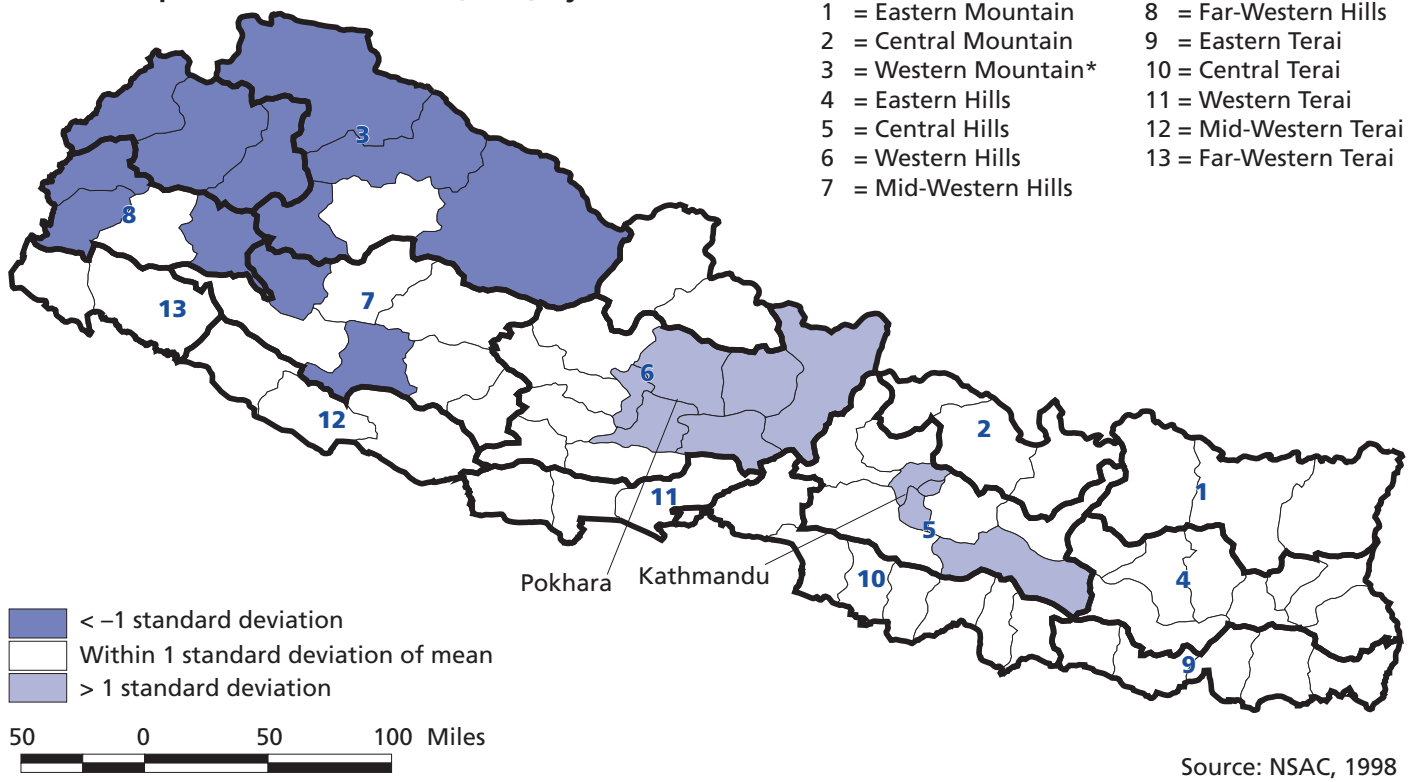
Map 1
Gender Development Index (GDI) by district



Source: NSAC, 1998

* Western, Mid-Western and Far-Western Mountain are combined to form the Western Mountain Sub-Region used by NDHS 2001.

Map 2
Gender Empowerment Measure (GEM) by district



Source: NSAC, 1998

* Western, Mid-Western and Far-Western Mountain are combined to form the Western Mountain Sub-Region used by NDHS 2001.

I for GDI = .6321 and for GEM = .5889—both highly significant at p = .001). That is, districts with high GDI scores tend to be located near other districts with high GDI scores (in the Kathmandu Valley, Pokhara, and the southeastern portion of the Eastern Development Region), while districts with low scores tend to be located near other districts with low scores (in the Far-Western and Mid-Western Mountains and Hills and in the area north of the Kathmandu Valley). GEM scores show a similar, but not identical, regional clustering (Map 2).

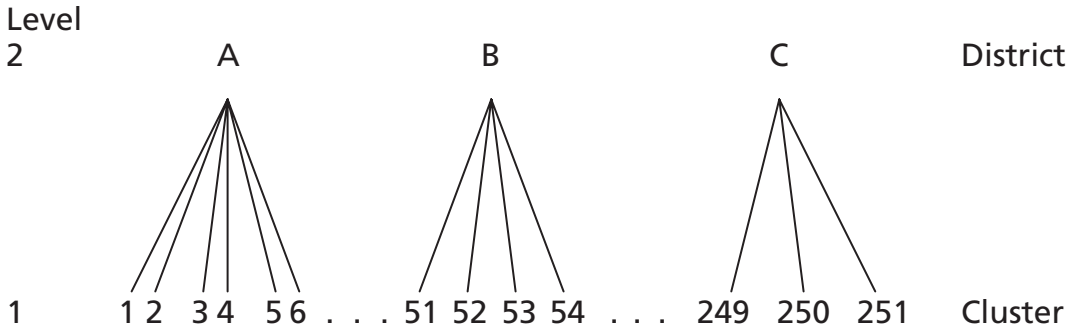
Geographic variation in gender development and empowerment variables across districts strongly suggests that considering contextual measures may enhance research on women's use of maternal health care.

Considering contextual measures may enhance research on women's use of maternal health care.

Contextual variables can be generated by aggregating data collected at the individual level, and that is the approach commonly taken by demographers and sociologists. In contrast, this study takes advantage of Demographic and Health Survey (DHS) cluster geocodes (latitude and longitude coordinates) and uses geographic information systems (GIS) to link to, and create, district-level attributes.[3] Researchers used GIS software to spatially join (1) 251 DHS clusters and the attribute data on individual women within each cluster with (2) district-level boundary files and their attributes. In other words, a multilevel dataset was generated (see Figure 1 and Map 3).

The choice of district as the second level of analysis is a pragmatic one. Comprehensive and reliable data are more widely available at the district level than for any smaller unit (e.g., village development committees or wards). In addition, the district offers a reasonable balance between small communities and large, heterogeneous ecological zones or development regions within Nepal (Hirschman and Guest, 1990). Larger administrative units in Nepal, such as Development Regions or sub-regions, often encompass diverse physical environments and heterogeneous populations, and they frequently differ in population size and distribution and in area.

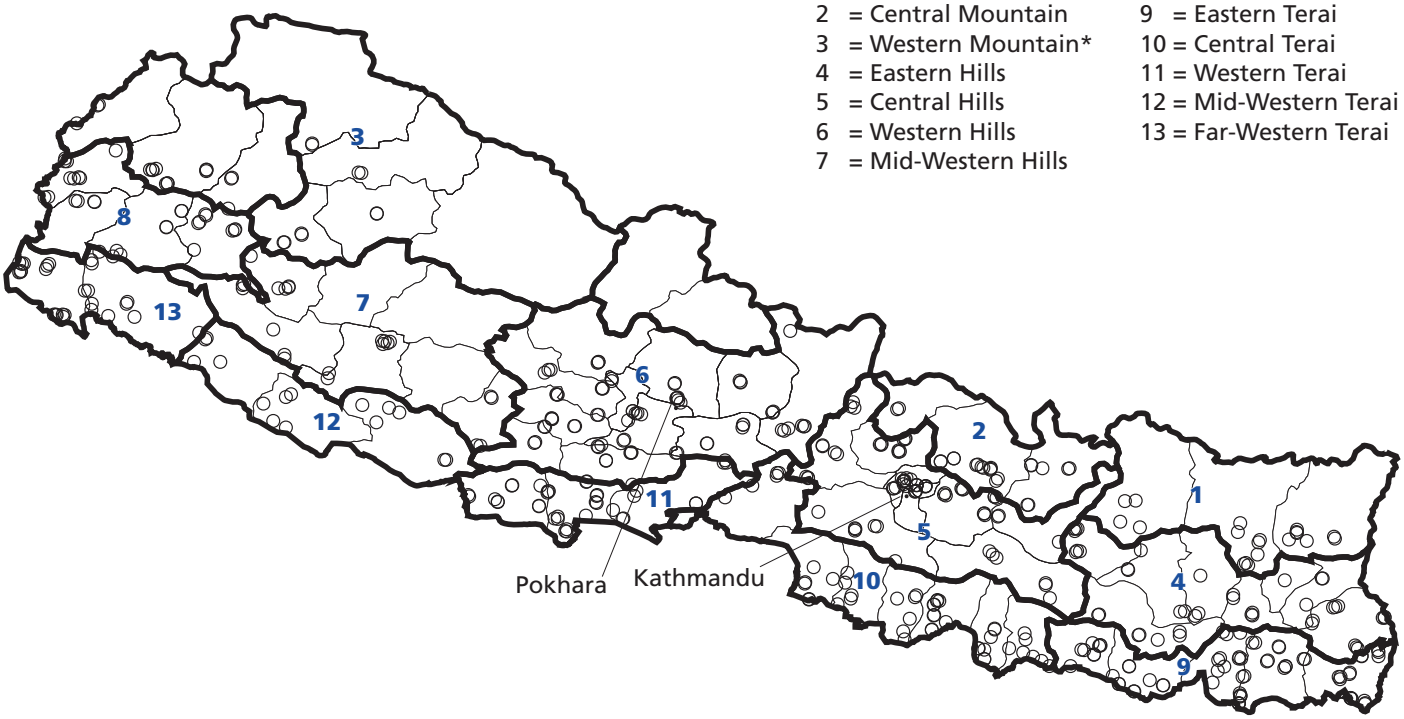
Figure 1
Construction of multilevel dataset



[3] The existence of latitude and longitude coordinates for Nepal DHS clusters allows researchers to link DHS to geographically defined contextual databases (as does the availability of district codes within DHS data files).

Map 3
DHS clusters by sub-region and district

1 = Eastern Mountain
2 = Central Mountain
3 = Western Mountain*
4 = Eastern Hills
5 = Central Hills
6 = Western Hills
7 = Mid-Western Hills
8 = Far-Western Hills
9 = Eastern Terai
10 = Central Terai
11 = Western Terai
12 = Mid-Western Terai
13 = Far-Western Terai



50 0 50 100 Miles

Source: NDHS 2001

* Western, Mid-Western and Far-Western Mountain are combined to form the Western Mountain Sub-Region used by NDHS 2001.

2 Theoretical Overview

Critics of the survey approach to demographic inquiry have urged that greater attention be paid to the context in which people make demographic decisions… large-scale surveys tend to pull the actors out of their dramatic context and place them on an empty stage.

—Ruth Dixon Mueller (2000, p. 97)

The main objective of this study is to explore the impact of ecological attributes on the use of antenatal care by married women, both before and after the inclusion of individual-level behavioral determinants. The theoretical model is adapted from a layout introduced by Hirschman and Guest (1990) as part of their work on reproductive behavior and is illustrated in Figure 2 (see also Kritz et al., 2000).

Figure 2
Model of antenatal health care use among married women in Nepal

Antenatal Care Utilization	Individual and Household Factors	Contextual Factors
Any use of antenatal care Number of antenatal care visits Other possible health outcomes: Antenatal care during the first trimester At least two tetanus toxoid injections	Geographic area (sub-region) Urban/rural location Distance to nearest hospital Age Parity Want child Empowerment measures: Refuse sex with husband Opinions about wife beating Decisionmaking Problems getting health services Land ownership Relationship to head of household Woman's education Partner's education Listens to radio Watches TV Woman's employment Partner's employment Religion Ethnicity Household utilities	Women's status: GDI GEM

Adapted from Hirschman and Guest (1990) and Kritz et al. (2000).

Work linking individual and contextual data is firmly grounded in the literature on women's health status and, more broadly, women's empowerment. The demographic literature is paying increasing attention to the issue of women's status, because empirical research worldwide consistently finds that variables related to women's status are negatively correlated with fertility, maternal health, and mortality (Sen and Batliwala,

2000). There is a general consensus that women's status is an important determinant of reproductive behavior and maternal health, especially in places where the status of women varies considerably, as is the case in Nepal.

The multidimensionality of women's status and its complex relations with demographic behavior has only recently started to receive attention.

Demographers typically have relied on traditional variables such as women's education and employment to measure women's status (Watkins, 1993; Presser, 1997). Studies in developing countries show strong empirical evidence of a correlation between women's education and a couple's fertility, age at marriage, desired family size, contraception, and use of maternal health services (Sen et al., 1994). However, critics of such measures note that these variables are at best proxy measures and do not fully capture the dynamics involved in measuring women's status. Indeed, the multidimensionality of women's status and its complex relations with demographic behavior has only recently started to receive attention. Growing recognition that the relationship between women's status and demographic outcomes is not as straightforward as indicated by previous research has led to a shift from the concept of women's status to women's empowerment (Riley, 1997).

Sen and Batliwala (2000) point out the importance of power relations at multiple levels, or contexts, within which women's lives are enmeshed: these include the household/family, community/village, market, and state levels. Women's subordinate status at one level is reinforced by power relations at other levels. Thus "even if power relations are eased or overturned at one level, e.g. within the household, they may continue to hold women in their grip through community-level strictures or ideologies, or through gender biased laws or discriminations in markets" (Sen and Batliwala, 2000, p.21).

Both Dixon-Mueller (2000) and Sen and Batliwala (2000) emphasize the interaction between macro and micro processes. The macro-micro framework asserts that social changes at the macro level determine opportunities and constraints at the micro level, thereby influencing individual decisions (Axinn and Barber, 2001; Axinn and Yabiku, 2001). Although an individual woman's ability to gain control over her life is imperative for demographic change, external forces operating at the macro level are just as important. They can create a context conducive to empowering women, which may then result in improved maternal health outcomes. As previously noted, improvements in women's education and employment may not bring about necessary demographic changes if the context is not empowering.[4]

While the empowerment literature recognizes the potential importance of contextual variables, the degree to which such variables are explicitly incorporated in the analy-

[4] Several empirical studies have examined the effects of gender systems on reproductive and maternal health outcomes. Marked differences in gender systems in northern and southern India have prompted numerous studies in which researchers have repeatedly found differences in fertility and other reproductive outcomes between the two regions (Dyson and Moore, 1983; Jain, 1989). Much of the difference has been attributed to varying levels of development and, most notably, the varying position of women in the two regions. Thus some argue that gender systems in different contexts play an important role in shaping reproductive behavior (Kritz et al., 2000). In Pakistan, the effect of education on fertility has only been observed in urban areas, where opportunities for education translate into employment and decision-making. In Bangladesh, Cleland et al. found a strong correlation at the individual level between exposure to formal schooling and fertility. When looking at South Asia as a whole, however, they found less support and concluded that the relationship is highly context specific. Similarly Jejeebhoy (1995) argues that importance should be given to the cultural context at different times and at different levels of development when examining education's influence on fertility. Sometimes women with no formal education have lower fertility and higher contraceptive use simply because they live in a society where the overall educational level is high (Riley, 1997). Furthermore, in contexts of high gender equity even small increments in education reduce fertility, whereas in contexts of low gender equity relatively high levels of education are needed to bring about changes in women's empowerment (Dixon-Mueller, 2000). Thus, these processes are linked and the links are context dependent.

sis varies. Not much research has linked individual-level data with contextual measures collected at the macro level. Studies by Balk (1994) and Kritz et al. (2000) obtained contextual gender equity indices by aggregating responses at the individual level, a typical approach among demographers. The work of Morgan and Niraula (1996) illustrates a slightly different approach: they chose two villages in Nepal with striking differences in women's status as a theoretical measure of contextual gender equity. Research examining determinants of infant mortality (Andes, 1996; Sastry, 1996; Sastry, 1997) has linked individual data with community-level data, but studies of maternal health have rarely done so (although see Stephenson and Tsui, 2002).

Sastry (1997) asserts that contextual analysis methods are of particular importance and relevance to policy makers, since omitted community variables can play a significant role in determining a particular outcome. The lack of research similar to Sastry's is due to the limited availability of community data that can be easily and appropriately linked to household and individual surveys, whether through DHS cluster geocodes or through district codes available within DHS datasets.

3 Study Site and Data Description

Nepal is a poor country: it is typically listed among the ten poorest countries in the world based on a per capita gross domestic product of $200–$250 per annum (Central Bureau of Statistics, 2001; NSAC, 1998). Although life expectancy has improved over time, it remains quite low at around 55 years in 1994 (NSAC, 1998). Nepal is one of the few countries in the world where a woman's life expectancy is less than her male counterpart's. Lower female life expectancy is a consequence of higher childhood mortality among girls and high maternal mortality. Indeed, Nepal has one of the highest maternal mortality rates in the world, estimated at about 850 to 1000 per 100,000 live births (RECPHEC, 1997).[5] A country's maternal mortality rate is an indicator of the overall health status of women, and such a high maternal mortality rate points to the human development deprivations facing women in Nepal (NSAC, 1998). Moreover, a World Bank report has concluded that 17 percent of the burden of disease in Nepal is a result of maternal and perinatal health problems (World Bank, 1996, cited by Hotchkiss, 2001), and almost 60 percent of households in Nepal report that they do not have adequate access to health care services (NSAC, 1998). These statistics provide an indication of the low status of women in Nepal.

Nepal has one of the highest maternal mortality rates in the world.

This study focuses on currently married Nepali women and their experience with maternal health care services. The majority of Nepali women do not have access to or use professional health facilities and services during pregnancy (see Table 1). Moreover, the use of antenatal care varies considerably across the country. For example, the 2001 Nepal Demographic and Health Survey (NDHS) found that around 18 percent of urban mothers did not receive any antenatal care compared with 53 percent of rural mothers. While only 44 percent of mothers in the Terai lacked antenatal care, 56 percent of mothers in the hills and 69 percent in the mountains went without antenatal care (Ministry of Health et al., 2002).

Table 1
Use of antenatal care in Nepal

Percentage of women who had a live birth in the 3–5 years preceding the NDHS 2001, by use of antenatal care (N=3,283)

Frequency and timing of antenatal care	Percent
Received antenatal care	
At least once	49.1
At least four times	14.3
During the first trimester	16.4

Source: Ministry of Health et al., 2002, Tables 9.1 and 9.2

3.1 Nepal Demographic and Health Survey

The 2001 Nepal Demographic and Health Survey (NDHS) is the sixth in a series of national level population and health surveys conducted in Nepal and the second

[5] RECPHEC (1997) cites a study by the United Missionaries of Nepal (UMN) which reported a maternal mortality rate of 279 deaths per 100,000 live births, although this was based solely on hospital data.

nationally representative comprehensive survey conducted as part of the worldwide Demographic and Health Surveys (DHS) project. A preliminary report based on the NDHS 2001 was issued in September 2001, and the final report followed in April 2002 (Ministry of Health et al., 2002). Briefly, the NDHS 2001 is a nationally representative survey of 8,726 women aged 15–49 and 2,261 men aged 15–59. It includes information on fertility, family planning, infant and child mortality, maternal and child health, nutrition, and knowledge of HIV/AIDS.

While the NDHS 2001 covers a wide variety of topical areas, this study focuses on the use of maternal health services.

3.2 Sample

To construct the study sample, all currently married women who had given birth during the past three years were selected from the NDHS 2001. The analysis was further limited to those women listed as a usual resident of the community in which they were surveyed.[6] With some missing values, the current analysis is based on a sample of 3,283 currently married women who had given birth within the past three years and who were usual residents of the community. The NDHS 2001 collected information on the utilization of antenatal care, delivery care, and postnatal care only for the last birth of these women.[7]

The majority of Nepali women do not have access to or use professional health facilities and services during pregnancy.

3.3 Outcome Measures

This report focuses on the determinants of antenatal health service use among Nepali married women included in the NDHS 2001. The analysis focuses on two dichotomous outcome measures:[8]

- Any antenatal care: A measure of whether a woman had received any antenatal care during her last pregnancy was constructed.[9] The analysis is based on a sample size of 3,283 women, of whom 48 percent had received any antenatal care.
- Four or more antenatal care visits: A measure of whether a woman had received antenatal care four or more times during her last pregnancy was constructed.[10] The analysis is limited to women who received some antenatal care (N=1,586). With some missing values, the analysis is based on a sample of 1,581 women, of whom 29 percent had made at least four antenatal care visits during their last pregnancy.

[6] It was important to limit the analysis to women who were usual residents of the community in order to avoid ascribing local contextual factors to women who did not normally live in the district where they were surveyed.

[7] Approximately 4 percent of currently married women who had a recent birth resided in a household with another eligible women (i.e., a currently married woman who had a recent birth) who also participated in the survey. Strictly speaking these women are not independent observations as they share some household-level attributes, although they do not share individual attributes (age, parity, wanted child, educational attainment, relation to head of household, etc.). The analysis assumes that the households with multiple women participating in the survey were distributed randomly.

