

Maternal health care amid political unrest: the effect of armed conflict on antenatal care utilization in Nepal

James I Price^{1*} and Alok K Bohara²

¹PhD Candidate, Department of Economics, University of New Mexico, USA and ²Professor, Department of Economics, University of New Mexico, USA

*Corresponding author. PhD Candidate, Department of Economics, MSC 05 3060, 1 University of New Mexico, Albuquerque, NM 87131-0001, USA. Tel: +1-505-277-5304. Fax: +1-505-277-9445. E-mail: jprice14@unm.edu

Accepted 13 April 2012

Armed conflicts, which primarily occur in low- and middle-income countries, have profound consequences for the health of affected populations, among them a decrease in the utilization of maternal health care services. The quantitative relationship between armed conflict and maternal health care utilization has received limited attention in the public health literature. We evaluate this relationship for a particular type of health care service, antenatal care, in Nepal. Using count regression techniques, household survey data and sub-national conflict data, we find a negative correlation between the number of antenatal care visits and incidents of conflict-related violence within a respondent's village development committee. Specifically, we find that under high-intensity conflict conditions women receive between 0.3 and 1.5 fewer antenatal care check-ups. These findings imply that maternal health care utilization is partially determined by characteristics of the social environment (e.g. political instability) and suggest health care providers need to revise maternal health strategies in conflict-affected areas. Strategies may include decentralization of services, maintaining neutrality among factions, strengthening community-based health services and developing mobile clinics.

Keywords Antenatal care, maternal health, health care utilization, political violence

KEY MESSAGES

- Among the consequences of armed conflict, which primarily occurs in low- and middle-income countries, is a decrease in demand for maternal health care services.
- Using count regression techniques, and sub-national data, we find a negative correlation between the number of antenatal care check-ups and incidents of conflict-related violence in Nepal.
- Health care providers need to revise maternal health strategies in conflict-affected areas. Strategies may include decentralization of services, maintaining neutrality among factions, strengthening community-based health services and developing mobile clinics.

Introduction

Armed conflicts have profound consequences for the health of affected populations. These consequences not only include the direct effects of violence, such as mortality and morbidity, but

also indirect impacts related to displacement, disruption of health care services and elevated risk of disease transmission (Murray *et al.* 2002). Although global estimates are not readily available, it is clear that the health consequences associated

with armed conflict are widespread. Since 2000 there have been 66 armed conflicts in 46 countries.¹ The World Health Organization (WHO) estimates 184 000 people died from conflict-related injuries in 2004 (Mathers *et al.* 2008). Moreover, in the same year there were 25.3 million people internally displaced (i.e. displaced within their home countries) as a result of conflict, generalized violence or violations of human rights (Norwegian Refugee Council and Internal Displacement Monitoring Centre 2005).

Recently, several ethnographic and qualitative studies have noted a link between conflict and utilization of maternal health care (Pettersson *et al.* 2004; Giacaman *et al.* 2005; Lee 2008; Teela *et al.* 2009; Varley 2010). These studies suggest that violent conflict reduces health care utilization through destruction of health care facilities, intimidation of medical personnel and by creating an atmosphere of insecurity that discourages travel. In this paper we investigate the relationship between conflict and maternal health care statistically, using household survey and community-level conflict data from Nepal.² More precisely, we analyse how the demand for a particular type of health care service, antenatal care (ANC), responds to violence associated with Nepal's Maoist uprising.

Within the context of this analysis, ANC serves as a measure of health care access and improved pregnancy outcomes. ANC has proven largely ineffective at meeting its intended purpose of identifying high-risk pregnancies. Results from several studies suggest there is no correlation between ANC and better maternal health outcomes (Lilford and Chard 1983; Carroli *et al.* 2001; Villar *et al.* 2001). Nevertheless, ANC has evolved to encompass a variety of health interventions that are widely believed to reduce the likelihood of adverse pregnancy outcomes (e.g. maternal mortality, morbidity, low birth weight and premature delivery) and improve post-delivery health for mother and child (AbouZahr and Wardlaw 2003; Pallikadavath *et al.* 2004). These interventions include treatment for anaemia, malaria and malnutrition, tetanus immunizations, prevention of mother-to-child HIV transmission, distribution of insecticide-treated bed-nets, and health education regarding sexually transmitted diseases, birth spacing and foetal growth (AbouZahr and Wardlaw 2003; World Health Organization 2005). Moreover, regular ANC is important to building good relationships between women and health care providers and ensuring women have access to proper care during labour and delivery (World Health Organization 2005).