[8] Other antenatal and maternal health outcomes also were considered in the analyses (see Appendix A).

[9] This measure was based on a recode of a DHS variable (M2N: Antenatal no one). A woman who received antenatal care during the last pregnancy was coded as 1 (N=1,586), and a woman who did not was coded as 0 (N=1,697).

[10] This measure was based on a recode of a DHS variable measuring the number of antenatal visits during pregnancy (M14: Number of ANC visits). All values 4 or higher were recoded as 1 (N=468), while all other valid codes were relabeled as 0 (N=2,813). Note that 1,697 women reported no antenatal care visits (M14=0).

Table 2 provides sample size and percent distribution information for each outcome.

Table 2
Outcome measures

Percent distribution of currently married women who had a child in the three years preceding the NDHS 2001 and who were usual residents of the community, by whether or not they received any antenatal care

Outcome variable	Percent	Sample size
Received any antenatal care		N=3,283
Yes	48.3	
No	51.7	

Percent distribution of currently married women who had a child in the three years preceding the NDHS 2001, who were usual residents of the community, and who received any antenatal care, by whether or not they made at least four antenatal care visits

Made at least four antenatal care visits		N=1,581
Yes	29.5	
No	70.5	

3.4 Independent Variables

The analytical models include individual (Level 1) variables that recent literature has associated with behaviors related to maternal health (see Figure 1). This section briefly describes these variables and discusses them in the context of the literature. Appendix B presents information on variable coding and recoding.

Tables 3 through 6 summarize the independent variables of interest, based on the sample of currently married women who had a child in the three years preceding the NDHS 2001 and who were usual residents of the community. These variables are divided into four groups: geographic variables, control and empowerment measures, individual and partner characteristics, and household characteristics.

3.4.1 Geographic Variables (Table 3)

In addition to examining contextual factors, the study aims to investigate how the use of antenatal care varies by geographic region. The NDHS 2001 reports on the utilization of maternal health services by urban/rural location, Ecological Zone (Mountain, Hill, and Terai), Development Region (Eastern, Central, Western, Mid-Western, and Far-Western), and sub-region (a combination of Ecological Zone and Development Region) (see Map 4). Geographic differences are quite evident in the contextual variables and, as shall be seen, in outcome measures as well.

Table 3
Geographic variables

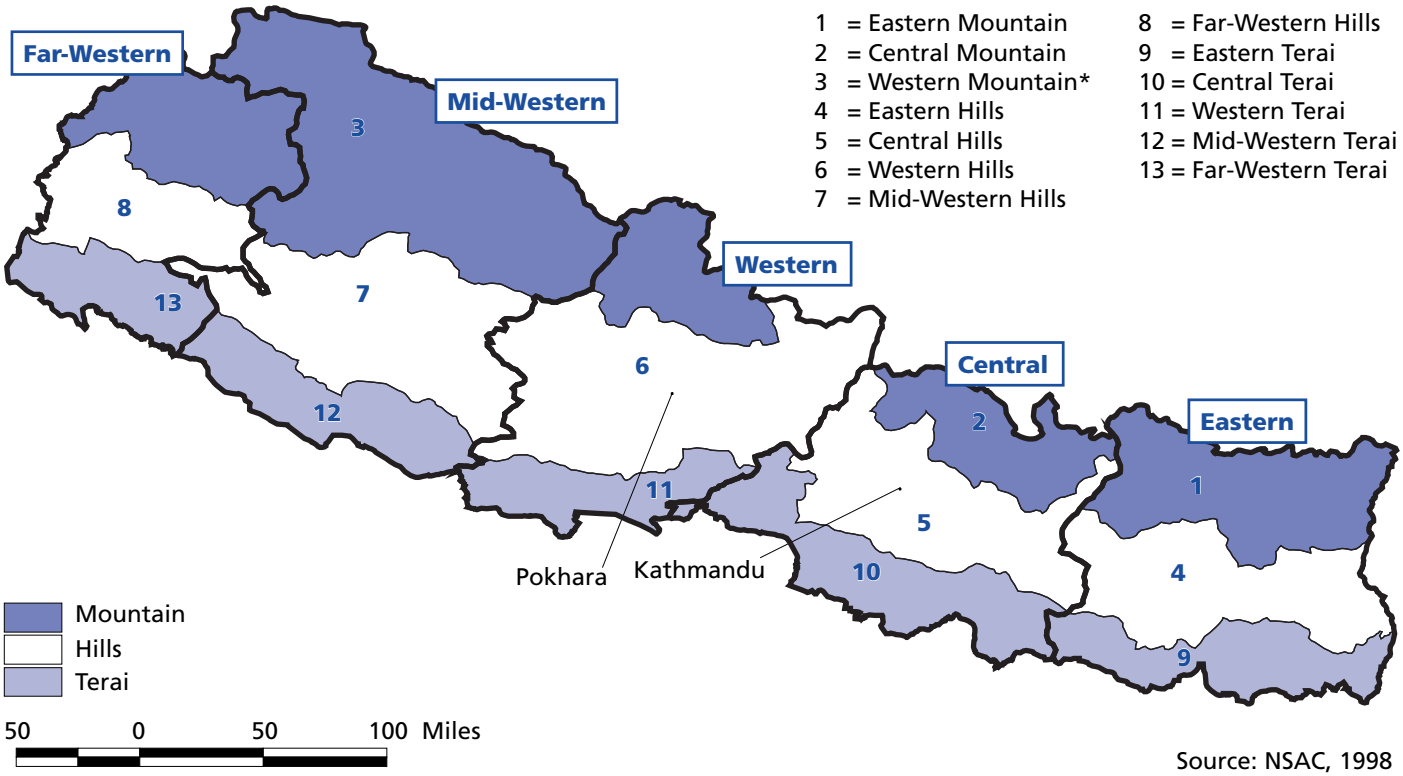
Percent distribution of currently married women who had a child in the three years preceding the NDHS 2001, by geographic variables (N=3,283)

Variable	Percent
Ecological Zone	
Mountain	15.0
Hill	37.2
Terai	47.8
Development Region	
Eastern	22.4
Central	27.3
Western	15.3
Mid-Western	14.1
Far-Western	20.9
Sub-region	
Eastern Mountain	3.5
Central Mountain	4.9
Western Mountain	6.6
Eastern Hill	6.8
Central Hill	9.1
Western Hill	7.2
Mid-Western Hill	5.6
Far-Western Hill	8.5
Eastern Terai	12.1
Central Terai	13.3
Western Terai	8.1
Mid-Western Terai	5.9
Far-Western Terai	8.4
Urban/rural location	
Urban	8.8
Rural	91.2
Distance to nearest hospital (miles)	10.7

Many researchers include regional dummy variables in their models. For example, Magadi et al. (2000) found an association between frequency of antenatal care use and region of residence in Kenya. Glei et al. (2003) also found large differences in the likelihood of obtaining pregnancy care across regions in Guatemala, perhaps due to regional variations in belief systems or unmeasured characteristics of communities and health services.

Table 3 presents the distribution of the study sample across Ecological Zones and Development Regions. These two regional breakdowns are often cited in the reports, policy documents, and planning documents is-

Map 4
Ecological Zones, Development Regions, and DHS sub-regions in Nepal



Source: NSAC, 1998

* Western, Mid-Western and Far-Western Mountain are combined to form the Western Mountain Sub-Region used by NDHS 2001.

sued by the government of Nepal and international non-governmental organizations. While separate analyses were run using the Ecological Zone and Development Region as regional dummy variables, this report only presents results from models based on sub-regions.

Sub-region. The sub-regional classification system cross-tabulates Nepal by Ecological Region and Development Region, although the NDHS 2001 combined data on three sub-regions (Far-Western Mountains, Mid-Western Mountains and Western Mountains) into a single "Western Mountains" sub-region.[11] This sub-regional classification is becoming more popular in Nepal, because it offers both a finer level of analysis and arguably more homogeneity than other geographic breakdowns. This analysis uses the Far-Western Hills as the comparison group, since this area typically performs poorly on national development indicators.

Urban-rural location. According to the NDHS 2001, 82 percent of urban women received antenatal care versus just 46 percent of rural women, and 44.5 percent of urban women gave birth in a health facility versus only 6.6 percent of rural women. Indeed, much research in maternal, reproductive, and general health has found that health facilities and professional medical personnel tend to be concentrated in larger urban centers with greater economic resources and public infrastructure. Many studies of maternal health outcomes have found that urban women are more likely than rural women to use antenatal care, as is the case in Jordan (Obermeyer and Potter, 1991), Guatemala (Pebley et al., 1996), and Thailand (Raghupathy, 1996). However, the urban association with antenatal care does not always appear. In a study of antenatal care

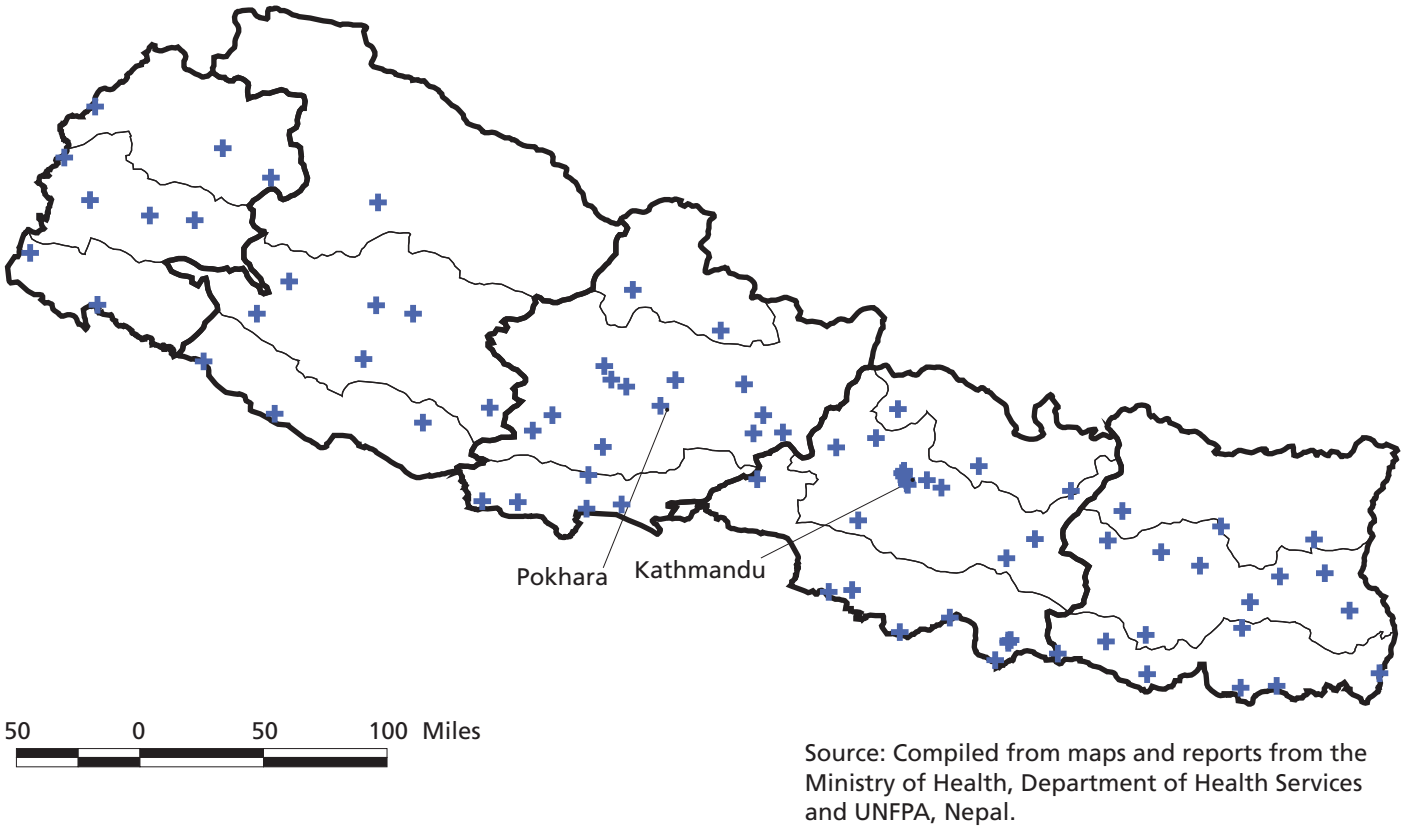
[11] There are no DHS clusters in the original Western Mountain sub-region. Six rural clusters could not be included in the DHS due to security concerns (Ministry of Health et al., 2002, p.6).

in Nepal, Hotchkiss (2001) found that urban/rural residence was not significant after controlling for physical access to health care and other individual, household, and community characteristics.

Sastry (1997) points out that an urban-rural comparison is a rather crude contextual measure that does not explain variations that might be evident within rural and urban areas. Considerable differences are found within rural areas of developing countries, where the majority of the population usually resides. This is especially so in Nepal, where 90 percent of the population lives in rural areas and where there is considerable regional variation. This analysis includes an urban/rural dummy variable, in which urban clusters are coded as 1.

Access to health services. The accessibility of health services is often cited as a critical determinant of health care choice in the developing world (Timyan et al, 1993), where an increase in distance to the health facility is associated with less use. In Nepal accessibility is complicated further by the rugged terrain (Hotchkiss, 2001). Most doctors, hospitals, and health facilities in Nepal are concentrated in the main urban centers and in parts of the Eastern, Central, and Western Development Regions (see Map 5). Hotchkiss et al. (1998) suggests that in Nepal inadequate referral linkages, poor quality care, high out-of-pocket costs for consultations and transportation, high levels of illiteracy, and gender bias also are likely to contribute to poor utilization of health care. Magadi et al. (2000) found an association between access to antenatal care and its use in Kenya, but they did not find an association between access and the timing of the first antenatal visit. Pebley et al. (1996) found that distance to the nearest clinic in Guatemala is significantly and negatively related to both antenatal care and delivery assistance. In a recent study in Guatemala (Glei et al., 2003) no measures of access—including biomedical services available within the community and access to free care—were significantly related to pregnancy care, but distance to the capital city was related.

Map 5
Location of main hospitals in Nepal



Source: Compiled from maps and reports from the Ministry of Health, Department of Health Services and UNFPA, Nepal.

In addition to existing data on DHS cluster classification, this study used GIS techniques to generate a crude distance measure reflecting access to health services. A georeferenced point file of all significant hospitals in the country was created, using data on the name and location of the main hospitals from the Ministry of Health's annual reports, gazetteers, topographic maps, and in-country health reports (Ministry of Health, 1995; Ministry of Health, 1996; Ministry of Health, 1998a; Ministry of Health, 1998b; Ministry of Health, 2001; Ministry of Health and UNFPA, 1995). These hospitals generally were located in the main town of each district. This hospital point file was used to create a straight-line distance measure to all DHS clusters. A more appropriate measure of health accessibility would have been based on roads, altitude, and other data sources, but this was not practical. Distance was measured in miles and ranged from 0 to 29 miles, with a mean of about 11 miles.

This measure provides a clear picture of which clusters are far from a main hospital and therefore relatively isolated. Hospitals tend to be located in the larger urban settlements throughout the country, especially in the main towns along the Nepal-India border (Terai) and in the Hill districts. Therefore the measure may be a good proxy for distance to the nearest main town, even though it was conceived as the distance to the nearest hospital.[12]

Distance from each DHS cluster to the nearest hospital ranges from 0 to 29 miles, with a mean of about 11 miles.

3.4.2 Control and Empowerment Measures (Table 4)

This study includes measures of women's empowerment along with traditional indicators of women's status. The NDHS 2001 included three new and important variables based on women's attitudes regarding wife beating, reasons to refuse sex with the husband, and involvement in decisionmaking.

Age. According to the NDHS 2001, 12.1 percent of women under age 20 gave birth in health facilities, compared with 8.9 percent of women aged 20–34 and 3.6 percent of women over 35 (Ministry of Health et al., 2002, Table 9.5, p.148). This is consistent with findings from Thailand (Raghupathy, 1996) and Peru (Elo, 1992), where younger women were more likely to accept modern health care and older women, with accumulated knowledge on maternal health care, were less likely to seek institutional care. In south India, Bhatia and Cleland (1995) found that mothers under age eighteen were less likely to receive antenatal care, but first-order pregnancies were more likely to receive antenatal care. Women are generally considered at greater obstetric risk when they give birth before age 18 or after age 34 (Amini et al., 1996; Walsh et al., 1993).

Age was recoded into three categories following the breakdown used in the NDHS 2001 report: under 20, 20–34, and over 35. Under 20 is the reference category.

Parity. Birth order, or parity, also is strongly associated with the use of antenatal care, with women more likely to seek care for first pregnancies. Women giving birth to their first child or to their fifth or higher-order child are generally considered at greater obstetric risk (Amini et al., 1996; Walsh et al., 1993). The risks of pregnancy and delivery complications increase after the third and especially after the sixth birth (Dixon-Mueller and Wasserheit, 1991).

Data from the NDHS 2001 suggests the importance of birth order in predicting antenatal care (Ministry of Health et al., 2002, Table 9.5, p.148). Because of their expe-

[12] While the analysis could have used a district-level dummy for whether or not a hospital was present, this measure was crude and unlikely to be of analytic interest. First, individuals in a cluster may reside in a district without a hospital but still live very close to a hospital in a neighboring district. Second, a map of a hospital dummy would reveal that all but a handful of districts in the country lack a hospital; moreover, some of these districts were not included in the NDHS 2001 (i.e., no DHS clusters exist in those districts). Thus a map of a hospital dummy variable would show little or no variation across the country and therefore would have no predictive power analytically.

rience with pregnancy-related matters, older women and women with high-order births may not seek antenatal care. In Guatemala (Glei et al., 2003), Peru (Elo, 1992), Turkey (Celik and Hotchkiss, 2000), India (Bhatia and Cleland, 1995; Stephenson and Tsui, 2002), and Thailand (Raghupathy, 1996), women having their first child were more likely to receive antenatal care. Magadi et al. (2000) found that high-order births in Kenya were associated with a delayed first antenatal care visit.

The total number of children ever born was recoded into four categories: 1, 2–3, 4–5, and 6 or more births. The reference category is a parity of 1.

Wanted last child. Pregnancies that are mistimed or not wanted are associated with late and irregular antenatal care compared with pregnancies that are wanted (Weller et al., 1987). In Kenya, Magadi et al. (2000) found that women who said their pregnancies were unwanted or mistimed made fewer antenatal care visits during pregnancy and delayed their first antenatal care visit.

Table 4
Control and empowerment measures

Percent distribution of currently married women who had a child in the three years preceding the NDHS 2001, by control and empowerment measures (N=3,283)

Variable	Percent
Age	
15–19	9.2
20–34	77.1
35+	13.6
Parity	
1	21.0
2–3	40.6
4–5	22.9
6+	15.5
Wanted last child	
Then	60.3
Later	14.7
Did not want	25.0
Relationship to head of household	
Head	7.2
Wife	57.3
Daughter-in-law	29.7
Other	5.8
Refuse to have sex with husband:	
Under all four circumstances	90.3
Under three or fewer circumstances	9.7
Wife beating is justified:	
Under no circumstances	71.5
Under at least one circumstance	28.5
Decisionmaking	
No decisions	53.9
1–2 types of decisions	24.9
3–4 types of decisions	21.2
Problems getting health services	
No problems	10.7
1–2 problems	27.0
3–5 problems	41.3
6–7 problems	21.0
Woman owns land	
Yes	5.7
No	94.3

Information on whether or not a woman wanted her last child was recoded into three categories signifying that the mother wanted the child then, wanted the child later, or did not want the child. The reference category is "did not want the child," which included one-fourth of the sample.

Relationship to head of household. The demographic literature increasingly recognizes the influence of gender-based power dynamics within couples' sexual relationships on reproductive outcomes (Mason and Smith, 2000; Riley, 1997; Sen and Batliwala, 2000). In a recent paper Larsen and Hollos (2003) find that the empowerment of women—as reflected in their socioeconomic and employment status, educational level, household organization, the dynamics of marital relations, and involvement in domestic decisionmaking—is an important factor in research on demographic outcomes. A woman's relationship to the head of the household sheds light on her position within the household.

Information regarding the respondent's relationship to the household head was recoded into four categories depending on whether the woman was: the head of the household, the wife of the household head, the daughter-in-law of the household head, or some other relation. The reference category is women who are household heads.

Refusing sex. The NDHS 2001 asked women whether they would refuse sex with their husbands in four situations: if he had a sexually transmitted infection (STI), if he had sex with other women, if she had had a recent birth, or if she was tired or not in the mood. Reponses to these questions were combined to create a measure of the number of circumstances in which a woman would refuse sex with her husband. If the women stated she would refuse to have sex with her husband for all four reasons, she was coded

as 1 (90.3 percent of the sample). All other values were coded as 0 (9.7 percent). In other words, almost 10 percent of women said that refusing sex was not justified for at least one of the reasons specified.

Wife beating. The NDHS 2001 asked women five questions about whether and under what circumstances wife beating was justified, including going out without telling the husband, neglecting children, arguing with the husband, refusing sex with the husband, and burning food. Responses to these questions were combined to create a measure of the number of circumstances in which women felt wife beating was justified. Women who said wife beating was never justified were coded as 1, while women who said wife beating was justified for at least one of the five reasons were coded as 0. Disturbingly, 28.5 percent of women felt wife beating was justified under at least one circumstance. According to the NDHS 2001 report, "there appears to be a mixed association between women's empowerment as measured by the number of reasons women believe that wife beating is justified and their care seeking behavior" (Ministry of Health et al., 2002, p.153)

Radio and television are an important source of maternal health information, especially for women who are illiterate or have minimal schooling.

Decisionmaking. Increasingly researchers are recognizing that women's participation in domestic decisionmaking affects their ability to make reproductive and maternal health decisions, particularly decisions regarding their fertility (Balk, 1994; Bloom et al., 2001; Dyson and Moore, 1983; Gage, 1995; Morgan and Niraula, 1996; Timyan et al., 1993). The NDHS asked women whether they were involved in making decisions in five areas: health care, large household purchases, household daily needs, visits to family or relatives, and food to be cooked. For each question, if the woman was either the sole decision maker or made the decision jointly with a partner or another person, the value was coded as 1. If she was not involved in the decision, the value was coded as 0. Since women tended to make all decisions regarding food preparation, responses to just the first four questions were combined to create a measure of women's involvement in decisionmaking. Women were categorized as being involved in making 0, 1–2, or 3–4 types of decisions. The reference category is no decisions, which includes 53.9 percent of the sample.

Problems getting medical help. Distance to the nearest health facility, lack of transportation, lack of knowledge about, and the perceived quality of services are all thought to be associated with the use of modern health care and seeking assistance from trained medical personnel (NoorAli et al., 1999; Paul, 1992; Paul and Rumsey, 2002; Sundari, 1992). Paul and Rumsey (2002) note that lack of access to health care facilities refers to economic and sociocultural distance as well as physical distance. Seven questions in the NDHS 2001 asked about problems facing women who seek health care, including knowledge of where to go, getting permission to go, getting money for treatment, the distance to the health facility, transportation, unwillingness to go alone, and concern that there will be no female provider. The response to each question was coded as 1 if the woman felt the issue posed a "big problem." These values were summed to create a measure of how many problems women faced in getting medical help. Four categories were created: whether a woman considered 0, 1–2, 3–5, or 6–7 issues to be big problems. The reference category is no problems.

Land ownership. The final variable in this empowerment grouping is whether a woman owns land or not. If the women owned land alone or jointly, this variable is coded as 1, otherwise 0.

3.4.3 Individual and Partner Characteristics (Table 5)

Women's and partner's education. Education can have an empowering effect on women, broadening their horizons, choices, and opportunities and "enabling women to take personal responsibility for their health and for that of their children" (Paul and Rumsey, 2002, p. 1757). Higher levels of maternal and head of household education

are associated with increased use of health care during pregnancy as well as having a modern delivery or a delivery by trained personnel (Bhatia and Cleland, 1995; Celik and Hotchkiss, 2000; Hotchkiss, 2001; Navaneetham and Dharmalingam, 2002; Obermeyer and Potter, 1991; Paul and Rumsey, 2002; Pebley et al., 1996; Raghupathy, 1996; Stephenson and Tsui, 2002). Women's education is an important predictor of the use of antenatal care services and the knowledge and use of contraceptives (for studies in Nepal, see Joshi, 1994 and Tuladhar, 1987). In some studies the effect of education differentials persisted even after controlling for selected demographic variables and place of residence (Jejeebhoy, 1995; Rodriguez, 1978; Tuladhar, 1987). However, neither Miles-Doan and Brewster (1998) in the Philippines nor Magadi et al. (2000) in Kenya found an association between education and the use of antenatal care after controlling for other covariates. A recent article by LeVine et al. (2004) implies that the effects of schooling on health behaviors are mediated through literacy skills.

The NDHS 2001 includes information on both women's and partners' education. Rather than use years of completed schooling, this study looked at three educational attainment levels: no education, primary education, and secondary or higher education. For both the woman and the partner, no education is the reference category.

Radio and television. Electronic media can be an important source of information regarding the benefits of preventive care for maternal health (Navaneetham and Dharmalingam, 2002; Stephenson and Tsui, 2002). Navaneetham and Dharmalingam (2002) suggest that exposure to electronic media can influence cultural barriers to using modern health care. Radio and television also can disseminate maternal health information to women who are illiterate or have minimal schooling. Two separate variables, which are not highly correlated with one another, are used to measure exposure to electronic media: whether or not the women listened to the radio daily (33.3 percent) or watched television at least weekly (16.8 percent).

Work status. Working women who contribute to household wealth are expected to have greater influence over household and individual decisionmaking, including resource allocation and maternal and child health care (Desai and Jain, 1994). That said, women in developing countries often work for the family and exert little influence over household and individual decisionmaking.

Table 5
Individual and partner characteristics

Percent distribution of currently married women who had a child in the three years preceding the NDHS 2001, by individual and partner characteristics (N=3,283)

Variable	Percent
Woman's education	
None	73.1
Primary	14.1
Secondary and higher	12.9
Partner's education	
None	33.7
Primary	26.5
Secondary and higher	38.0
Don't know	1.8
Listens to radio daily	
Yes	33.3
No	66.7
Watches television weekly	
Yes	16.8
No	83.2
Woman's employment	
Not working	14.4
Agricultural or self-employed	80.2
Non-agricultural	5.1
Partner's employment	
Agricultural	53.7
Non-agricultural	43.1
Don't know or missing	3.2

Economic status of the household also may help determine the use of health services insofar as it reflects the ability of the household to pay for health care costs. Usually families belonging to a higher economic class are more aware of and have easier access to sources of health care (Feldman, 1983). Several studies have shown a relationship between the use of health care and the financial stability of the household (Celik and Hotchkiss, 2000; Pebley et al., 1996; also see Section 3.4.4 on household utilities). In a study of Nepali women, Tuladhar (1987) found the highest levels of knowledge of, use of, and access to maternal and family planning services among women engaged in non-farm occupations. Thus, women engaged in wage employment are expected to be more likely to use antenatal health services (Kritz et al., 2000; United Nations, 1985).

Women's work status is classified as not working (14.4 percent), works in agriculture

(80.2 percent), or works outside agriculture (5.1 percent). The reference category is does not work. The NDHS 2001 also provides information on the work status of the respondent's partner. This is classified as works in agriculture (53.7 percent), works outside agriculture (43.1 percent), or work status is unknown (3.2 percent). The reference category is working in agriculture.

3.4.4 Household Characteristics (Table 6)

Utilities. A household's socioeconomic status is related to the use of health facilities and trained medical personnel (Paul and Rumsey, 2002), so that measures of standard of living are likely to be associated with the use of maternal heath care. According to Navaneetham and Dharmalingam (2002), households with higher living standards are expected to be more modern and receptive to modern health care services. Magadi et al. (2000) found an association between socioeconomic status and the frequency of antenatal care as well as the timing of the first antenatal care visit in Kenya. In the Philippines, Miles-Doan and Brewster (1998) found an association between low socioeconomic status and underutilization of health services. Stephenson and Tsui (2002) in their work on reproductive health in Uttar Pradesh, India found the household-asset index (a proxy for household socioeconomic status) was significantly and positively associated with receiving antenatal care and giving birth in a medical institution. Celik and Hotchkiss (2000) found that measures of household wealth and resources were associated with use of antenatal care.

To measure the standard of living of households in Nepal, this study created an index based on a set of household utilities used by Raghupathy (1996). The NDHS 2001 gathered information on a number of household utilities and resources including sources of drinking water, type of toilet facility, presence of electricity, type of flooring material, type of cooking fuel, and durable goods (bicycle, television, telephone). Four of these are included in a utility index: the presences of piped water, a toilet or latrine, modern cooking fuel, and electricity. Respondents are categorized depending on how many of these utilities are present in their household: none, 1, or 2 or more. The reference category is no utilities.

Religion. The dominant religion in Nepal is Hindu, and over 80 percent of the study sample is Hindu. A dummy variable based on religion is included in the analysis.

Table 6
Household characteristics

Percent distribution of currently married women who had a child in the three years preceding the NDHS 2001, by household characteristics (N=3,283)

Variable	Percent
Household utilities	
None	65.9
1 utility	20.7
2+ utilities	13.4
Religion	
Hindu	84.4
Non-Hindu	15.6
Ethnicity	
Brahmin	9.3
Chhetri, Thakuri, and Rajput	22.4
Newar	3.7
Gurung and Magar	6.3
Tamang and Sherpa	7.1
Rai and Limbu	5.2
Muslim and Churaute	5.1
Tharu and Rajbanshi	8.9
Yadav and Ahir	2.8
Occupational	21.2
Other Hill and Terai	8.0

Ethnicity. Ethnicity is an important social factor in Nepal and can both facilitate and hinder use of maternal heath care. For example, while small in number there are Muslims in Nepal who may be less likely to use maternal care services. Navaneetham and Dharmalingam (2002) found in India that Muslim women, who have less autonomy to interact with males outside of their immediate families, are less likely to use antenatal services or delivery assistance if only a male doctor is available.

The NDHS 2001 reported on an extensive range of ethnic groups (see Appendix B). Following that example, these ethnic groups were first recoded into thirteen categories. Then the Gurung and Magar groupings were combined, as were other Hill and other Terai groupings, to make eleven ethnic categories: Brahmin, Chhetri/Thakuri/Rajput, Newar, Gurung/Magar, Tamang/Sherpa, Rai/Limbu, Muslim/Churaute, Tharu/Raj-

banshi, Yadav/Ahir, occupational groups, and other Hill and Terai groups. The Brahmin ethnic group, which is one of the highest caste groups in Nepal, is used as the reference category.

3.5 Summary

This study's approach to modeling antenatal care is based on integrating individual and contextual data. Rather than use aggregate measures of individual attributes to create contextual measures, the study includes what the literature refers to as global measures of context (Lazarsfeld and Menzel, 1969, cited in Kreft and De Leeuw, 1998). The existence of geocodes for DHS clusters allows researchers to use GIS and related technologies to create unique hierarchical or multilevel datasets that can include global measures. Thus this project allows researchers to draw on numerous individual, or Level 1, measures of women's empowerment (e.g., involvement in decisionmaking, attitudes about wife beating and refusing sex with the husband, and land ownership) and women's status (e.g., education and work). Moreover, the contextual modeling framework focuses explicitly on adding broader, Level 2 measures of women's empowerment at the district level (i.e., GEM and GDI).

4 Analytical Methods

This study employs both logistic regression models, using SPSS (Statistical Package for the Social Sciences), and hierarchical generalized linear models, using HLM (Hierarchical Linear Model). Binomial logistic regression is a form of regression used when the dependent variable is dichotomous and the independent variables are of any type. Logistic regression applies maximum likelihood estimation after transforming the dependent variable into a logit (the natural log of the odds of the dependent variable occurring or not). In this way, logistic regression estimates the probability of a certain event occurring. Logistic regression calculates changes in the log odds of the dependent variable; it does not calculate changes in the dependent variable as does ordinary least squares (OLS) regression. Unlike OLS regression, logistic regression does not assume linearity of the relationship between independent variables and the dependent variable, it does not require normally distributed variables, and it does not assume homoscedasticity. In general, it also has less stringent requirements.

This study employs both logistic regression models and hierarchical generalized linear models.

As shown by Stephenson and Tsui (2002), hierarchical modeling techniques offer a mechanism for measuring the influence of community factors and unobserved community effects on health outcomes, while providing a robust method for analyzing multilevel data (Diez-Roux, 2001; DiPrete and Forrestal, 1994; Duncan et al., 1998; Goldstein, 1995). Due to the hierarchical structure of this data set, with women clustered in districts, a multilevel modeling structure is employed. OLS regression assumes that all observations are independent. In this study, however, women experiencing the outcomes are not independent, because they share common district characteristics. A multilevel modeling strategy accommodates the hierarchical nature of the data and corrects the estimated standard errors to allow for the clustering of observations within units (i.e., women within districts). The hierarchical analysis explicitly integrates two levels of data:

- Individual, or Level 1, data from the NDHS 2001, and
- District, or Level 2, data from the gender-sensitive development index (GDI) and gender empowerment measure (GEM).

As the dependent variables of interest are dichotomous, a hierarchical generalized linear model (HGLM)—which is a special case of hierarchical linear models—was used.[13]

The study examines the influence of contextual and individual factors on the use of antenatal health care. The same set of predictor variables is used in both sets of analysis. Separate logistic regression models are fitted for each of the outcome measures of interest. They take the form:

$$\log[p\mathrm{i}1/1-p\mathrm{i}1] = \alpha 0 + \alpha 1\, Xij + \alpha 2\, Yij + \alpha 3\, Zj + \in 1ij$$

[13] Since the occurrence and non-occurrence of these events are two categories in the dependent variable, a Bernoulli analysis is performed to suit the distribution of the dependent variable.

The independent variables are classified into three groups: geographic/community, individual/household, and contextual factors. They are represented by the vectors X, Y, and Z, respectively, and αs represent the net effect of these variables on the probabilities of using health care. The term $\in 1$ represents unobserved determinants of antenatal care utilization and follows a logistic distribution.

The basic HLM formula for logistic regression is:

$$\begin{array}{ll} \text{Level 1 model} & \log[p_{ij}/(1-p_{ij})] = \beta_0 + \beta_1 x_{ij} \\ \text{Level 2 model} & \beta_{0j} = \beta_0 + u_j \\ \text{Combined model} & \log[p_{ij}/(1-p_{ij})] = \beta_0 + \beta_1 x_{ij} + u_j \end{array}$$

where i = women, j = districts, and u is the random effect at level 2.[14]

The logistic regression and HGLM result tables include four models. Model 1 includes only geographic variables. Model 2 includes both geographic variables and the individual and household variables extracted from the 2001 NDHS. Model 3a builds on Model 2 by adding a single contextual variable: GDI. Model 3b parallels Model 3a but includes GEM instead of GDI.[15]

The success of the logistic regression and HGLM models can be assessed in a variety of ways. In the case of the logistic regression, the classification table shows correct and incorrect classifications of the dichotomous outcome variables, which are reported in the tables as percent correct prediction. Goodness-of-fit tests, such as model chi-square, provide a measure of model appropriateness. The –2 log likelihood (–2LL) statistic is called the scaled deviance and is used to assess the significance of the regression. The chi-square value for –2LL, or model chi-square, provides a significance test for a logistic model; that is, model chi-square measures the improvement in fit that the explanatory variables make compared with a null model. Model chi-square is a likelihood ratio test that reflects the difference between error not knowing the values of the independent variables (initial chi-square) and error when the independent variables are included in the model (deviance). There is no accepted direct analog to R-squared in an OLS regression model, although Nagelkerke's R-square, constrained to the range 0–1, is often reported.

In the case of HGLM, the variance components of each successive model show the percentage of between variance that has been explained by the addition of variables in the model, as compared with the null model. The formula used here is:

$$R^2 \text{ Between} = (\text{variance of null model} - \text{variance of model})/\text{variance of null model}$$

In the logistic and HGLM models, the slope coefficients are not the rate of change in the dependent variable as X changes. Instead, the slope coefficient is interpreted as a rate of change in the "log odds" as X changes. A more intuitive interpretation of the logit coefficients, especially for dummy variables, is the "odds ratio"(OR)—which is Exp(B) in the tables. The exponent of B is the effect of the independent variable on the odds ratio, that is, the odds of the probability of an event divided by the probability of a non-event. For example, if Exp(B) equals 2, then a one-unit change in X would make the event twice as likely to occur. Negative coefficients generate odds ratios less than one. It is worth noting that the odds ratios for continuous independent variables tend to be close to one, but this does not indicate that the coefficients are insignificant.

[14] The classic texts on hierarchical linear and multilevel models are those by Goldstein (1995) and Raudenbush and Bryk (2002).

[15] The researchers also calculated models using additional contextual models, but it was difficult to devise a clean set of uncorrelated contextual predictors that made sense to use in models for all of the outcome measures. Also, as noted earlier, both GDI and GEM are composite scores based on variables that are likely to be highly correlated with other measures associated with economic, social, and infrastructure development.

5 Modeling Results

There is no universal explanation that applies to all places and times: the determinants of utilization of maternal health care services are not the same across socioeconomic and cultural contexts.
—Navaneetham and Dharmalingam (2002, p. 1849)

5.1 Any Antenatal Care

This study is concerned with exploring and better understanding factors that determine the use of antenatal services, especially the influence of geographic factors. Mapping the outcome variables based on the cluster and sub-regional geocodes is a useful first step. The mapped distribution of outcomes is, to some extent, the pattern which the study seeks to explain. Two types of maps are presented: point maps of aggregate scores on maternal health outcomes for DHS clusters, and pie-chart maps at the sub-regional level based on data from the NDHS 2001.

Mapping data values may be of limited use if the data are drawn from small samples for clusters that are not representative. However, the maps included here seek to reveal general patterns; mapping specific data values for each cluster is not the goal. The focus is on values that diverge from the national average by more than one standard deviation.

Map 6 shows whether the rate of use of antenatal care—defined as making at least one antenatal visit—in each DHS cluster was at, above, or below the average for all clusters. Map 7 shows the proportion of women in each sub-region who made at least one antenatal care visit.

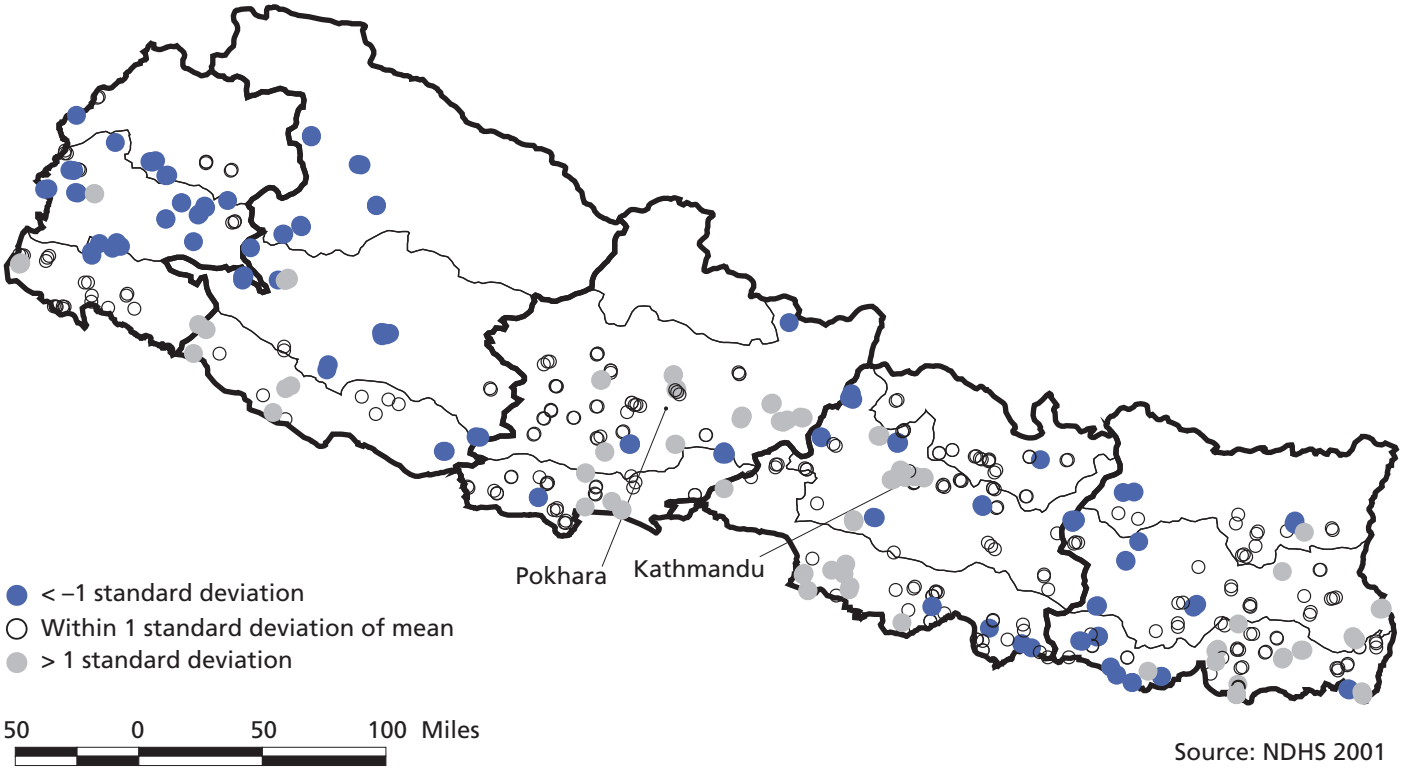
As Map 6 illustrates, the rate of use of antenatal care is low in the Far-Western and Mid-Western Development Regions (particularly in the Hill and Mountain Ecological Zones) and, to a lesser extent, throughout the western side of the Eastern Development Region. The Eastern Development Region exhibits more variability: usage rates in many clusters are above the mean, while rates in many other clusters are below the mean. The rate of use of antenatal care appears to be considerably higher in the eastern half of the Eastern Development Region than in the western half, especially in the Terai. Usage rates are generally high in the main urban areas (Kathmandu and Pokhara clusters).