The remainder of this paper is organized as follows. The next section describes recent maternal health care trends in Nepal and provides background information on the Maoist insurgency. We then detail the statistical methods used in this analysis, including discussions of the data, statistical model and control variables. Results and discussion are presented in the final two sections.

Background

ANC in Nepal

Nepal, a country of rich cultural heritage, is characterized by its great diversity of languages, religions and ecological conditions. The country is located in South Asia, between India and China, and has a population of more than 29 million. Per capita gross domestic product (GDP) is US\$438 and, according to the most

recent estimates, 31% of the population lives below the national poverty line (World Bank 2009). Services comprise the largest share of Nepal's economy, accounting for 49% of GDP. The remainder of the economy is composed of agriculture, at 34% of GDP, and industry, 17% of GDP (World Bank 2009). Politically, Nepal operated as a monarchy under the Shah dynasty until the late 20th century. In 2008, following years of political turmoil, the monarchy was abolished and a republic established.

Since the mid-1990s, efforts have been made to improve maternal health care services in Nepal. In 1994 the Nepalese government, in conjunction with the WHO, initiated the Safe Motherhood Programme. The main objectives of the programme are three-fold: provide around-the-clock emergency obstetric care services, ensure the presence of skilled attendants at birth, and enhance public awareness of safe motherhood issues (e.g. ANC and postnatal care) through community mobilization (Halim 2007). Evidence from the Nepal Demographic and Health Survey (NDHS) indicates considerable improvement in maternal health care indicators between 1996 and 2006. Maternal mortality, for example, experienced a sharp decline from 539 to 281 deaths per 100 000 live births (NDHS 2007). Likewise, the fraction of births occurring at health facilities increased from 7.6 to 17.7%, the fraction of births attended by a skilled birth attendant increased from 9 to 18.7%, and the fraction of c-section deliveries increased from 1 to 2.7%.

Notably, several researchers have questioned the validity of the NDHS maternal mortality estimates, which indicate a 48% decrease between 1996 and 2006 (Wee *et al.* 2010). This scepticism is based on two considerations. First, it is unclear what changes in maternal health care underlie the reduction in mortality. Moderate improvements in key health indicators (e.g. births occurring at a health facility, skilled attendants at birth and the number of c-section deliveries) are insufficient to bring about a large reduction in mortality. Second, during the same period that maternal mortality declined, Nepal experienced a prolonged armed conflict that resulted in widespread displacement and disrupted access to health care services (Sharma *et al.* 2002; Ghimire and Pun 2006; Orbinski *et al.* 2007). The expected effect of the conflict would be an increase in mortality. Subsequent analyses suggest Nepal's maternal mortality rates are considerably higher than indicated by the 2006 NDHS. Wee *et al.* (2010) find a maternal mortality rate of 529 deaths per 100 000 live births in the southern district of Sarlahi. Likewise, model-based estimates presented by Hill *et al.* (2007) indicate a maternal mortality rate of 830 deaths per 100 000 live births. In contrast to the NDHS, these estimates suggest utilization of maternal health care in Nepal, despite steady improvements, remains among the lowest in Asia. By comparison maternal mortality in Asia is estimated at 329 deaths per 100 000 live births (Hill *et al.* 2007).

ANC is one aspect of maternal health care that has improved considerably, and unambiguously, in Nepal over the past 20 years. The 2006 NDHS indicates that 44% of mothers receive at least one ANC check-up from a skilled birth attendant; up from 24% in 1996 (NDHS 2007). Another 28% receive at least one check-up from a trained health professional such as an auxiliary or village health worker (NDHS 2007). Substantially fewer mothers obtain the recommended number of ANC visits. WHO recommends healthy women receive a minimum of four ANC check-ups (AbouZahr and Wardlaw 2003). Women

identified as having a high-risk pregnancy are encouraged to receive additional check-ups. In Nepal, many women commence ANC in the later stages of pregnancy and consequently receive an inadequate number of check-ups. Approximately 29% of mothers obtain the recommended number (NDHS 2007). Several studies suggest the quality of ANC is more important to health outcomes than the quantity (Kogan *et al.* 1994; Barber 2006). Direct measures of ANC quality are unavailable in the NDHS. However, as evidenced by the increase in mothers receiving ANC from a trained professional, the quality of ANC in Nepal appears to have improved in recent years.