Throughout the Terai, most women received antenatal care, although the proportion does not exceed 70 percent in any sub-region (Map 7). In the Far-Western Hills, Mid-Western Hills, and Western Mountains, less than 25 percent of women received antenatal care. An interesting juxtaposition is found in the Mid-Western Development Region: approximately 65 percent of women in the Terai received antenatal care (the highest rate in the country), while only 23 percent of women in the neighboring sub-region in the Hills received antenatal care (one of the lowest rates in the country). Women seem to use antenatal care to the same degree within both the Eastern and the Central Development Regions, with the likelihood of using antenatal care decreasing

Approximately 65 percent of women in the Terai received antenatal care (the highest rate in the country), while only 23 percent of women in the neighboring sub-region in the Hills received antenatal care (one of the lowest rates in the country).

Map 6

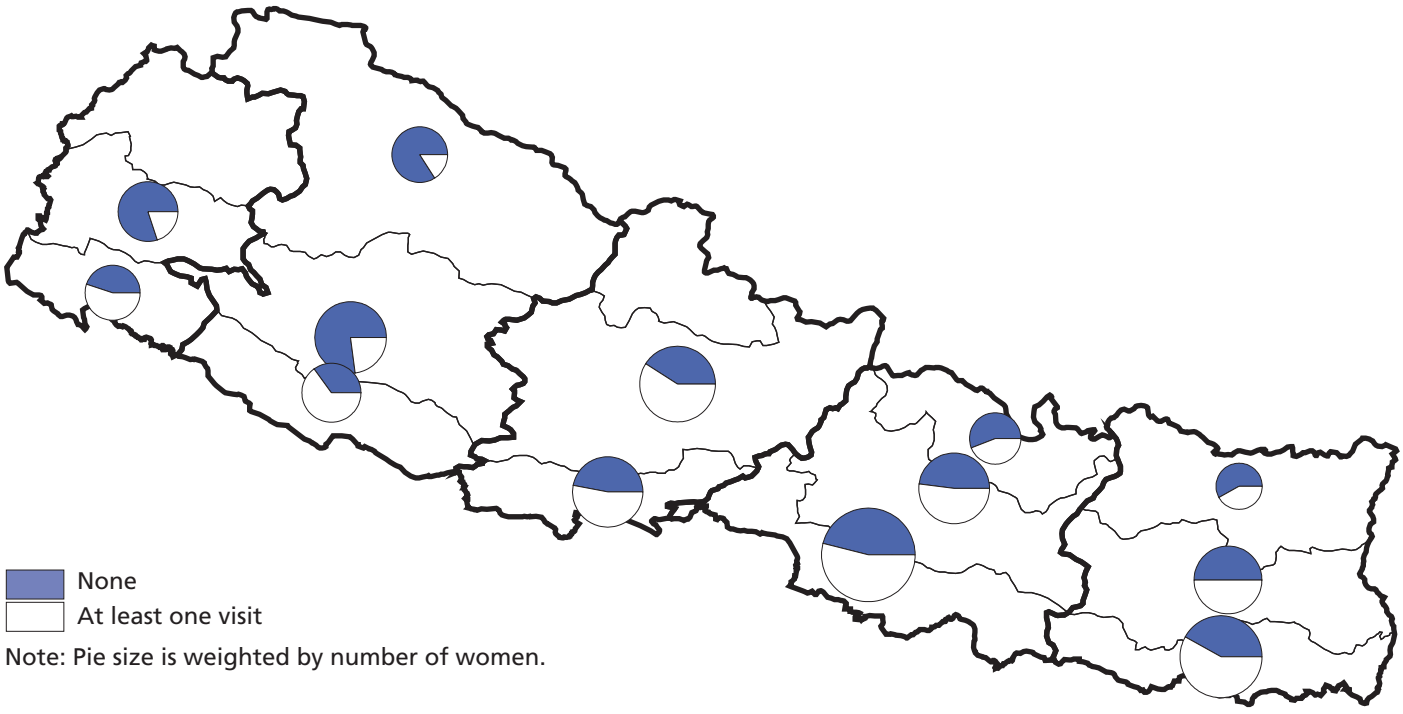
Usage rate for any antenatal care (women making at least one visit) by DHS cluster, relative to the average for all clusters



Source: NDHS 2001

Map 7

Proportion of women making at least one antenatal care visit by sub-region



Source: NDHS 2001, Table 9.1, p. 140.

northwards (i.e., by Ecological Zone).

In all models presented in main body of this report the geographic breakdown of Nepal is based on sub-regions.[16]

5.2 Models Predicting Any Use of Antenatal Care[17]

At 48.3 percent, the rate at which women use antenatal care—defined as making at least one visit—is low among the study sample of 3,283 Nepali women. To explore some of the factors that might be associated with use of antenatal care, both logistic regression and HGLM models were run. The results are presented in Tables 7 and 8, respectively.[18] The results of both types of models are similar in directionality and the size of the log odds, so their findings are interpreted together.

Model 1 includes geographic variables based on sub-region (with the Far-Western Hills serving as reference category), an urban dummy, and a continuous measure of distance to the nearest hospital. The overall performance of the model is significant, and the association between independent variables is as expected. That is, the Far-Western Hills is the area of Nepal where pregnant women are least likely to receive antenatal care. The only sub-regions where the difference does not appear to be significant in the logistic regression are the Western Mountain (which includes the Western, Mid-Western, and Far-Western Mountains) and Mid-Western Hills sub-regions. This confirms the impression given by Maps 6 and 7. Even other remote areas of the country, the Eastern and Central Mountains, have odds ratios of 2.7 and 4.1, respectively, for use of antenatal care (although these sub-regions are not significant in the HGLM model). Other sub-regions in the hills have odds ratios ranging from 3.4 to 5.7; that is, women living in these areas of Nepal are approximately 3 to 6 times more likely to use antenatal care than women living in the Far-Western Hills. Women living in the Terai, including those in the Far-Western Development Region, are consistently and significantly more likely to use antenatal care than women in the Far-Western Hills.

The further away women live from a hospital, the lower is their use of antenatal care.

Looking at the other variables in Model 1, women living in urban areas are 2 to 3 times more likely (depending on the model) to use antenatal care than those living in rural areas. Distance to the nearest hospital, which is a proxy for health service accessibility and infrastructure, has a negative coefficient. This implies that the further away women live from a hospital, the lower is their use of antenatal care.

For the most part the geographic associations observed in Model 1 hold up in Model 2, although modified after controlling for individual and household variables. After including these other covariates, the rural/urban distinction is no longer a significant predictor. Adding GDI (Model 3a) or GEM (Model 3b) dampens all sub-regional odds ratios. Although substantial variations in the use of antenatal care by sub-region remain in the logistic Models 3a and 3b, the significance of many sub-regions disappears in the HGLM Models 3a and 3b.

Model 2 includes all other covariates taken from the NDHS 2001. Among the logistic models, Model 2 is a considerable improvement over Model 1 in terms of overall performance measures. However, the R-squared between measures dips in the HGLM models.[19] The percentage of women whom outcome measures would correctly predict increases from 64.7 percent in Model 1 to 72.6 percent in Model 2; the –2LL decreases;

[16] Models using Development Region were run, but the results are not reported here—and for the most part, the results regarding other covariates in the models are somewhat similar. Appendix C includes one example where antenatal care was modeled using Development Region dummy variables, with the Far Western Development Region serving as the reference category.

[17] The analyses presented here are based on unweighted data. The analysis has been replicated using weights, and the substantive findings do not change.

[18] Significance at $p < 0.001$ ***, $p < 0.01$ **, and $p < 0.05$ *

Table 7
Logistic regression: Predictors of any use of antenatal care (N=3,283)

	Model 1		Model 2		Model 3a (GDI)		Model 3b (GEM)	
Background characteristic	B	Exp(B)	B	Exp(B)	B	Exp(B)	B	Exp(B)
Sub-region								
Eastern Mountain	1.006***	2.734	1.154***	3.171	-0.036	0.964	0.384	1.468
Central Mountain	1.417***	4.124	1.85***	6.361	1.282***	3.604	0.828**	2.288
Western Mountain	0.008	1.008	0.21	1.234	0.488	1.629	0.116	1.123
Eastern Hills	1.358***	3.887	1.786***	5.965	0.703*	2.02	0.767**	2.154
Central Hills	1.232***	3.429	1.469***	4.345	0.949***	2.582	0.511	1.667
Western Hills	1.753***	5.774	1.446***	4.247	0.37	1.448	0.036	1.036
Mid-Western Hills	0.322	1.38	0.264	1.302	-0.198	0.82	-0.029	0.972
Eastern Terai	1.72***	5.586	1.738***	5.688	0.274	1.316	0.907***	2.477
Central Terai	1.493***	4.451	1.812***	6.126	0.949***	2.583	1.294***	3.647
Western Terai	1.643***	5.168	2.049***	7.759	1.092***	2.981	0.886**	2.426
Mid-Western Terai	2.186***	8.901	2.612***	13.623	1.93***	6.891	1.62***	5.052
Far-Western Terai	1.646***	5.189	2.033***	7.64	1.423***	4.151	1.425***	4.157
Urban	1.076***	2.933	0.055	1.056	-0.124	0.883	-0.111	0.895
Distance to hospital	-0.052***	0.95	-0.036***	0.965	-0.038***	0.962	-0.038***	0.963
Age								
20–34			0.137	1.147	0.151	1.163	0.143	1.153
35+			-0.135	0.873	-0.137	0.872	-0.151	0.86
Parity								
2–3			-0.242	0.785	-0.235	0.79	-0.207	0.813
4–5			-0.592***	0.553	-0.575***	0.563	-0.55***	0.577
6+			-0.685***	0.504	-0.697***	0.498	-0.677***	0.508
Want child								
Then			0.144	1.154	0.15	1.162	0.132	1.142
Later			0.249	1.283	0.265	1.303	0.238	1.269
Refuse sex			0.373	1.453	0.411**	1.508	0.413**	1.512
Wife beating			-0.213*	0.808	-0.205*	0.815	-0.157	0.855
Decisionmaking								
1–2			0.149	1.161	0.165	1.18	0.125	1.133
3–4			0.337**	1.401	0.361**	1.434	0.343**	1.409
Problems getting services								
1–2			-0.025	0.975	-0.055	0.947	-0.071	0.931
3–5			-0.099	0.905	-0.168	0.846	-0.203	0.816
6–7			-0.463*	0.629	-0.471*	0.624	-0.481*	0.618
Owns land			-0.111	0.895	-0.102	0.903	-0.015	0.985
Relation to head of household								
Wife			0.302	1.353	0.31	1.363	0.264	1.302
Daughter-in-law			0.326	1.385	0.355	1.426	0.328	1.388
Other			0.329	1.389	0.318	1.374	0.333	1.395
Women's education								
Primary			0.446***	1.562	0.419***	1.52	0.408**	1.504
Secondary			1.091***	2.976	1.053***	2.866	1.104***	3.015
Partner's education								
Primary			0.049	1.051	0.028	1.028	0.033	1.034
Secondary & Higher			0.26*	1.297	0.266*	1.305	0.322**	1.38
Don't know			0.59	1.804	0.587	1.798	0.702*	2.018
Listens to radio			0.433***	1.542	0.455***	1.577	0.453***	1.573
Watches TV			0.496***	1.642	0.418**	1.518	0.456**	1.578
Woman's employment								
Agricultural/self-employed			-0.332*	0.718	-0.319*	0.727	-0.287*	0.75
Non-agricultural			-0.432	0.649	-0.547*	0.579	-0.487	0.614
Partner's employment								
Non-agricultural			0.135	1.145	0.138	1.148	0.15	1.161
Unknown			0.222	1.248	0.209	1.232	0.14	1.15
Hindu			-0.312	0.732	-0.266	0.767	-0.349	0.705
Ethnicity								
Chhetri/Thakuri/Rajput			-0.323	0.724	-0.312	0.732	-0.261	0.77
Newar			-0.663*	0.515	-0.711*	0.491	-0.602	0.548
Gurung/Magar			-1.448***	0.235	-1.434***	0.238	-1.398***	0.247
Tamang/Sherpa			-1.387***	0.25	-1.408***	0.245	-1.398***	0.247
Rai/Limbu			-1.276***	0.279	-1.402***	0.246	-1.364***	0.256
Muslim/Churaute			-0.938*	0.391	-0.926*	0.396	-0.98**	0.375
Tharu/Rajbanshi			-1.207***	0.299	-1.258***	0.284	-1.226***	0.294
Yadav/Ahir			-1.044***	0.352	-0.974**	0.378	-0.788*	0.455
Occupational			-0.674***	0.51	-0.696***	0.498	-0.598**	0.55
Other Hills/Terai			-0.709**	0.492	-0.705**	0.494	-0.527*	0.59
Utilities								
1			0.205	1.228	0.172	1.188	0.074	1.077
2+			0.484*	1.622	0.337	1.401	0.192	1.212
GDI					0.089***	1.093		
GEM							0.134***	1.143
Constant	-0.895***	0.409	-0.849	0.428	-2.443***	0.087**	-1.627	0.197
-2 log likelihood	4059.76		3494.23		3451.44		3422.37	
Nagelkerke R^2	0.183		0.365		0.376		0.386	
% correct prediction	64.7		72.6		73		73.1	
Model chi-square (df)	484.91(14)***		1050.44(56)***		1093.23(57)***		1122.30(57)***	
Block chi-square (df)	484.91(14)***		565.53(42)***		42.79(1)***		71.86(1)***	

Significance at p < 0.001 ***, p <0.01 **, and p <0.05 *

Table 8
HGLM: Predictors of any use of antenatal care (N=3,283)

	Model 1		Model 2		Model 3a (GDI)		Model 3b (GEM)	
Background characteristic	Coeff	Exp (B)	Coeff	Exp (B)	Coeff	Exp (B)	Coeff	Exp (B)
Sub-region								
Eastern Mountain	0.793	2.21	1.271	3.565	0.167	1.182	0.595	1.813
Central Mountain	1.129	3.092	2.038**	7.679	1.539*	4.66	1.242	3.462
Western Mountain	-0.373	0.689	-0.16	0.853	0.12	1.128	-0.171	0.843
Eastern Hills	1.278*	3.588	1.999***	7.38	0.944	2.571	1.101	3.007
Central Hills	1.335**	3.8	1.635**	5.127	0.993	2.7	0.691	1.996
Western Hills	1.68**	5.365	1.488**	4.429	0.502	1.653	0.292	1.34
Mid-Western Hills	0.1	1.105	-0.003	0.997	-0.385	0.68	-0.224	0.799
Eastern Terai	1.545**	4.688	1.736**	5.673	0.406	1.501	1.058	2.882
Central Terai	1.503**	4.495	1.855**	6.391	1.08	2.945	1.436**	4.202
Western Terai	1.46*	4.307	1.987**	7.295	1.21	3.353	1.081	2.948
Mid-Western Terai	2.172***	8.775	2.776***	16.05	2.126**	8.379	1.921**	6.827
Far-Western Terai	1.817*	6.152	2.271**	9.689	1.66**	5.26	1.705*	5.501
Urban	0.692***	1.998	-0.18	0.835	-0.235	0.791	-0.212	0.809
Distance to hospital	-0.065***	0.937	-0.047***	0.954	-0.047***	0.954	-0.046***	0.955
Age								
20–34			0.211	1.235	0.211	1.234	0.205	1.227
35+			-0.053	0.949	-0.059	0.943	-0.062	0.94
Parity								
2–3			-0.322*	0.725	-0.314*	0.731	-0.306*	0.736
4–5			-0.622***	0.537	-0.614***	0.541	-0.607***	0.545
6+			-0.742***	0.476	-0.737***	0.478	-0.731***	0.482
Want child								
Then			0.199	1.22	0.197	1.218	0.195	1.215
Later			0.276	1.317	0.273	1.314	0.272	1.313
Refuse sex			0.256	1.291	0.285	1.33	0.288	1.334
Wife beating			-0.142	0.868	-0.137	0.872	-0.129	0.879
Decisionmaking								
1–2			0.202	1.223	0.2	1.221	0.194	1.214
3–4			0.275*	1.317	0.279*	1.322	0.278*	1.321
Problems getting services								
1–2			-0.21	0.811	-0.216	0.806	-0.217	0.805
3–5			-0.267	0.766	-0.284	0.753	-0.287	0.75
6–7			-0.612**	0.542	-0.617**	0.539	-0.61**	0.544
Owns land			-0.059	0.943	-0.055	0.946	-0.038	0.963
Relation to household head								
Wife			0.075	1.078	0.083	1.086	0.077	1.08
Daughter-in-law			0.13	1.138	0.141	1.152	0.137	1.147
Other relation			0.141	1.151	0.145	1.156	0.146	1.157
Women's education								
Primary			0.449***	1.566	0.442***	1.556	0.443***	1.557
Secondary and higher			1.158***	3.182	1.15***	3.159	1.158***	3.185
Partner's education								
Primary			0.037	1.038	0.033	1.033	0.037	1.037
Secondary and higher			0.382**	1.465	0.383**	1.467	0.391**	1.478
Don't know			0.736*	2.087	0.732*	2.08	0.743*	2.102
Listens to radio			0.439***	1.551	0.444***	1.559	0.446***	1.562
Watches TV			0.452**	1.572	0.436**	1.546	0.441**	1.554
Women's employment								
Agricultural/self-employed			-0.189	0.828	-0.18	0.835	-0.183	0.833
Non-agricultural			-0.257	0.774	-0.305	0.737	-0.308	0.735
Partner's employment								
Non-agricultural			0.143	1.154	0.143	1.153	0.145	1.157
Unknown			0.196	1.217	0.19	1.209	0.184	1.201
Hindu			-0.113	0.893	-0.126	0.881	-0.132	0.877
Ethnicity								
Chettri/Thakuri/Rajput			-0.333	0.717	-0.331	0.718	-0.315	0.73
Newar			-0.744*	0.475	-0.748*	0.473	-0.742*	0.476
Gurung/Magar			-1.524***	0.218	-1.534***	0.216	-1.517***	0.219
Tamang/Sherpa			-1.405***	0.245	-1.394***	0.248	-1.39***	0.249
Rai/Limbu			-1.595***	0.203	-1.618***	0.198	-1.6***	0.202
Muslim			-1.044**	0.352	-1.057**	0.347	-1.046*	0.351
Tharu/Rajbansi			-1.394***	0.248	-1.403***	0.246	-1.384***	0.251
Yadav/Ahir			-0.99**	0.372	-0.988**	0.372	-0.955**	0.385
Occupational			-0.522*	0.594	-0.532*	0.587	-0.508*	0.601
Other Hills/Terai			-0.539	0.583	-0.549*	0.578	-0.515	0.598
Utilities								
1			-0.001	0.999	0.001	1.001	-0.011	0.989
2+			0.345	1.412	0.289	1.335	0.278	1.321
GDI					0.079**	1.082		
GEM							0.109***	1.115
Intercept	-0.618	0.539	-0.652	0.521	-2.054*	0.128	-1.32	0.267

Variance comp	Null Model	Model 1	Model 2	Model 3a	Model 3b
Tau (Level 2 variance)	1.24	0.651***	0.71***	0.601***	0.564***
R^2 between		0.475	0.427	0.515	0.545

Significance at p < 0.001 ***, p <0.01 **, and p <0.05 *

and the model chi-square is highly significant with 56 variables in the logistic model.

A number of independent variables are associated with the use of antenatal care. Age is not a significant predictor, but parity is negatively associated with antenatal care. When a pregnancy is a fourth or higher order birth, women are less likely to use antenatal care. The relationship is consistent: as parity level increases, women are less likely to use antenatal care compared with first-time and lower parity mothers. This association holds up when either GDI or GEM is added to the model (Models 3a and 3b).

Turning to individual empowerment variables, women who believe that no circumstances justify wife beating are less likely to use antenatal care, at least according to the logistic model. This somewhat perplexing association is documented in the NDHS 2001 report (Ministry of Health et al., 2002). However, women who are involved in decisions about health care, purchases, daily needs, and family visits are 1.3 to 1.4 times more likely to use antenatal care than women who are not involved in such decisionmaking. Women who report six or seven "big" problems in securing access to health services are less likely to use antenatal care than women who report no such problems; the odds ratio in the HGLM is 0.54.

Women are more likely to use antenatal care if they live in districts with higher GDI scores.

Among more traditional women's status variables, women's education is strongly associated with use of antenatal care. Compared with women who have no education, women with primary education were 1.5 times more likely to use antenatal care, and those with secondary or higher levels of education were 3 times more likely. Partner's education level also was moderately significant with an odds ratio of 1.3 to 1.5. Women's work status has a seemingly paradoxical association: women who were not employed were more likely to use antenatal care than those who worked in agriculture or were self-employed (although this is not significant in the HGLM). Perhaps as noted earlier, this may be explained by the fact that women often work for the family and exert little influence over household and individual decisionmaking. Partner's work status was not significant in determining the use of antenatal care.

Women who regularly listened to the radio or watched television were 1.5 to 1.6 times more likely to use antenatal care than women who did not. According to the logistic model, women living in households with two or more utilities were 1.6 times more likely to use antenatal care than women living in households without access to any utilities (piped water, a toilet or latrine, modern cooking fuels, and electricity); however, utilities were not significant in the HGLM. Lastly, Brahmin women (the reference category) were more likely than women of any other ethnic group to use antenatal care, including other higher caste groups such as Newar. Odds ratios were lowest (ranging from 0.2 to 0.3) for the Gurung/Magar, Tamang/Sherpa, Rai/Limbu, and Tharu/Rajbanshi. Being Hindu was not a significant predictor of the use of antenatal care.

Model 3a adds one additional covariate: GDI, which is based on gender differences in life expectancy, sex ratio, literacy and schooling, and income. Model 3a provides no real improvement over Model 2, although the overall model performance measures are strong and the GDI variable is highly significant, implying that women are more likely to use antenatal care if they live in districts with higher GDI scores. The HGLM model includes summary measures that allow for the identification of the importance of contextual factors. In Table 8 the Level 2 variance components show that there is significant variation across districts. The inclusion of contextual variables improves overall explained variance in the use of antenatal care compared with Model 2. Indeed, the HGLM results suggest that adding GDI to individual and household variables increases explained variance for predicting the use of antenatal care by 9 percentage points.

[19] This is not a concern since it is always a possibility when there are many dichotomous variables in a model. Moreover, the directionality and the significance of individual covariates are consistent with the study's theoretical expectations and model.

Including GDI changes the associations between some of the other covariates and use of antenatal care. As noted above, including GDI (Model 3a) or GEM (Model 3b) dampens all sub-regional odds ratios. In addition, while substantial variations in use of antenatal care by sub-region remain in the logistic models, the significance of most sub-regions disappears in the HGLM models. There are minor differences in which sub-regions remain significant between GDI and GEM models.

In the logistic models, some individual covariates are significant in Model 3a that were not in Model 2, although the HGLM models are almost identical. In the logistic model, women who said they would refuse sex with their husbands under all four circumstances were more likely to use antenatal care than women who said they would not refuse sex in at least one circumstance (odds ratio = 1.5).

Model 3b replaces GDI with GEM, which is based on women's economic and political participation. Among the logistic models, Model 3b is better than Model 3a based on comparative model performance measures (–2LL), although it, too, is only a modest improvement over Model 2. HGLM results from Model 3b imply a 12-percentage point increase in explained variance for predicting antenatal care after including GEM. The GEM measure is highly significant, suggesting that women are more likely to use antenatal care if they live in districts with higher GEM scores. Among the logistic models, refusing sex is the only covariate that becomes significant in Model 3b compared with Model 2, while household utilities lose significance. The main effect of including GEM in the model is the dampening of the significance of the sub-regional variables, especially compared with Model 2. In both the logistic and HGML models, the odds ratios of the sub-regions that remain significant are halved in some cases. In other words, including GEM in the model reduces sub-regional differences in the use of antenatal care. For example, the odds of using antenatal care in the Terai sub-regions are 5–16 times higher than in the Far-Western Hills according to Model 2, but only 2–6 times higher according to Model 3b.

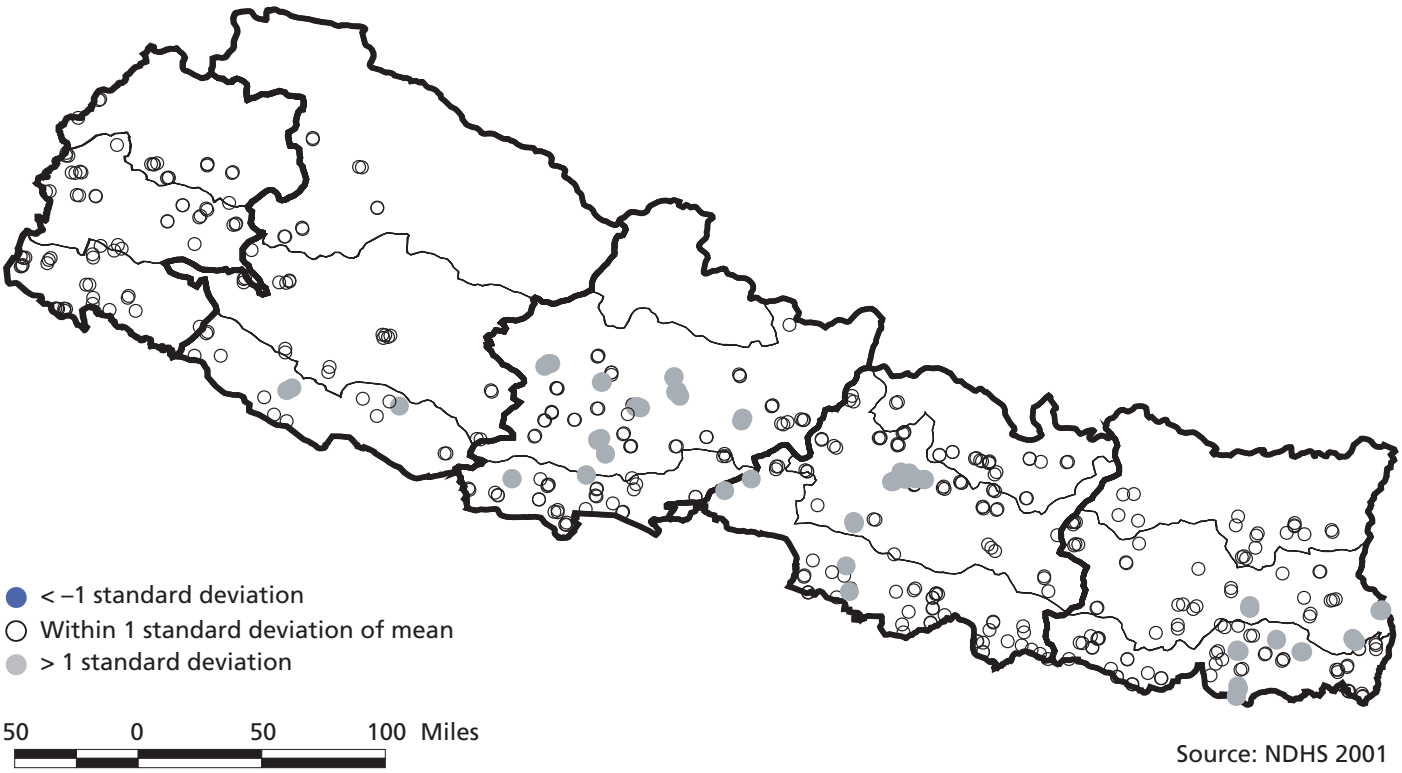
In summary, models that include contextual variables, either GDI or GEM, provide a better overall explanation for the variation in use of antenatal care by married Nepali women. In models with contextual variables, there is some sub-regional variation in antenatal care, especially within the Terai, and a significant negative association with distance to nearest main hospital (the greater the distance to a hospital, the less likely a woman is to use antenatal care services). Regarding individual and household covariates, married women are less likely to use antenatal care as their parity increases, if they report many problems accessing health care, and if they are not Brahmin. Married women are more likely to use antenatal care if they make more decisions in the household, are educated, have partners who are educated, listen to the radio, and watch television.

5.3 Four or More Antenatal Care Visits

Map 8 illustrates geographic variations in the proportion of women who make extensive use of antenatal care, defined as four or more visits, relative to the national average. The map is based only on those women who reported using any antenatal care. The average value for all DHS clusters was 27.1 percent, with a standard deviation of 28.1 percent. This makes it impossible for any cluster to fall in the below-average category, which is defined as less than one standard deviation below the mean.

The map does reveal where above-average proportions of women made extensive use of antenatal care during their pregnancy. Kathmandu (Central Hills) falls in this category, although few other clusters in the Central Development Region do. Most women in Pokhara (Western Hills) made at least four antenatal visits, as did women in a number of other clusters throughout the Western Hills. Women in the eastern half of the Eastern Development Region are most likely to have made four or more antenatal

Map 8
Usage rate for extensive antenatal care (women making at least four visits) by DHS cluster, relative to the average for all clusters



Source: NDHS 2001

care visits, in sharp contrast to the Far-Western Development Region where not a single cluster falls in the above-average category.

5.4 Models Predicting Extensive Use of Antenatal Care

As previously noted, 48 percent of the 3,283 women in the study sample received antenatal care. Of these 1,586 women, only 29.5 percent made at least four antenatal visits, the minimum recommended by the National Safe Motherhood Program in Nepal. The same set of predictors as before is used to explore which women are likely to make extensive use of antenatal care. Logistic regression results are presented in Table 9, and HGLM results in Table 10. Discussion of the results is combined.

Model 1 reveals that women who receive antenatal care in the Far-Western Hills (the reference category) differ little from women elsewhere in Nepal as to whether they make four or more antenatal care visits. According to the logistic model, in only three sub-regions of the country are women more likely to make extensive use of antenatal care: odds ratios range from 2.3 to 3.0 in the Eastern Terai, Central Hills, and Western Hills. In the HGLM, only one sub-region is marginally different: women in the Western Hills are 3 times more likely to make extensive use of antenatal care than those in the Far-Western Hills. Among women who have attended antenatal care facilities at least once, urban women are 2 to 3 times more likely than rural women to make four or more visits. Distance to the nearest hospital is not significant in this model, presumably because women in this sample, all of whom had made at least one antenatal care visit, had already proved their ability to overcome accessibility issues.

Model 2 uncovers some modest associations. The geographic variables are generally weaker, with no significant differences in the HGLM model. The urban dummy variable is no longer significant after the individual-level covariates have been added. Age

Table 9
Logistic regression: Predictors of four or more antenatal care visits (N=1,586)

Background characteristic	Model 1		Model 2		Model 3a (GDI)		Model 3b (GEM)	
	B	Exp(B)	B	Exp(B)	B	Exp(B)	B	Exp(B)
Sub-region								
Eastern Mountain	0.192	1.211	-0.195	0.823	-1.316*	0.268	-1.091*	0.336
Central Mountain	-0.022	0.978	-0.043	0.957	-0.501	0.606	-1.165*	0.312
Western Mountain	-0.614	0.541	-0.463	0.629	-0.329	0.72	-0.604	0.547
Eastern Hills	0.425	1.529	0.363	1.437	-0.671	0.511	-0.725	0.485
Central Hills	0.884*	2.42	0.541	1.718	-0.299	0.742	-0.768	0.464
Western Hills	1.114**	3.047	0.801*	2.227	-0.209	0.811	-0.599	0.549
Mid-Western Hills	-0.564	0.569	-0.591	0.554	-1.041	0.353	-0.916	0.4
Eastern Terai	0.833*	2.301	0.747	2.111	-0.546	0.579	-0.186	0.83
Central Terai	0.043	1.044	0.305	1.356	-0.468	0.626	-0.281	0.755
Western Terai	0.458	1.58	0.7	2.013	-0.158	0.854	-0.377	0.686
Mid-Western Terai	0.006	1.006	0.057	1.059	-0.495	0.61	-0.842	0.431
Far-Western Terai	0.268	1.308	0.447	1.564	-0.102	0.903	-0.165	0.847
Urban	1.106***	3.022	0.326	1.386	0.15	1.162	0.127	1.136
Distance to hospital	-0.008	0.992	0.007	1.007	0.009	1.009	0.005	1.005
Age								
20–34			0.507*	1.661	0.511*	1.668	0.499*	1.646
35+			0.618	1.855	0.596	1.815	0.636	1.889
Parity								
2–3			-0.416*	0.659	-0.431*	0.65	-0.418*	0.658
4–5			-0.685**	0.504	-0.678**	0.508	-0.642*	0.526
6+			-0.705	0.494	-0.73*	0.482	-0.713	0.49
Want child								
Then			0.157	1.17	0.143	1.154	0.147	1.159
Later			0.426	1.532	0.428	1.535	0.44	1.552
Refuse sex			0.466	1.594	0.586*	1.797	0.614	1.848
Wife beating			0.02	1.02	0.044	1.045	0.095	1.099
Decisionmaking								
1–2			0.152	1.164	0.173	1.189	0.144	1.155
3–4			0.293	1.34	0.316	1.372	0.325	1.384
Problems getting services								
1–2			-0.227	0.797	-0.275	0.76	-0.301	0.74
3–5			-0.187	0.83	-0.268	0.765	-0.323	0.724
6–7			-0.217	0.805	-0.231	0.794	-0.273	0.761
Owns land			-0.06	0.942	-0.063	0.939	-0.043	0.958
Relation to household head								
Wife			0.375	1.456	0.393	1.481	0.389	1.476
Daughter-in-law			0.555	1.742	0.599	1.82	0.622	1.862
Other			0.469	1.599	0.479	1.614	0.536	1.709
Women's education								
Primary			-0.005	0.995	-0.03	0.97	-0.038	0.963
Secondary			0.237	1.268	0.216	1.241	0.236	1.266
Partner's education								
Primary			-0.084	0.92	-0.057	0.945	-0.056	0.946
Secondary and higher			0.344	1.41	0.41*	1.507	0.427*	1.532
Don't know			0.635	1.888	0.713	2.041	0.793	2.21
Listens to radio			0.016	1.016	0.056	1.058	0.052	1.054
Watches TV			0.383*	1.467	0.283	1.328	0.339	1.403
Women's employment								
Agricultural/self employed			-0.413*	0.662	-0.378	0.685	-0.403*	0.669
Non-agricultural			-0.351	0.704	-0.433	0.649	-0.438	0.645
Partner's employment								
Non-agricultural			0.232	1.261	0.234	1.264	0.247	1.28
Unknown			-0.083	0.921	-0.182	0.834	-0.159	0.853
Hindu			-0.491	0.612	-0.473	0.623	-0.531	0.588
Ethnicity								
Chhetri/Thakuri/Rajput			0.417	1.517	0.429	1.536	0.503*	1.654
Newar			0.214	1.238	0.266	1.305	0.25	1.284
Gurung/Magar			-0.33	0.719	-0.299	0.741	-0.253	0.777
Tamang/Sherpa			-0.563	0.57	-0.425	0.654	-0.378	0.685
Rai/Limbu			-0.479	0.619	-0.552	0.576	-0.461	0.631
Muslim/Churaute			-1.17*	0.31	-1.076*	0.341	-1.171*	0.31
Tharu/Rajbanshi			-0.759*	0.468	-0.756*	0.469	-0.727*	0.484
Yadav/Ahir			-0.545	0.58	-0.427	0.653	-0.276	0.759
Occupational			-0.271	0.763	-0.203	0.816	-0.088	0.916
Other Hills/Terai			-0.75*	0.472	-0.682*	0.505	-0.586*	0.556
Utilities								
1			0.572***	1.771	v0.565***	1.76	0.505**	1.658
2+			0.712***	2.038	0.639**	1.895	0.557*	1.746
GDI					0.076***	1.079		
GEM							0.118***	1.125
Constant	-1.427***	0.24	-2.405**	0.09	-3.926***	0.02	-3.217***	0.04
-2 log likelihood	1783.43		1559.1		1538.49		1528.57	
Nagelkerke R^2	0.119		0.292		0.306		0.313	
% correct prediction	73.7		76.9		77.7		77.6	
Model chi-square(df)	363.06(56)***		138.72(14)***		383.67(57)***		393.52(57)***	
Block chi-square(df)	224.34(42)***		138.72(14)***		20.61(1)***		30.53(1)***	

Significance at p < 0.001 ***, p <0.01 **, and p <0.05 *

Table 10
HGLM: Predictors of four or more antenatal care visits (N=1,586)

Background characteristic	Model 1 Coeff	Model 1 Exp (B)	Model 2 Coeff	Model 2 Exp (B)	Model 3a Coeff	Model 3a Exp (B)	Model 3b Coeff	Model 3b Exp (B)
Sub-region								
Eastern Mountain	0.23	1.258	-0.041	0.96	-1.275	0.279	-0.965	0.381
Central Mountain	-0.535	0.586	-0.41	0.663	-0.845	0.429	-1.402	0.246
Western Mountain	-0.727	0.483	-0.535	0.585	-0.317	0.729	-0.624	0.536
Eastern Hills	0.295	1.343	0.386	1.47	-0.761	0.467	-0.716	0.489
Central Hills	0.898	2.455	0.569	1.766	-0.325	0.722	-0.751	0.472
Western Hills	1.104*	3.017	0.867	2.38	-0.23	0.795	-0.578	0.561
Mid-Western Hills	-0.624	0.536	-0.627	0.534	-1.122	0.326	-0.968	0.38
Eastern Terai	0.58	1.787	0.611	1.843	-0.789	0.454	-0.26	0.771
Central Terai	0.006	1.006	0.298	1.347	-0.539	0.583	-0.263	0.769
Western Terai	0.559	1.749	0.867	2.38	-0.021	0.979	-0.257	0.773
Mid-Western Terai	0.073	1.075	0.158	1.171	-0.511	0.6	-0.833	0.435
Far-Western Terai	0.404	1.498	0.53	1.7	-0.122	0.885	-0.154	0.858
Urban	0.827***	2.286	0.171	1.186	0.098	1.103	0.101	1.106
Distance to hospital	-0.016	0.984	-0.003	0.997	0	1	0	1
Age								
20–34			0.485*	1.624	0.492*	1.635	0.479*	1.614
35+			0.595	1.812	0.589	1.803	0.604	1.829
Parity								
2–3			-0.443**	0.642	-0.445**	0.641	-0.431*	0.65
4–5			-0.7**	0.497	-0.692**	0.501	-0.663**	0.515
6+			-0.729*	0.482	-0.733*	0.481	-0.714	0.49
Want child								
Then			0.178	1.195	0.169	1.184	0.173	1.189
Later			0.429	1.536	0.427	1.532	0.437	1.548
Refuse sex			0.568*	1.764	0.626*	1.871	0.636*	1.888
Wife beating			0.077	1.08	0.091	1.095	0.112	1.118
Decisionmaking								
1–2			0.164	1.178	0.171	1.186	0.158	1.171
3–4			0.344	1.41	0.352	1.422	0.36	1.434
Problems getting services								
1–2			-0.319	0.727	-0.338	0.713	-0.346	0.708
3–5			-0.346	0.708	-0.374	0.688	-0.386	0.68
6–7			-0.334	0.716	-0.325	0.723	-0.314	0.73
Owns land			-0.022	0.978	-0.032	0.968	-0.011	0.99
Relation to household head								
Wife			0.475	1.608	0.474	1.607	0.463	1.589
Daughter-in-law			0.671*	1.956	0.684*	1.981	0.689*	1.991
Other relation			0.593	1.809	0.587	1.799	0.608	1.837
Women's education								
Primary			0.016	1.016	0.001	1.001	-0.002	0.998
Secondary and higher			0.296	1.345	0.282	1.325	0.293	1.34
Partner's education								
Primary			-0.17	0.844	-0.151	0.86	-0.135	0.873
Secondary and higher			0.329	1.39	0.363	1.437	0.382	1.464
Don't know			0.721	2.056	0.754	2.125	0.79	2.202
Listen to radio			-0.008	0.992	0.011	1.011	0.011	1.011
Watches TV			0.246	1.279	0.213	1.237	0.24	1.272
Women's employment								
Agricultural			-0.379	0.685	-0.362	0.696	-0.383	0.682
Non-agricultural			-0.415	0.661	-0.456	0.634	-0.465	0.628
Partner's employment								
Non-agricultural			0.263	1.3	0.257	1.293	0.262	1.299
Unknown			-0.114	0.893	-0.165	0.848	-0.159	0.853
Hindu			-0.467	0.627	-0.465	0.628	-0.498	0.608
Ethnicity								
Chettri/Thakuri/Rajput			0.503*	1.654	0.501*	1.65	0.544*	1.723
Newar			0.307	1.359	0.322	1.38	0.301	1.351
Gurung/Magar			-0.355	0.701	-0.347	0.707	-0.303	0.738
Tamang/Sherpa			-0.441	0.644	-0.388	0.678	-0.372	0.689
Rai/Limbu			-0.641	0.527	-0.674	0.51	-0.622	0.537
Muslim			-1.057*	0.347	-1.052*	0.349	-1.06*	0.347
Tharu/Rajbansi			-0.576	0.562	-0.603	0.547	-0.579	0.56
Yadav/Ahir			-0.234	0.791	-0.22	0.802	-0.155	0.857
Occupational			-0.147	0.864	-0.135	0.873	-0.065	0.937
Other Hills/Terai			-0.964**	0.381	-0.919**	0.399	-0.846*	0.429
Utilities								
1			0.426*	1.531	0.439**	1.55	0.423*	1.526
2+			0.629**	1.876	0.594**	1.811	0.573**	1.774
GDI					0.083***	1.087		
GEM							0.122***	1.13
Intercept		-1.378**	0.252	-2.512**	0.081	-4.055***	0.017	-3.284***	0.037

Variance comp	Null Model	Model 1	Model 2	Model 3a	Model 3b
Tau (Level 2 variance)	0.72	0.461***	0.444***	0.32***	0.245*
R^2 between		0.36	0.383	0.556	0.66

Significance at p < 0.001 ***, p <0.01 **, and p <0.05 *

is significant: women aged 20-34 are 1.6 times more likely than those under 20 years to extensively use antenatal care. There is also a negative association with parity: women experiencing their first pregnancy are more likely than others to make four or more antenatal visits. Women also are almost twice as likely to make four antenatal visits if they are the household head's daughter-in-law, according to the HGLM model.