ANC utilization in Nepal differs across regions, urban–rural settings and public–private health care providers. Nepal is comprised of five development regions: Eastern, Central, Western, Mid-Western and Far-Western. The percentage of mothers receiving at least one check-up from a skilled birth attendant is highest in the Western region (51%) and lowest in the Far-western region (26%) (NDHS 2007). Likewise, there is a large discrepancy in utilization between urban and rural areas; 85% of urban mothers receive at least one check-up compared with 38% of rural mothers (NDHS 2007). Rural areas, in particular, have experienced a dramatic increase in ANC coverage. Since 1996 the number of rural mothers receiving at least one check-up has increased by more than 50% (Pant *et al.* 2008). The majority of ANC services, in both urban and rural areas, are provided by government health facilities. Specifically, of women receiving ANC, 57% reported going to district hospitals, 19% to government health posts and 13% to private clinics (CIET 1998). In addition to utilization, the quality and cost of ANC differs across regions, urban–rural settings and public–private health care providers. Although difficult to measure, evidence suggests the quality of maternal health care is superior in urban settings and private health facilities (CIET 1998; NDHS 2007). The median cost of ANC, accounting for purchasing power and adjusted to 2005 US\$, is approximately \$3.54 per visit (CIET 1998).

Prior analyses have identified several factors affecting ANC utilization in Nepal. These analyses find significant correlation between utilization and individual characteristics such as age, education and work status. In particular, mother's education is identified as a key determinant, where more highly educated mothers have a greater likelihood of receiving ANC (Matsumura and Gubhaju 2001; Shakya 2006; Halim 2007). With respect to household and community characteristics, analyses consistently find significant correlation between ANC utilization and household wealth, family structure, caste, region and whether the household is located in an urban area (Matsumura and Gubhaju 2001; Shakya 2006; Halim 2007). In addition, positive correlations are found for media exposure (Shakya 2006; Halim 2007) and familiarity with health services (Shakya 2006). Matsumura and Gubhaju (2001) evaluated the effect of women's decision-making power on the likelihood of receiving ANC, but found no significant relationship.

Political conflict in Nepal

In 1996 the Communist Party of Nepal (Maoists) launched an armed revolt in the Rolpa district of Western Nepal (Do and Iyer 2007). The primary objectives of the movement were to establish a people's republic, draft a new constitution and curtail the monarchy's authority. The movement also emphasized the need

for land reform, equal treatment for castes and women, and job quotas for minorities (Bohara *et al.* 2006; Do and Iyer 2007). By 2002 the conflict had spread throughout most of the country, resulting in numerous deaths, kidnappings and incidents of torture. Between 1996 and 2004 political violence was directly responsible for the death of more than 13 000 people (Do and Iyer 2007). Approximately, 39% of these deaths occurred to Maoist insurgents, 19% to government forces and 41% to noncombatants.³ During the same period, over 12 000 incidents of torture were reported, the vast majority perpetuated by the Royal Nepal Army (RNA). Figure 1 depicts incidents of death and torture between 1996 and 2003. It shows a gradual increase in the number of incidents between 1996 and 2001, followed by a dramatic escalation in 2002. Violent conflict subsided in 2003 in response to cease-fire negotiations between Maoists and the government (Bohara *et al.* 2006). However, by 2004 violent conflict resumed as Maoist insurgents extended their campaign to urban areas, including a blockade of Kathmandu (Do and Iyer 2007). In response to these attacks, King Gyanendra dismissed the Prime Minister, seized power and curtailed civil liberties—decisions that ultimately led to King Gyanendra's resignation and disbanding of the monarchy. In 2008, Nepal officially abolished the monarchy and established a secular republic. A detailed account of Nepal's Maoist uprising and subsequent political transition is provided in Bohara *et al.* (2006) and Do and Iyer (2007). Figure 2 depicts a map of Nepal with the total number of conflict-related deaths per district. It indicates that the Maoist insurgency impacted populations throughout the entire county, albeit with varying degrees of intensity.