The logistic models also show a positive association for women who watch TV regularly, a negative association for those who work in agriculture, and a negative association for various ethnic groups: Muslim, Tharu/Rajbanshi, and the other Hills and Terai. Muslim women are about one-third as likely as Brahmin women to attend four or more antenatal visits. Of the variables discussed in this paragraph only the ethnic differences are significant in HGLM Model 2.

One of the strongest associations found in both the logistic and HGLM models concerns modern utilities. Women living in households with one utility are 1.5–1.7 times more likely to make extensive use of antenatal care than women in households lacking utilities. Women in households with two or more utilities are 1.9-2.0 times more likely to use antenatal services as those without utilities.

Model 3a is a slight improvement on Model 2, and GDI is significant. As Table 10 shows, the Level 2 variance components are significant. Compared with Model 2, the inclusion of GDI as a contextual variable improves overall explained variance by 17 points among women who attend antenatal care a minimum of four times.

For the most part, the same set of variables discussed in Model 2 are significant predictors in Model 3a. However, the inclusion of GDI eliminates the significance of sub-regional associations (although in the logistic Model 3a women from the Eastern Mountains are significantly less likely to make four antenatal care visits than women in the Far Western Hills). Adding GDI also means that TV watching and women's employment are no longer significant.

Model 3b includes GEM, and the HGLM results show a 28-point increase in explained variance for predicting extensive use of antenatal care compared with Model 2, although the model is marginally significant.[20] The geographic pattern changes again in the logistic model, with women in both the Eastern and Central Mountains one-third as likely to use antenatal care as women in other mountain areas. There are no sub-regional differences in the HGLM formulation. Women employed in agriculture were two-thirds as likely as women who did not work to make extensive use of antenatal care, and Chhetri women were 1.6–1.7 times more likely to do so than Brahmin women. There are no other major differences between the HGLM models including GDI or GEM.

It is not surprising to find a reduced set of significant associations in this analysis, given that it attempts to differentiate between women who made more or less use of antenatal care and excludes those who never received antenatal care. The inclusion of GDI or GEM accounts for most of the small sub-regional variations, and other geographic variables were never significant after the inclusion of individual covariates. In addition to parity, there is a modest age effect, with women aged 20–34 more likely than younger women to make at least four antenatal visits. An empowerment variable (women's attitudes toward refusing sex) also was significant: women who hold strong views were more likely than others to make extensive use of antenatal care. Other positive associations were observed for women who were a daughter-in-law of the head of household, Chhetri, and who lived in households with a greater number of modern utilities. Negative associations were found among some ethnic groups, most notably Muslim, Tharu/Rajbansi, and other Hill/Terai groups.

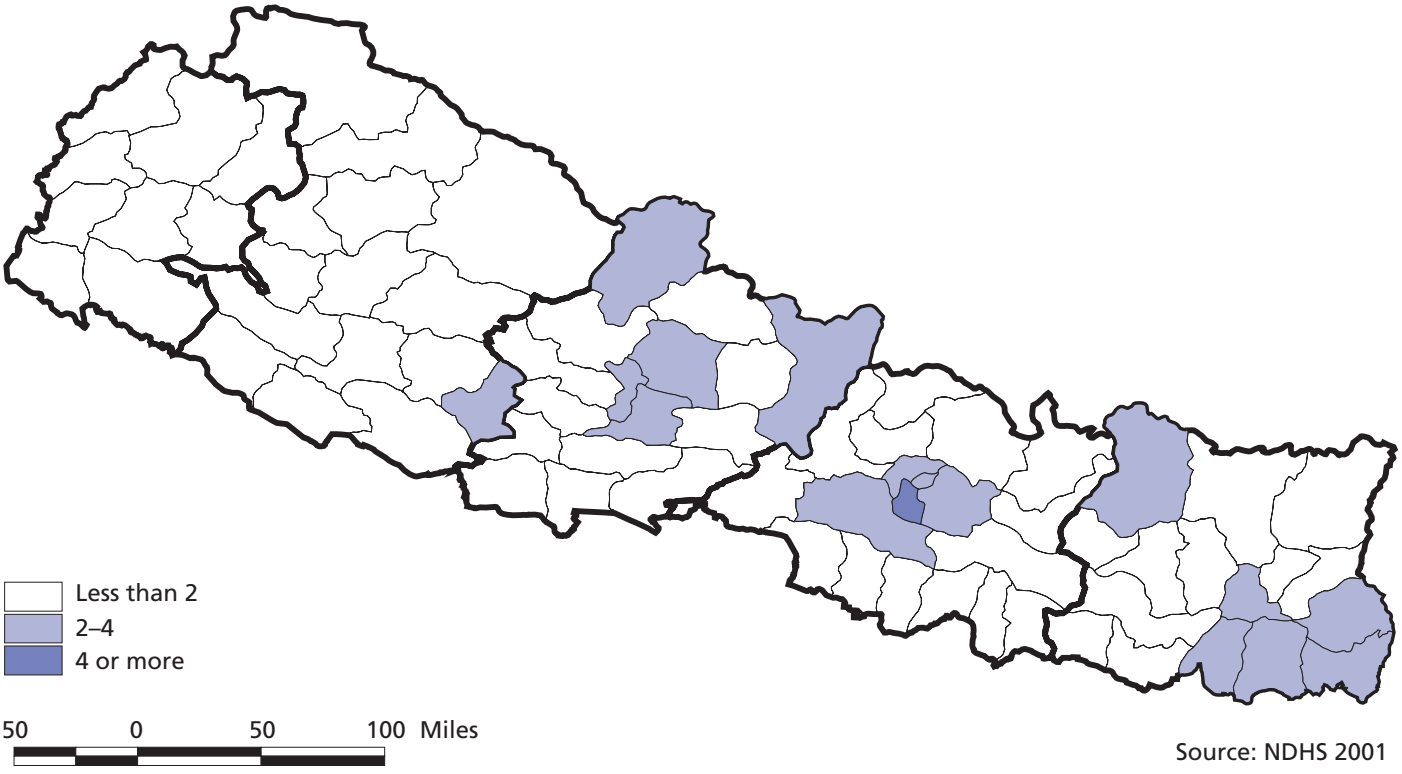
Women who hold strong views on the right to refuse sex were more likely than others to make extensive use of antenatal care.

Modeling was used to explore other contextual variables, but more often than not the variables added were not significant and did not change the substantive findings.

[20] This is not a concern, as discussed in footnote 12.

For example, Appendix D presents a model with an additional contextual variable: the average number of antenatal care visits reported for each pregnancy in the district, which was derived from a government report (Ministry of Health, 2001). Because this is district-level data, it can be mapped (see Map 9). Note that the Level 2 variance component is not significant in this example, which is presented as Model 4 (see Table D.1). The additional variable is expected to be associated with the frequent use of antenatal care by women in the NDHS 2001 sample. This contextual variable is marginally significant, and moderates the effect of GEM.

Map 9
Average number of antenatal care visits by district



Source: NDHS 2001

6 Discussion

6.1 Overall Analytical Findings

Given our interest in women's empowerment, we have been encouraged by the findings. Using the NDHS 2001 enabled the study to draw on a larger set of women's empowerment measures—some of which appear to be important predictors of the use of antenatal care—that go beyond the traditional women's status variables of education and work. At the same time the study has been able to situate women in broader gender empowerment contexts at the district level.

Models that include the contextual variables, GDI or GEM, seem to provide a better overall explanation for the variation in the use of antenatal care by married Nepali women, although in many instances coefficients and odds ratios do not change compared with models that do not exclude Level 2 variables. After controlling for GDI or GEM, evidence remains for some sub-regional variation in the use of antenatal care, especially among Terai areas, and for the significant impact of distance to nearest main hospital (the greater the distance to a hospital, the less likely a woman is to use antenatal care services). Regarding individual and household covariates, married women are less likely to use antenatal care as their parity increases, if they report many problems regarding access to medical care, and if they are not Brahmin. Married women are more likely to use antenatal care if they make more decisions in the household, if they are educated, if their partner is educated, and if they regularly listen to the radio or watch television.

Married women are more likely to use antenatal care if they make more decisions in the household, if they are educated, if their partner is educated, and if they regularly listen to the radio or watch television.

The models also were able to detect the influence of contextual factors on whether women who received any antenatal care made four or more visits. All women in this smaller sample received antenatal care, so the goal of the investigation was to determine who was most likely to make extensive use of antenatal services and whether gender context matters. That made finding significant differences based on the covariates in the model quite challenging. Including GDI or GEM accounts for most of the small sub-regional variations, and other geographic variables were never significant after the inclusion of individual covariates. In addition to parity, there are modest age and empowerment-related effects. Positive associations were observed for women who were daughters-in-law of the head of household, were Chhetri, and who lived in households with more modern utilities. Negative associations were found among some ethnic groups, most notably Muslim, Tharu/Rajbansi, and other Hill and Terai groups.

6.2 Implications for Research and Policy

This macro-micro level analysis of the use of antenatal care in Nepal contributes to the existing literature and opens up new directions for research. Paying close attention to processes operating at various spatial scales can help us better understand gender differences in health. Policies and programs conceived without consideration for local context and place will have limited impact, unless they are informed by data that appreciates the vital connection between women's health and women's status across scales.

This analysis has been preliminary: there are theoretical, methodological, and data issues that have only been briefly touched upon. Some may question how the study has treated hierarchies. The study model employs a straightforward, two-level structure based on individual women living within districts. Some variables that strictly speaking are measured at the cluster level—such as distance to the nearest hospital and urban/rural location—are treated as individual factors. The study also blends variables at the individual and household levels. Thus it could be argued that we should have developed and made operational a more complex three- or four-level model that situates women within households and within clusters, as well as within districts. If the study had taken a traditional approach, which aggregates individual and household characteristics to create cluster-level variables, we might have thought more carefully about a three-level structure. Instead, however, the study's strategy was to explore the availability of "global" variables that would demonstrate a significant strength of a spatial perspective and the use of geographic information systems (GIS); clusters were linked to non-DHS derived variables for geographic contexts of interest.

While it was possible to generate a measure for distance to the nearest main hospital for each cluster, it would have been more difficult to justify the feasibility, reliability, and, most importantly, validity of other distance and/or density measures derived at the cluster level. Moreover, the search for possible global variables at higher geographic levels, such as the district, showed that more complete and reliable data was available at those levels than the cluster level. Other variables created at the cluster level also likely would be highly correlated with one another and therefore of limited analytical value (these might include, for example, distance to major road, density of road network, whether served by a bus route, distance to main urban center, distance to hospital, density of health personnel, even latitude and elevation).[21]

The models used here are quite basic when considered from the perspective of the emerging application of hierarchical linear modeling. They do not fully explore cross-level interactions or the application of different forms of random and fixed models. These are important directions to pursue in the future.

6.3 DHS Geocodes and Geographical Information Systems

While this study did not fully exploit DHS geocodes, in the future researchers will increasingly employ geographic information systems and related technologies to explore the possibility of integrating an array of different data sets with geocoded surveys such as DHS. Researchers may begin to analyze DHS data in new ways to explore new questions, especially questions relating to the significance of the geographic context. Within the next decade both the quantity and quality of geospatial data available to researchers will significantly increase. In some countries rich geospatial data may already exist, and they may include attribute information relevant to DHS-based research. Of course, researchers need to be cautious and avoid creating and linking data together across scales without thinking through the theoretical model and analytic plan. For example, adding additional geographic or contextual levels could result in multiple embedded data levels (e.g., individuals, within households, within clusters, within village development committees, within districts). Such complexity can create modeling challenges and methodological problems related to sample size issues at the different levels, which might well preclude the identification of significant salient variables.

[21] Since this application focuses on antenatal care, it did not warrant including "global" environmental variables. There is much climate, land use, and other environmental data available for small raster grids, however, and it would be feasible to link DHS cluster geocodes to these raster cells and expand the number of variables included in a model at the cluster level.

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Appendix A
Other Antenatal and Maternal Outcomes

Two other antenatal health outcome measures were considered for inclusion in this report:

- Use of antenatal care during the first trimester, and
- Receipt of at least two tetanus toxoid injections.

Antenatal care during the first trimester: A dichotomous outcome classifying whether or not a pregnant women had received antenatal care during the first trimester was created, based on DHS variable M13$1 (TIMING OF FIRST ANTENATAL CHECKUP IN MONTHS). A dummy variable labeled ANTU4MTH was created, and a value of 1 was assigned when the month was coded as 1, 2 or 3. A value of 0 was assigned in all other instances. The sample size for analysis is 1,581. Almost one-third of all women who received antenatal care did so during the first trimester.

At least 2 tetanus toxoid injections: This dichotomous variable is based on data contained in the DHS variable M1$1 (NUMBER OF TETANUS TOXOID INJECTIONS BEFORE BIRTH). It was recoded as a series of three dummy variables to reflect the number of times tetanus toxoid (TT) injections were given, matching the breakdown used in the 2001 NDHS report (Ministry of Health et al., 2002): (a) where a women did not receive a TT injection was coded as 1, all others 0; (b) where a women received one injection was coded as 1, all other 0; and, (c) where a women received two or more TT injections was coded as 1, all others 0. The third dummy, labeled TT2, is used as the outcome measure.

Two shots are recommended for a first pregnancy, one shot for each subsequent pregnancy, and five shots offers lifetime protection. While antenatal care visits are important in the provision of TT injections, such injections can be administered during other health visits. Thus not all women who had antenatal care received a TT injection, and not all women who received a TT injection had antenatal care. Therefore, the sample for analysis includes all respondents (N=3,279), not just women who received antenatal care. Forty-three percent of women had received at least two TT injections.

Table A.1 shows the distribution of women in the study sample for these two outcomes.

Table A.1
Other antenatal and maternal outcomes

Percent distribution of currently married women who had a child in the three years preceding the NDHS 2001, by additional outcome measures

Outcome variable	Percent	Sample size
ANC visit during first trimester		N=1,581
Yes	32.3	
No	67.7	
Received tetanus toxoid (TT) injections at least twice		N=3,279
Yes	43.5	
No	56.5	

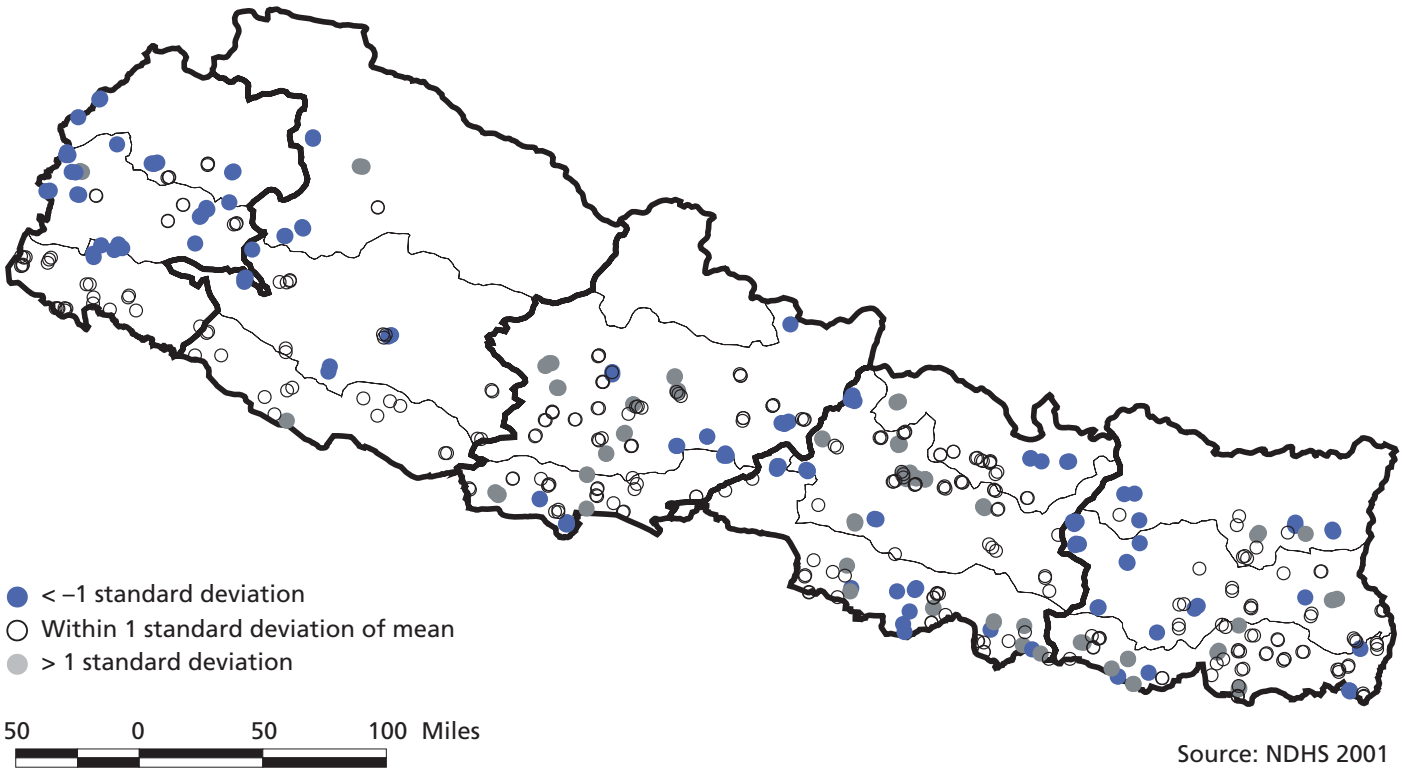
Map A.1 shows whether the usage rate for antenatal care during the first trimester in each DHS cluster is at, above, or below the average for all clusters. It is based on data only from those women who received some antenatal care (48.3 percent of the sample). Usage rates are below average in clusters in the Far-Western Development Region, although many of the clusters within the Far-Western Terai are within one standard deviation of the mean. The pattern elsewhere is quite varied, but use of early antenatal care appears to be lowest in remote areas and among the highest in major urban areas.

Map A.2 compares each cluster's tetanus toxoid immunization rate (defined as at least two injections) with the average for all clusters. The mean is reasonably high at 69.7 percent, with a standard deviation of 30 percent. Thus clusters with a high immunization rate fall within one standard deviation of the mean and do not show up in a separate category on the map. The map does show clusters where the immunization rate is very low (that is, less than one standard deviation below the mean). Interestingly, all sub-regions contain at least one DHS cluster that falls into this category. A clearer regional pattern emerges from the map of aggregated data at the sub-regional level (Map A.3).

Tables A.2 and A.3 present logistic regression model results for first trimester antenatal care and TT injections, respectively.

The contextual variables GDI and GEM are not significant in the models predicting antenatal care during the first trimester. It is worth noting that this model is calibrated for the reduced sample, i.e., only those women who reported using antenatal care during their pregnancy. The most significant covariates across the models are the sub-regional dummy variables for the Central Hills (Kathmandu) and Western Hills (Pokhara), where women are about 3 times more likely than those in the Far-Western Hills to seek antenatal care during the first trimester. While this emphasizes the domi-

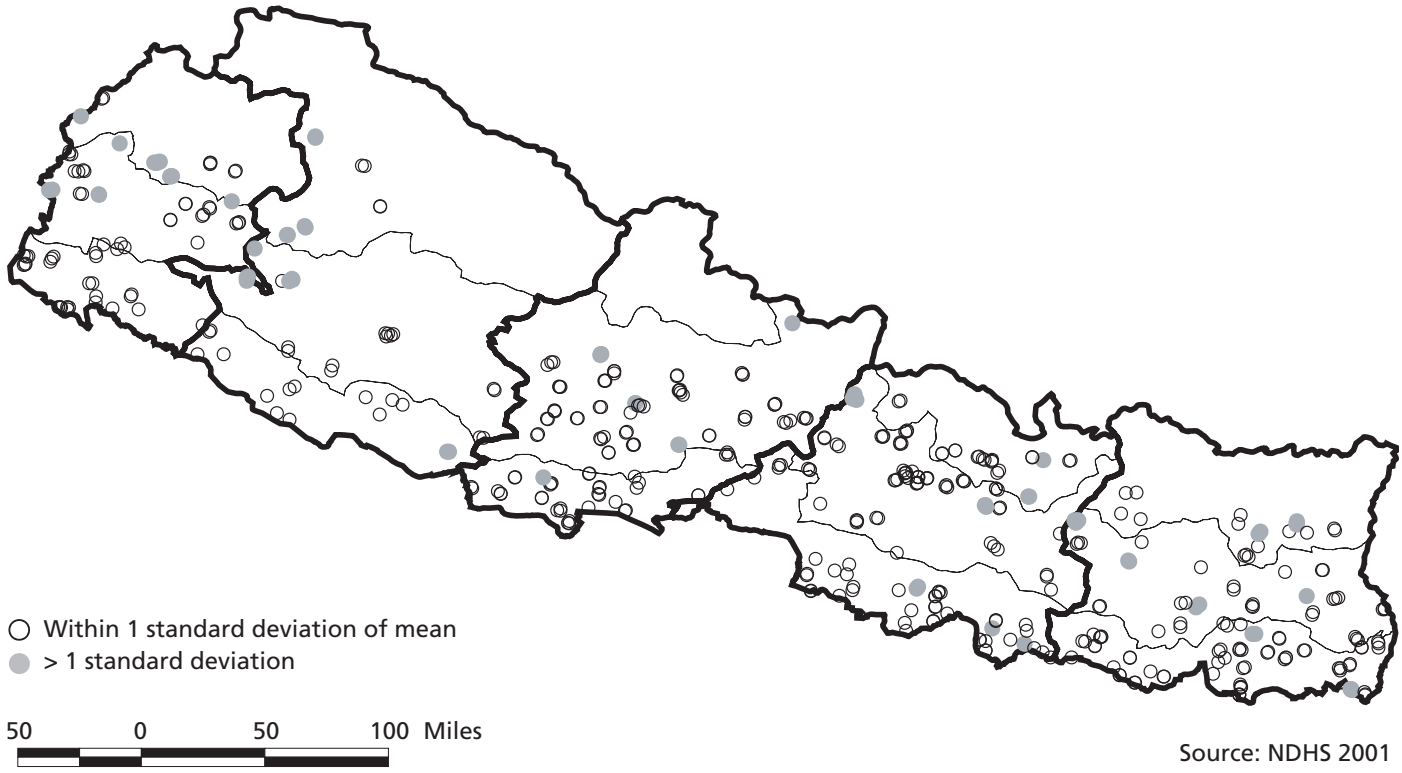
Map A.1
Usage rate for antenatal care during the first trimester by DHS cluster, relative to the average for all clusters



Source: NDHS 2001

Map A.2

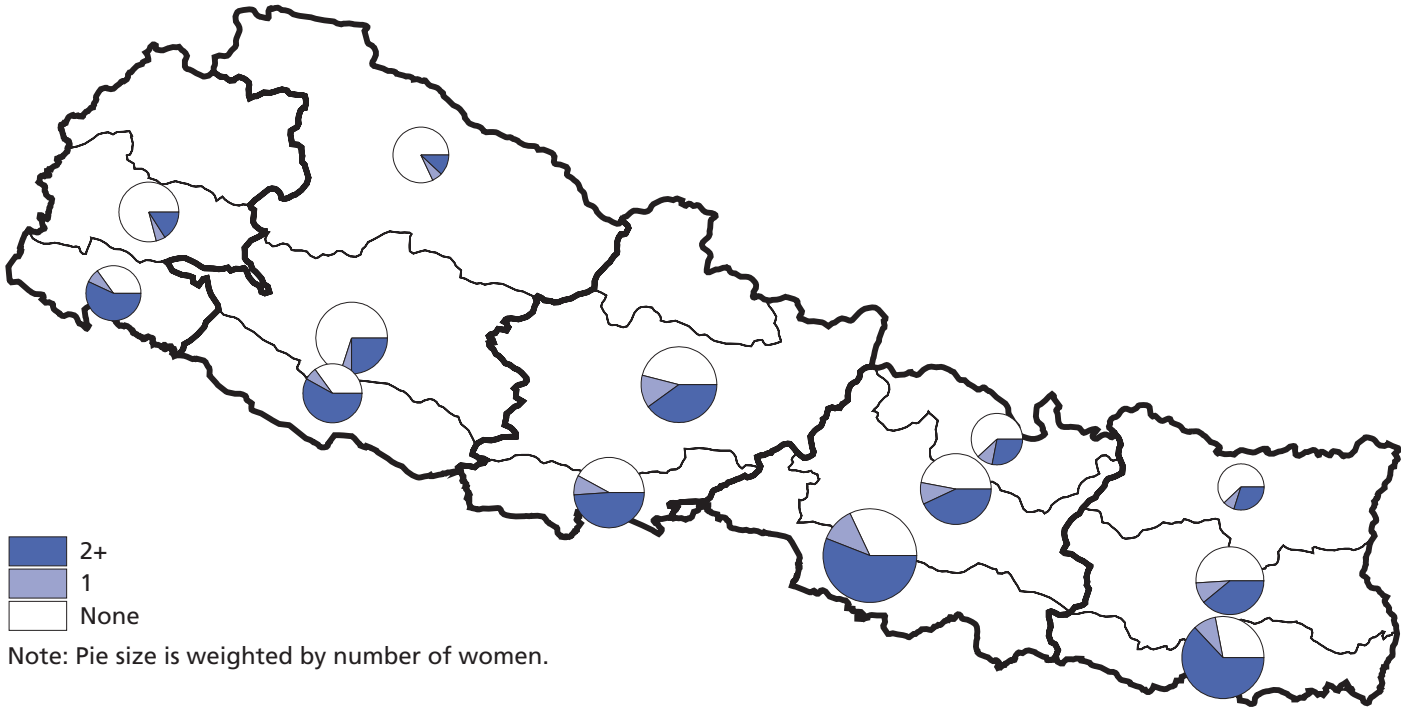
Tetanus toxoid immunization rate (at least two injections) by DHS cluster, relative to the average for all clusters



Source: NDHS 2001

Map A.3

Number of tetanus toxoid injections women received, by sub-region



Source: NDHS 2001, Table 9.4, p. 146.

Table A.2

Logistic regression: Predictors of antenatal care during the first trimester, using sub-region (N=1,586)

	Model 1		Model 2		Model 3a (GDI)		Model 3b (GEM)	
Background characteristic	B	Exp(B)	B	Exp(B)	B	Exp(B)	B	Exp(B)
Sub-region								
Eastern Mountain	0.679	1.972	0.507	1.661	0.36	1.433	0.485	1.624
Central Mountain	0.946*	2.575	1.098*	2.998	1.033*	2.809	1.07*	2.915
Western Mountain	0.643	1.902	0.809	2.246	0.829	2.291	0.805	2.237
Eastern Hills	0.515	1.674	0.586	1.797	0.45	1.569	0.559	1.748
Central Hills	1.361***	3.899	1.116***	3.053	1.008*	2.739	1.083*	2.953
Western Hills	1.328***	3.773	1.101***	3.007	0.968*	2.632	1.066*	2.903
Mid-Western Hills	0.205	1.227	0.314	1.369	0.25	1.284	0.305	1.356
Eastern Terai	1.027**	2.793	0.764	2.146	0.597	1.817	0.741	2.098
Central Terai	0.459	1.582	0.457	1.58	0.359	1.433	0.443	1.558
Western Terai	0.991*	2.695	0.915*	2.497	0.808	2.243	0.888	2.43
Mid-Western Terai	1.033**	2.81	0.879*	2.409	0.805	2.236	0.856	2.355
Far-Western Terai	0.241	1.273	0.251	1.285	0.182	1.2	0.236	1.266
Urban	0.445**	1.561	-0.026	0.974	-0.054	0.948	-0.031	0.969
Distance to hospital	-0.005	0.995	0.006	1.006	0.006	1.006	0.006	1.006
Age								
20–34			0.433*	1.542	0.433*	1.542	0.433	1.542
35+			0.63	1.877	0.627	1.872	0.63	1.878
Parity								
2–3			-0.054	0.947	-0.056	0.946	-0.054	0.947
4–5			-0.243	0.784	-0.243	0.784	-0.242	0.785
6+			-0.487	0.614	-0.49	0.612	-0.488	0.614
Want child								
Then			-0.176	0.838	-0.178	0.837	-0.177	0.838
Later			-0.027	0.973	-0.027	0.973	-0.027	0.973
Refuse sex			0.029	1.029	0.041	1.042	0.032	1.032
Wife beating			-0.136	0.873	-0.133	0.876	-0.134	0.875
Decisionmaking								
1–2			0.177	1.194	0.18	1.197	0.177	1.193
3–4			0.028	1.028	0.03	1.03	0.028	1.029
Problems getting services								
1–2			-0.302	0.739	-0.31	0.734	-0.304	0.738
3–5			-0.1	0.905	-0.111	0.895	-0.103	0.902
6–7			-0.097	0.908	-0.099	0.905	-0.098	0.907
Owns land			0.135	1.145	0.137	1.147	0.136	1.145
Relation to household head								
Wife			-0.298	0.742	-0.297	0.743	-0.298	0.742
Daughter-in-law			-0.177	0.838	-0.173	0.841	-0.176	0.838
Other			-0.07	0.932	-0.07	0.933	-0.069	0.934
Women's education								
Primary			-0.149	0.862	-0.152	0.859	-0.15	0.861
Secondary			0.34	1.405	0.335	1.398	0.34	1.404
Partner's education								
Primary			-0.255	0.775	-0.25	0.779	-0.254	0.775
Secondary and higher			0.351*	1.42	0.358*	1.431	0.353*	1.423
Don't know			0.468	1.596	0.476	1.61	0.471	1.602
Listens to radio			0.123	1.13	0.129	1.137	0.124	1.132
Watches TV			-0.028	0.972	-0.044	0.957	-0.03	0.971
Women's employment								
Agricultural or self-employed			-0.261	0.771	-0.257	0.773	-0.26	0.771
Non-agricultural			-0.326	0.722	-0.338	0.713	-0.328	0.72
Partner's employment								
Non-agricultural			0.281*	1.325	0.279*	1.322	0.281*	1.325
Unknown			0.304	1.356	0.293	1.34	0.302	1.353
Hindu			-0.192	0.825	-0.188	0.829	-0.193	0.825
Ethnicity								
Chhetri/Thakuri/Rajput			0.16	1.173	0.163	1.177	0.162	1.176
Newar			0.425	1.53	0.428	1.533	0.426	1.53
Gurung/Magar			0.278	1.32	0.284	1.328	0.281	1.324
Tamang/Sherpa			0.212	1.237	0.234	1.264	0.219	1.245
Rai/Limbu			-0.01	0.99	-0.018	0.983	-0.009	0.991
Muslim/Churaute			0.256	1.292	0.265	1.304	0.256	1.292
Tharu/Rajbanshi			0.41	1.507	0.406	1.501	0.41	1.507
Yadav/Ahir			-0.426	0.653	-0.414	0.661	-0.42	0.657
Occupational			0.26	1.297	0.268	1.307	0.265	1.303
Other Hills/Terai			0.392	1.48	0.399	1.491	0.396	1.486
Utilities								
1			-0.086	0.917	-0.086	0.918	-0.088	0.915
2+			0.302	1.352	0.292	1.34	0.297	1.346
GDI					0.01	1.01		
GEM							0.003	1.003
Constant	-1.595***	0.203	-1.644*	0.193	-1.837*	0.159	-1.664*	0.189
-2 log likelihood	1920.2		1822.28		1821.82		1822.25	
Nagelkerke R^2	0.059		0.14		0.14		0.14	
% correct prediction	68.9		71.3		71.1		71.3	
Model chi-square(df)	68.76(14)***		166.68(56)**		167.15(57)***		166.71(57)***	
Block chi-square(df)	68.76(14)***		97.93(42)***		0.46(1)		.03(1)	

Significance at p < 0.001 ***, p <0.01 **, and p <0.05 *

Table A.3

Logistic regression: Predictors of at least two tetanus toxoid injections, using sub-region (N=3,279)

	Model 1		Model 2		Model 3a (GDI)		Model 3b (GEM)	
Background characteristic	B	Exp(B)	B	Exp(B)	B	Exp(B)	B	Exp(B)
Sub-region								
Eastern Mountain	0.845***	2.327	0.969**	2.636	1.316**	3.727	1.5100**	4.527
Central Mountain	0.974***	2.648	0.627	1.873	0.774	2.169	1.3320**	3.789
Western Mountain	-0.027	0.974	0.141	1.151	0.064	1.066	0.2146	1.239
Eastern Hills	1.380***	3.977	1.626***	5.084	1.947***	7.006	2.3110***	10.084
Central Hills	1.260***	3.526	1.260***	3.526	1.445***	4.243	1.9784***	7.231
Western Hills	1.297***	3.658	0.342	1.408	0.655	1.925	1.3046***	3.686
Mid-Western Hills	0.777***	2.176	1.103***	3.014	1.247***	3.482	1.3509***	3.861
Eastern Terai	2.352***	10.503	2.050***	7.769	2.464***	11.756	2.5962***	13.412
Central Terai	1.956***	7.073	1.495***	4.460	1.743***	5.716	1.8731***	6.508
Western Terai	1.734***	5.665	1.303***	3.680	1.576***	4.837	2.0654***	7.889
Mid-Western Terai	2.265***	9.628	1.688***	5.408	1.873***	6.509	2.3169***	10.145
Far-Western Terai	2.077***	7.980	2.016***	7.510	2.180***	8.848	2.4063***	11.093
Urban	0.564***	1.757	-0.089	0.915	0.014	1.014	0.1263	1.135
Distance to hospital	-0.051***	0.950	-0.029***	0.972	-0.028**	0.972	-0.0260**	0.974
Age								
20–34			0.344	1.411	0.342	1.407	0.3536	1.424
35+			-0.062	0.940	-0.061	0.941	-0.0409	0.960
Parity								
2–3			-0.098	0.907	-0.097	0.908	-0.1078	0.898
4–5			-0.407**	0.665	-0.407*	0.666	-0.4214*	0.656
6+			-1.016***	0.362	-1.007***	0.365	-1.0073***	0.365
Want child								
Then			-0.148	0.862	-0.146	0.864	-0.1380	0.871
Later			-0.020	0.980	-0.020	0.980	-0.0184	0.982
Antenatal care			3.128***	22.818	3.157***	23.504	3.2659***	26.203
Refuse sex			-0.394	0.674	-0.418*	0.658	-0.4477**	0.639
Wife beating			0.053	1.055	0.051	1.053	0.0208	1.021
Decisionmaking								
1–2			0.123	1.130	0.118	1.125	0.1411	1.152
3–4			0.067	1.069	0.068	1.071	0.0610	1.063
Problems getting services								
1–2			-0.380*	0.684	-0.371*	0.690	-0.3519	0.703
3–5			-0.379	0.685	-0.359	0.698	-0.3102	0.733
6–7			-0.209	0.812	-0.198	0.820	-0.2037	0.816
Owns land			0.209	1.233	0.207	1.230	0.1570	1.170
Relation to household head								
Wife			-0.659*	0.517	-0.653**	0.520	-0.6528**	0.521
Daughter-in-law			-0.585	0.557	-0.585*	0.557	-0.6013*	0.548
Other			-0.449	0.639	-0.433	0.649	-0.4404	0.644
Women's education								
Primary			-0.108	0.898	-0.097	0.907	-0.0755	0.927
Secondary			0.075	1.077	0.091	1.095	0.1030	1.109
Partner's education								
Primary			-0.079	0.924	-0.076	0.927	-0.0812	0.922
Secondary and higher			0.533***	1.704	0.526***	1.693	0.4784***	1.614
Don't know			0.070	1.072	0.062	1.063	-0.0129	0.987
Listens to radio			0.230*	1.258	0.220	1.246	0.2054	1.228
Watches TV			-0.018	0.982	0.004	1.004	-0.0007	0.999
Women's employment								
Agricultural/self employed			0.226	1.254	0.225	1.252	0.2016	1.223
Non-agricultural			0.226	1.254	0.275	1.316	0.3331	1.395
Partner's employment								
Non-agricultural			-0.137	0.872	-0.136	0.873	-0.1544	0.857
Unknown			0.253	1.287	0.261	1.298	0.2914	1.338
Hindu			0.275	1.317	0.271	1.312	0.2826	1.327
Ethnicity								
Chhetri/Thakuri/Rajput			-0.234	0.791	-0.240	0.787	-0.2983	0.742
Newar			0.365	1.441	0.373	1.452	0.4041	1.498
Gurung/Magar			-0.503*	0.605	-0.514*	0.598	-0.5610*	0.571
Tamang/Sherpa			-0.397	0.673	-0.407	0.666	-0.4270	0.652
Rai/Limbu			-0.950***	0.387	-0.914**	0.401	-0.8939**	0.409
Muslim/Churaute			1.107**	3.025	1.109**	3.031	1.0857*	2.962
Tharu/Rajbanshi			-0.478	0.620	-0.463	0.629	-0.4436	0.642
Yadav/Ahir			0.535	1.707	0.513	1.670	0.3483	1.417
Occupational			0.449	1.567	0.451*	1.570	0.3534	1.424
Other Hills/Terai			0.924***	2.520	0.923***	2.517	0.7853**	2.193
Utilities								
1			-0.309*	0.734	-0.303*	0.738	-0.2384	0.788
2+			-0.598**	0.550	-0.549*	0.577	-0.4144	0.661
GDI					-0.026	0.975		
GEM							-0.0902***	0.914
Constant	-1.2428***	0.289	-2.209***	0.110	-1.782**	0.168	-1.727**	0.178
-2 log likelihood	4089.95		2596.27		2683.19		2657.81	
Nagelkerke R^2	0.164		0.572		0.573		0.579	
% correct prediction	67.30		82.10		82.70		82.00	
Model chi-square(df)	427.91(14)***		1894.19(57)***		1834.67(58)***		1860.05(58)***	
Block chi-square(df)	427.91(14)***		1393.39(43)***		3.38(1)		28.76(1)***	

Significance at p < 0.001 ***, p <0.01 **, and p <0.05 *

nance of the two major cities, note that the urban variable is not significant in Models 2, 3a, and 3b. Other covariates of significance in Models 2 and 3a include an age effect: women aged 20–34 are more likely to seek antenatal care visit during the first trimester than women under age 20. It is possible that women were seeking confirmation of the pregnancy during this first visit. While women's status and empowerment variables are not significant, having a partner with at least a secondary level of education (odds ratio = 1.4) and a partner who is employed in non-agricultural work (odds ratio = 1.3) are both significant.

In the models predicting TT injections, the sub-regions are highly significant for the most part. Women in various sub-regions are 2 to 10 times more likely than women in the Far Western Hills to have had two TT injections, with the exception of women in the Western Mountain sub-region. These geographic relationships hold across all models, with odds ratios generally lower in Model 2 but significantly higher in Models 3a and 3b. Women who received antenatal care were over 20 as likely to have received two TT injections as women who did not receive antenatal care. Other significant predictors in Model 2 include parity, problems getting health care, being the wife of the household head, partner's education, listening to the radio, and living in a household with modern utilities. Women of some ethnic groups were significantly less likely to receive two TT injections than Brahmin women (e.g., Gurung/Magar and Rai/Limbu), but others were more likely (e.g., Muslim and Hill/Terai groups). Adding GDI and GEM modify the results of Model 2 on the margin: listening to the radio is no longer significant but refusal of sex becomes significant. Model 3b is the better of the two contextual models. GDI is not significant in Model 3a.

Appendix B
NDHS Variables in the Analysis

To construct the sample, all currently married women (V501 = 1) who had given birth during the past three years (V238 = >0) were selected. The analysis was limited to those women listed as a "usual resident" (V135 = 1). This generated an initial sample of 3,285 currently married women who had given birth within the past three years and who were usual residents of the community in which they were interviewed.

Variables relevant to the analysis of the primary outcome measures of interest were extracted. The listing below begins with these outcome measures, followed by individual, household, and community variables.[22] Items used in the analysis are highlighted in **BOLD**.

B.1 Outcome Measures

ANTENATAL

A dichotomous outcome measure was constructed based on whether or not the woman had received any antenatal care during her last pregnancy. This measure was based on a recode of variable M2N (antenatal no one), in which a woman who received antenatal care during her last pregnancy was coded as 1 (N=1,586) and a woman who did not receive care was coded as 0 (N=1,697). Analysis is based on N=2,383.

ANTNUM4

A dichotomous outcome measure was constructed based on whether or not the woman had received antenatal care at least four times during her last pregnancy. This measure was based on a recode of variable M14 (number of antenatal visits for pregnancy). All values 4 or higher were recoded as 1 (N=468), and all other valid codes were recoded as 0 (N=2,813). Note that 1,697 women reported no antenatal care visits (M14=0). These women are not included in logistic regression and HGLM models for this outcome measure. Instead the analyses is limited to women who received some antenatal care (N=1,586). Analysis is based on N=1,581.