Methods

Data

This paper uses a count regression model to estimate how exposure to insecurity, as measured by incidents of local violence, affects the number of ANC visits. Data for this analysis are largely obtained from two sources: the Nepal Demographic and Health Survey (NDHS) and the Informal Sector Service Center (INSEC). The NDHS is a nationally representative survey of Nepalese households, which uses a stratified cluster-sampling design to collect information on women aged 15 to 49 (NDHS 2002). It records information on fertility, family planning, child mortality, maternal and child health, nutrition and socio-demographics. Specific to ANC, the NDHS records the number of check-ups received for each live birth in the previous 5 years and the type of ANC provider (e.g. doctor, nurse, midwife, health worker or traditional assistant). We combine observations from the 2001 and 2006 NDHS surveys, thus constructing a dataset that covers the entire period of Maoist insurgency. The 2001 and 2006 NDHS contain responses for 8726 and 10 793 women, respectively.

The INSEC, a non-governmental human rights organization in Nepal (Bohara *et al.* 2006), maintains a unique sub-national database of the number of violent incidents caused by the Maoist insurgency between 1996 and 2003. During the insurgency, INSEC collected information on the annual number of violent incidents within each village development committee (VDC).⁴ This data distinguishes between several forms of violence: death, injury, abduction, rape and threat of torture. In some instances, the data further distinguish between type of