B.2 Predictors

B.2.1 Geographic variables

ZONES

The analytical models used sub-regions as the primary demarcation of place within Nepal. In total there are thirteen sub-regions: Eastern Mountain, Central Mountain, Western Mountain, Eastern Hills, Central Hills, Western Hills, Mid-Western Hills, Far-Western Hills, Eastern Terai, Central Terai, Western Terai, Mid-Western Terai, and Far-Western Terai. The variable SREF3 (sub-region) was used to create dummy

[22] Other variables used in data manipulation and exploratory analysis are not listed.

variables for these regions, which were labeled respectively as **ZONEEM, ZONECM, ZONEWM, ZONEEH, ZONECH, ZONEWH, ZONEMWH, ZONEFWH, ZONEET, ZONECT, ZONEWT, ZONEMWT, ZONEFWT**. Far Western Hills (ZONEFHW) is used as the reference category.

DEVELOPMENT REGIONS

The variable V024 (region) was used to create regional dummies for the five Development Regions: EASTERN, CENTRAL, WESTERN, MIDWEST, FARWEST. The reference category is the Far-Western Development Region.

ECOLOGICAL REGIONS

The variable SREG1 (ecological region) was used to create dummy variables for the three main ecological regions of Nepal: MOUNTAIN, HILL, TERAI. Mountain is used as the reference category.

URBAN

The variable V025 (urban place of residence) was recoded, with rural as 0 and urban as 1.

CLD2HOSP

Nepal DHS cluster geocodes were used together with locational data on hospitals throughout Nepal (derived from the Ministry of Health's annual reports) to calculate distances between a cluster and the nearest main hospital. Given the data available, these are straight-line distance measured in miles—an assumption that may be more tenable in the Terai than other areas of Nepal. Distances ranged from 0 to 29 miles.

B.2.2 Individual Characteristics

RESPONDENT'S AGE

The variable V013 (age in 5-year groups) was recoded into three dummy variables to be consistent with the 2001 NDHS report: (a) under 20 years equals 1, all others are 0 (AGEU20); (b) 20–34 years equals 1, all others are 0 (AGE2034); and (c) 35 years or more equals 1, all others are 0 (AGE35P). AGEU20 is used as the reference category.

PARITY

The variable V201 (total number of children ever born) was recoded as four dummy variables: (a) parity equals 1 if a woman had one child ever born, all others are 0 (PARITY1); (b) parity equals 2 or 3 if a woman had two or three children ever born, all others are 0 (PARITY23); (c) parity equals 4 or 5 if a woman had four or five children ever born, all others are 0 (PARITY45), and, (d) parity equals 6 or more if a woman had six or more children ever born, all others are 0 (PARITY6). PARITY1 is used as the reference category.

WANTED LAST CHILD

V367 provides information on whether or not the woman wanted the last child. This variable was recoded into three dummy variables: (a) wanted then equals 1, all others are 0 (WANTTHEN); (b) wanted later equals 1, all others are 0 (WANTLATE); and (c) wanted no more equals 1, all others are 0 (NOTWANT). NOTWANT is used as the reference category.

B.2.3 Control and empowerment variables

REFUSE SEX

Four variables include data on whether a woman would refuse sex with her hus-

band: V633A (if the husband has an STD); V633B (if a husband has other women); V633C (if the woman had a recent birth); and V633D (if a women was tired or not in the mood). In all instances "don't know" was recoded as 0 to create dummy variables in which "yes" equals 1 and all others are 0. The dummy variables were labeled as REFSTD, REFWOMEN, REFBIRTH, and REFTIRED, respectively. Next a new variable (REFUSE) was created; it is equivalent to the sum of V633A(REFSTD) + V633B(REFWOMEN) + V633C(REFBIRTH) + V633D(REFTIRED) and ranges from 0 to 4. Finally, a single dummy variable was created from REFUSE: women who would refuse to have sex for all four reasons are coded as 1, all others are 0. This variable was labeled REFUSE4.

WIFE BEATING

Five questions (V744A through V744E) asked about whether and under what circumstances a woman thought wife beating was justified. They address going out without telling the husband, neglecting children, arguing with the husband, refusing sex with the husband, and burning food. Dummy variables were recreated for these five variables, where "yes" equals 1 and all others (including "don't know") are 0. They were labeled EMPGOOUT, EMPNEGCH, EMPARGUE, EMPREFSX, and EMPBURNF. Next was the creation of a new variable (BEATING) that is the sum of V744A(EMPGOOUT) + V744B(EMPNEGCH) + V744C(EMPARGUE) + V744D(EMPREFSX) + V744E(EMPBURNF); it ranges from 0 to 5. Finally, a single dummy variable based on BEATING was created: women who said no reason justified wife beating are coded as 1, all others (that is, women who felt at least one of the five reasons justified wife beating) are 0. This variable was labeled BEAT.

DECISIONS

Five questions (V743A-V743E) asked about decisionmaking. For each question, women were coded as 1 if they were the sole decisionmaker or made the decision jointly with a partner or another person (values 1–3); all others (who did not contribute to the decision) were coded as 0. The five questions were: final say on health care (V743A, EMPHEALTH), final say on large household purchases (V743B, EMPPURCH), final say on household daily needs (V743C, EMPNEEDS), final say on visits to family or relatives (V743D, EMPVISIT), and final say on food to be cooked (V743E, EMPFOOD).

Because women tend to make all decisions on food preparation, a variable **DECISION2** was created that that is the sum of V743A(EMPHEALTH), V743B(EMPPURCH), V743C(EMPNEEDS), and V743D(EMPVISIT). Its value ranges from 0 to 4. From this variable, three dummy variables were created: (a) the woman makes no decisions equals 1, all others are 0 (**DECIS0**); (b) the woman makes 1-2 decisions equals 1, all others are 0 (**DECIS12**); and (c) the woman makes 3-4 decisions equals 1, all others are 0 (**DECIS34**). DECIS0 is used as the reference category.

PROBLEMS

Seven questions (V467A through V467G) asked about the problems women face when seeking health care: For each question, dummy variables were created in which "a big problem" was coded as 1, and all others as 0. The variables created were (a) know where to go (MEDHLP1), (b) getting permission to go (MEDHLP2), (c) getting money for treatment (MEDHLP3), (d) the distance to the health facility (MEDHLP4), (e) having to take transportation (MEDHLP5), (f) not willing to go alone (MEDHLP6), and, (g) concern that there will be no female provider (MEDHLP7). Then a new variable (NPROBS1) equal to the number of problems was created (V467A + V467B + … + V467G); it ranges in value from 0 to 7. Finally, NPROBS1 was recoded into four dummy variables: (a) zero problems equals 1, all others equal 0 (NPROBS0); (b)

1–2 problems equals 1, all others equal 0 (NPROBS12); (c) 3–5 problems equals 1, all others equal 0 (NPROBS35), and, (d) 6–7 problems equals 1, all others equal 0 (NPROBS67). NPROBS0 is used as the reference category.

OWN LAND

Variable S618 signifies whether or not a woman owns land. If a women owned land alone or jointly, it was recoded as 1, all other responses were coded as 0. The variable name assigned was OWNLAND.

RELATION TO HEAD OF HOUSEHOLD

Variable V150 (relationship to household head) was used to create a series of four dummy variables: (a) head equals 1, all others 0 (HEAD); (b) wife equals 1, all others 0 (WIFE); (c) daughter-in-law equals 1, all others 0 (DINLAW); and (d) other relationships equal 1, all others 0 (OTHERHH). HEAD is used as the reference category.

B.2.4 Other Individual and Household Characteristics

WOMEN'S EDUCATION

Variable V106 (highest educational level for respondent) was used to create three dummy variables: (a) no education equals 1, all others 0 (RESNOED); (b) primary education equals 1, all others 0 (RESRIED); and (c) secondary education and higher equals 1, all others 0 (RESSECED). RESNOED is used as the reference category.

PARTNERS EDUCATION

Variable V701 (educational level of respondent's partner) was recoded to create three dummy variables: (a) no education equals 1, all others 0 (PARTNOED); (b) primary education equals 1, all others 0 (PARTPRIE); and (c) secondary education and higher equals 1, all others 0 (PARTSECE).PARTNOED is used as the reference category.

LISTENS TO RADIO

Variable S114 (listens to radio everyday) was relabeled as RADIO_D. Values of 1 indicate that the woman listens to the radio daily; other responses were coded as 0.

WATCHES TV

Variable S115 (watches TV at least once a week) was relabeled as TV_D. Values of 1 indicate that the woman watches TV at least once per week; other reponses were coded as 0.

WOMEN'S WORK STATUS

Variable V717 (respondent's occupation) was recoded to create three dummy variables: (a) not working equals 1, all others 0 (NOTWORK); (b) working in agriculture and/or self employed equals 1, all others 0 (AGSELFEM); and (c) working as professional, technical, manager, clerical and sales, services, skilled and unskilled manual equals 1, all others 0 (NONAGWK). NOTWORK is used as the reference category.

PARTNER'S WORK STATUS

Variable V705 (occupation of respondent's partner) was recoded to create three dummy variables: (a) working in agriculture and/or self employed equals 1, all others 0 (PARAGRIC); (b) working as professional, technical, manager, clerical and sales, services, skilled and unskilled manual equals 1, all others 0 (PARNONAG); and (c) missing and unknown equals 1, all others 0 (PARUNKN). PARAGRIC is used as the reference category.

RELIGION

The variable V130 reports on religious groups. A dummy variable was created to indicate whether or not the respondent was Hindu. V130 was recoded so that Hindu equals 1, all others 0 (HINDU).

ETHNICITY

V131 reports on numerous ethnic groups within Nepal (see Table B.1). Following the 2001 NDHS report, V131 was recoded to create thirteen ethnic groupings (ETHNIC). Gurung and Magar were combined, as were other Hill and other Terai groups, to create a variable labeled ETHNIC2. From ETHNIC2 eleven ethnic group dummies were created, where a value of 1 equals a specific ethnic group and all others are coded as 0. This generated variables for Brahmin (BRAHMIN), Chhetri, Thakuri, and Rajput (CHTARAJ), Newar (NEWAR), Gurung and Magar (GURMAG), Tamang and Sherpa (TAMSHER), Rai and Limbu (RAILIMBU), Muslim and Churaute (MUSLIM), Tharu and Rajbanshi (THARRAJB), Yadav and Ahir (YADAHIR), occupational groups (OCCUP), and Hill and Terai origin groups (HILTERAI). BRAHMIN is used as the reference category.

Table B.1
Ethnicity in Nepal

V131 Code for Ethnicity (ETHNIC2)	DHS Code (ETHNIC2)
1 Yadav Ahir	10
2 Kayastha	3
3 Kumhar	11
4 Baniya	13
5 Dhobi	11
6 Sundhi Kalwar	11
7 Kurmi	11
8 Brahman	1
9 Rajput	2
10 Tharu	9
11 Teli	13
12 Kushwaha	13
13 Musalman	8
14 Haluwai	11
15 Malaha	13
16 Rajbanshi	9
17 Dhimal	11
19 Marwadi	13
20 Bangali	13
21 Dhanuk	11
23 Dushad	11
24 Chamar	11
25 Khatwe	11
26 Bhumihar	11
27 Kewat	11
29 Kanu	11
30 Tarai others	13
31 Brahman	1
32 Chhetri	2
33 Thakuri	2
34 Sanyashi	2
35 Newar	3
36 Limbu	7
37 Rai	7
38 Gurung	4
39 Thakali	12
40 Tamang	6
41 Magar	5
42 Danuwar	11
44 Majhi	11
45 Sunuwar	11
46 Gaine	11
47 Chepang	11
48 Kumhal	11
55 Thami	11
56 Damai	11
57 Kami	11
58 Sharki	11
59 Badi	11
60 Pahadi others	12
61 Sherpa	6
62 Mugrali/Humli/Kar bhote	6
96 Others	12

UTILITIES

Several questions were asked about household utilities and resources, including V113 (sources of drinking water), V116 (type of toilet facility), V119 (has electricity), V127 (type of material for floor), and V161 (type of cooking fuel used). Then (a) V113 (sources of drinking water) was recoded so that "piped into house/yard" equals 1, all others 0 (H20HOUSE); (b) V116 (type of toilet facility) was recoded so that "toilet/latrines" equals 1, no facility equals 0 (TOILET2); (c) V161 (type of cooking fuel) was recoded so that LPG/natural gas, biogas, and kerosene equal 1, all others 0 (FUELMAT); and (d) V119 was relabeled ELECTRIC. A basic utilities variable, UTILITY, was created; it is equal to the sum of TOILET2, H20HOUSE, FUELMAT, and ELECTRIC. UTILITY was then recoded into three dummies: (a) no utilities equals 1, all others 0 (UTILZERO); (b) one utility equals 1, all others 0 (UTILONE); and (c) two or more utilities equals 1, all others 0 (UTIL2P). UTILZERO is used as the reference category.

Appendix C

Logistic Model Results for Antenatal Care using Development Region Dummy Variables

Table C.1

Logistic regression: Predictors of any use of antenatal care, using Development Region (N=3,283)

	Model 1		Model 2		Model 3a (GDI)		Model 3b (GEM)	
Background characteristic	B	Exp(B)	B	Exp(B)	B	Exp(B)	B	Exp(B)
Development Region								
Eastern	0.72***	2.054	0.521***	1.684	-0.831***	0.436	-0.259	0.772
Central	0.62***	1.859	0.627***	1.872	0.057	1.058	0.036	1.037
Western	0.926***	2.524	0.561***	1.752	-0.326	0.722	-0.715***	0.489
Mid-Western	0.268*	1.307	0.081	1.085	-0.2	0.819	-0.365	0.694
Urban	1.365***	3.916	0.368	1.444	0.048	1.05	0.002	1.002
Distance to hospital	-0.049***	0.952	-0.03***	0.971	-0.033***	0.967	-0.033***	0.967
Age								
20–34			0.1	1.105	0.09	1.094	0.138	1.148
35+			-0.172	0.842	-0.181	0.834	-0.159	0.853
Parity			-0.213	0.808	-0.202	0.817	-0.174	0.84
2–3								
4–5			-0.568***	0.566	-0.549***	0.578	-0.513***	0.599
6+			-0.651***	0.522	-0.695***	0.499	-0.603**	0.547
Want child			0.091	1.095	0.123	1.131	0.114	1.121
Then								
Later			0.231	1.26	0.235	1.265	0.212	1.237
Refuse sex			0.194	1.214	0.229	1.258	0.279	1.321
Wife beating			-0.187*	0.83	-0.174	0.84	-0.172	0.842
Decisionmaking								
1–2			0.181	1.198	0.182	1.199	0.132	1.142
3–4			0.335**	1.398	0.299*	1.349	0.353**	1.424
Problems getting services								
1–2			-0.109	0.897	-0.118	0.889	-0.174	0.841
3–5			-0.301	0.74	-0.308	0.735	-0.412*	0.662
6–7			-0.725***	0.484	-0.619***	0.538	-0.734***	0.48
Owns land			0.054	1.055	0.051	1.052	0.113	1.12
Relation to household head								
Wife			0.288	1.334	0.33	1.391	0.212	1.236
Daughter-in-law			0.329	1.389	0.366	1.442	0.325	1.384
Other			0.386	1.471	0.386	1.471	0.367	1.443
Women's education								
Primary			0.597***	1.816	0.501***	1.65	0.467***	1.596
Secondary			1.138***	3.119	1.001***	2.722	1.105***	3.019
Partner's education								
Primary			0.061	1.063	0.025	1.026	0.017	1.017
Secondary and higher			0.219	1.245	0.228*	1.256	0.318**	1.375
Don't know			0.424	1.528	0.395	1.484	0.69*	1.995
Listens to radio			0.44***	1.552	0.465***	1.592	0.425***	1.529
Watches TV			0.535***	1.707	0.405**	1.499	0.555***	1.742
Women's employment								
Agricultural/self–employed			-0.424**	0.654	-0.321*	0.725	-0.427**	0.653
Non-agricultural			-0.442	0.642	-0.511*	0.6	-0.535*	0.586
Partner's employment								
Non-agricultural			0.089	1.093	0.101	1.107	0.074	1.076
Unknown			0.096	1.101	0.091	1.095	-0.001	0.999
Hindu			-0.444	0.641	-0.462	0.63	-0.352	0.703
Ethnicity								
Chhetri/Thakuri/Rajput			-0.327	0.721	-0.357	0.7	-0.286	0.751
Newar			-0.446	0.64	-0.57	0.565	-0.616*	0.54
Gurung/Magar			-1.12***	0.326	-1.313***	0.269	-1.229***	0.293
Tamang/Sherpa			-1.23***	0.292	-1.328***	0.265	-1.518***	0.219
Rai/Limbu			-1.015***	0.363	-1.222***	0.295	-1.258***	0.284
Muslim/Churaute			-0.403	0.668	-0.802*	0.448	-0.462	0.63
Tharu/Rajbanshi			-0.091	0.913	-0.605**	0.546	-0.515*	0.598
Yadav/Ahir			-0.517	0.596	-0.74*	0.477	-0.2	0.819
Occupational			-0.342	0.71	-0.615***	0.541	-0.356	0.7
Other Hills/Terai			-0.239	0.788	-0.579*	0.56	-0.014	0.986
Utilities								
1			0.193	1.213	0.135	1.144	-0.025	0.975
2+			0.404*	1.498	0.265	1.303	0.008	1.008
GDI					0.113***	1.12		
GEM							0.178***	1.195
Constant	-0.163	0.85	0.393	0.717	-1.785***	0.168	-0.932	0.394
-2 log likelihood	4256.48		3656.67		3554.09		3494.47	
Nagelkerke R^2	0.112		0.316		0.348		0.365	
% correct prediction	58.7		71.1		72.3		73.7	
Model Chi-square(df)	288.19(6)***		886.00(48)***		990.58(49)***		1050.20(49)***	
Block Chi-square(df)	288.19(6)***		597.81(42)***		104.579(1)***		164.20(1)***	

Significance at p < 0.001 ***, p <0.01 **, and p <0.05 *

Appendix D

HGLM Predictors of Four or More Antenatal Visits (Model 4)

Table D.1

HGLM: Predictors of four or more antenatal visits, Model 4, using average number of antenatal care visits in district (N= 1,586)

Background characteristic	Coeff	Exp (B)
Sub-region		
Eastern Mountain	-0.804	0.447
Central Mountain	-1.072	0.342
Western Mountain	-0.611	0.543
Eastern Hills	-0.505	0.603
Central Hills	-0.795	0.451
Western Hills	-0.205	0.815
Mid-Western Hills	-0.984	0.374
Eastern Terai	-0.244	0.783
Central Terai	0.042	1.043
Western Terai	0.152	1.164
Mid-Western Terai	-0.391	0.676
Far-Western Terai	0.015	1.015
Urban	0.132	1.141
Distance to hospital	0.003	1.003
Age		
20–34	0.489*	1.631
35+	0.598	1.818
Parity		
2–3	-0.436**	0.647
4–5	-0.674**	0.509
6+	-0.711	0.491
Want child		
Then	0.156	1.168
Later	0.434	1.543
Refuse sex	0.671**	1.957
Wife beating	0.124	1.132
Decisionmaking		
1–2	0.148	1.16
3–4	0.356	1.427
Problems getting services		
1–2	-0.352	0.703
3–5	-0.387	0.679
6–7	-0.354	0.702
Owns land	-0.011	0.989
Relation to household head		
Wife	0.479	1.614
Daughter-in-law	0.702*	2.018
Other relation	0.63	1.878
Women's education		
Primary	-0.003	0.997
Secondary and higher	0.299	1.349
Partner's education		
Primary	-0.137	0.872
Secondary and higher	0.394	1.483
Don't know	0.801	2.227
Listens to radio		
Watches TV	0.008	1.008
Women's employment	0.254	1.29
Agricultural/self-employed	-0.371	0.69
Non-agricultural	-0.498	0.608
Partner's employment		
Non-agricultural	0.257	1.294
Unknown	-0.15	0.861
Hindu	-0.488	0.614
Ethnicity		
Chettri/Thakuri/Rajput	0.548*	1.729
Newar	0.255	1.29
Gurung/Magar	-0.322	0.724
Tamang/Sherpa	-0.38	0.684
Rai/Limbu	-0.659	0.517
Muslim	-1.065*	0.345
Tharu/Rajbansi	-0.592	0.553
Yadav/Ahir	-0.177	0.838
Occupational	-0.067	0.935
Other Hills/Terai	-0.851**	0.427
Utilities		
1	0.402*	1.495
2+	0.537*	1.711
GDI		1
GEM	0.076*	1.079
Average # of ANC visits	0.702*	2.018
Intercept	-4.24***	0.014

Variance comp	Null Model	Model 4
Tau (Level 2 variance)	0.72	0.213
R^2 between		0.704

Significance at p < 0.001 ***, p < 0.01 **, and p < 0.05 *