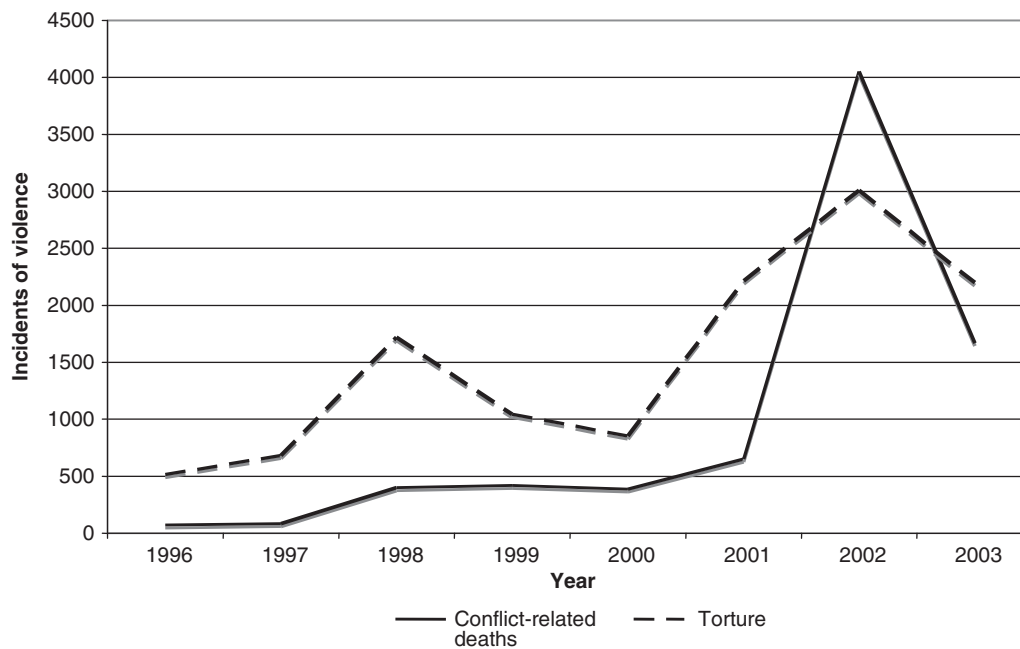


Figure 1 Incidents of political violence in Nepal 1996–2003

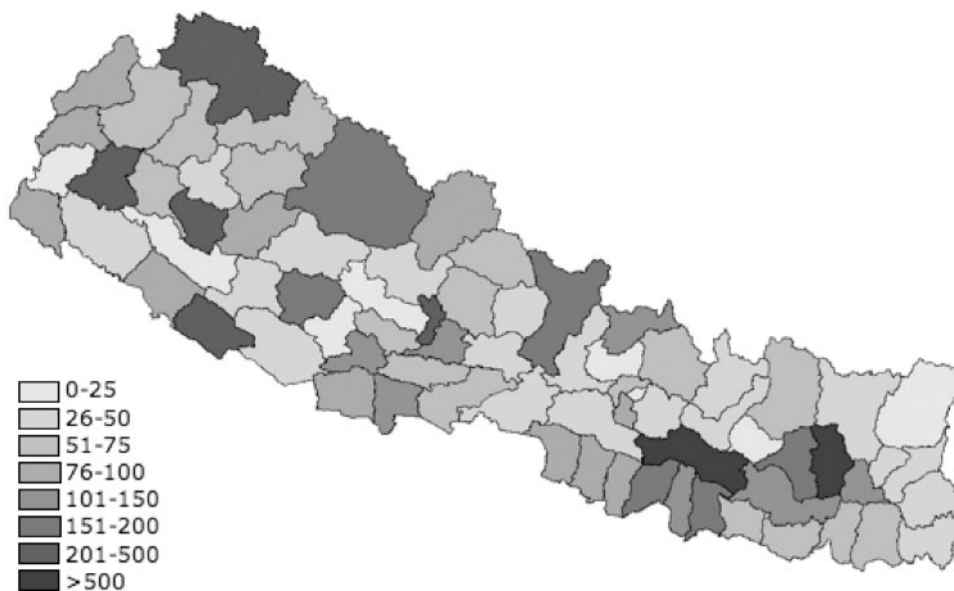


Figure 2 Total number of conflict-related deaths in Nepal by district

aggressor and victim. Conflict-related deaths are separated into four categories: civilians killed by Maoists, RNA personnel killed by Maoists, civilians killed by the RNA and Maoists killed by the RNA. Likewise, abductions are separated into two categories: civilians abducted by Maoists and RNA personnel abducted by Maoists. For this analysis, we use incidents of civilian-directed violence as a proxy for the level of insecurity within a VDC. Other forms of violence (i.e. violence directed at the RNA or Maoists), while relevant, are excluded from the analysis because their impact on insecurity is ambiguous. For

example, Maoist deaths could reflect an increase in conflict and personal risk or signal a defeat of Maoist forces and a subsequent improvement in security.

The combined 2001 and 2006 NDHS surveys contain more than 40 000 birth records, spanning 1966 to 2006. Of these birth records, approximately 14 500 occur between 1997 and 2003. These records are matched with the violence data obtained from the INSEC. Specifically, each record is paired with the cumulative number of conflict-related violent incidents that occurred within the respondent’s VDC up until the year of

birth. Cumulative incidents of violence serve as a measure of local insecurity, where insecurity is assumed to depend on events occurring in both current and previous years. For example, ‘insecurity’ for a 1998 birth is the summation of violent incidents, within the respondent’s VDC, for the years 1996, 1997 and 1998. The summation period varies with the date of birth, so that births occurring in later years have longer summation periods.⁵ Previous studies provide little insight into the proper specification of insecurity. While individuals may place greater weight on recent events, or recent trends, we argue that in the present context cumulative violence is a valid measure of insecurity. In particular, we argue that during a period characterized by growing tension and expanding insurgent activity, individual perceptions of security depend upon events occurring over the course of the entire conflict.

Since ANC information is not available for all birth records, the final analysis contains 4654 observations. These observations represent all 75 of Nepal’s districts and nearly 300 VDCs. We explore the possibility of selection bias within this reduced dataset by comparing the average socio-economic and demographic characteristics to all NDHS respondents who gave birth between 1997 and 2003. The two samples are similar with regards to most variables (e.g. geographic distribution, educational attainment, household size, health status, religion and caste), suggesting a representative sample. However, the two samples differ in that women included in the final analysis come from slightly poorer households and are more likely to live in rural areas.

Statistical methods

We employ count regression models to estimate the determinants of maternal health care utilization. These models are appropriate when the dependent variable consists of non-negative integers. In general notation, count models assume $E(y_i|x_i) = \exp(X_i\beta)$; where the right-hand-side is the conditional mean of the dependent variable and $X_i\beta$ is a vector of explanatory variables. Specifically, we assume a type-2 negative binomial distribution. The negative binomial is a generalized formulation of the Poisson distribution, which does not require the mean and variance to equal (i.e. there is overdispersion) (Greene 2003).⁶ The probability distribution, the link function and the vector of explanatory variables are presented in Equations 1, 2 and 3, respectively. The log-likelihood function is presented in Equation 4.

$$\Pr(Y_i = y_i) = \left[\frac{\Gamma(y_i + \frac{1}{\alpha})}{y_i! \Gamma(\frac{1}{\alpha})} \right] \left[\frac{(\alpha\mu) \exp(y_i)}{(1 + \alpha\mu) \exp(y_i + \frac{1}{\alpha})} \right] y_i = 0, 1, 2, \dots, n \tag{1}$$

$$\mu_i = \exp(X_i\beta) \tag{2}$$

$$X_i\beta = \beta_0 + \beta_1 N_i + \beta_2 H_i + \beta_3 C_i \tag{3}$$

$$\ln L = \sum \ln\left(y_i + \frac{1}{\alpha}\right) - \sum \ln(y_i!) - n \ln\left(\frac{1}{\alpha}\right) + \sum y_i \ln(\alpha\mu) - \sum \left(y_i + \frac{1}{\alpha}\right) \ln(1 + \alpha\mu) \tag{4}$$

Here Y represents the number of ANC visits for individual i , α is a random parameter with a gamma distribution, N is a vector of

individual characteristics, H is a vector of household characteristics and C is a vector of community characteristics. It is possible to confirm that the negative binomial, as opposed to the Poisson, is the preferred distribution. This can be done either by comparing the mean and variance of the dependent variable or with a formal test of the α parameter. If the parameter is significantly different from 0, as it is in this analysis, then the negative binomial is preferred.

Variables

Explanatory variables consist of individual, household and community characteristics. Individual characteristics include mother’s age at time of birth (AGE), whether the mother is currently working (WORK), a series of dummy variables indicating whether the mother has a primary (M_PRIMARY), secondary (M_SECONDARY) or post-secondary (M_POST) education, and whether the NDHS interview was conducted during 2001 (SURVEY01) as opposed to 2006. Descriptive statistics for these variables are presented in Table 1.

Household characteristics include a wealth index (WEALTH), the number of women in the household (HH_WOMEN), the number of children in the household (HH_CHILDREN), whether the household head is male (MALE_HEAD), whether the household is Hindu (HINDU), whether the household is from the Brahmin or Chhetri caste (BRACHH), and whether the father has a primary (F_PRIMARY), secondary (F_SECONDARY) or post-secondary (F_POST) education.⁷ The wealth index is constructed using the principal component analysis developed by Filmer and Pritchett (2001). This method is used extensively in Demographic and Health Surveys and for the World Bank’s Living Standards Measurement Surveys. The principal component analysis derives an index for household wealth based on variation in asset ownership. In particular, it determines weights for various asset variables that are then used to calculate the wealth index. Households with a greater number of assets receive a higher index value. For this analysis, the wealth index is constructed using 13 asset variables. These variables indicate whether a household owns or has access to a radio, television, bicycle, telephone, private water source, public water source, unimproved water source, finished floor, natural floor, flush toilet, pit toilet, other type of toilet and electricity. The index ranges from -1.63 to 7.51.

Community variables consist of VDC population density (POPDEN), VDC road density (ROADS), whether the VDC is located in the mountains (MOUNTAINS) or hills (HILLS), and the measure of insecurity. We employ two constructs for insecurity: the cumulative number of conflict-related deaths within the VDC between 1996 and the year of birth (INSECURITY1), and the cumulative number of deaths, abductions, rapes and threats within the VDC between 1996 and the year of birth (INSECURITY2).⁸ INSECURITY1 ranges from 0 to 20 with a mean of 0.35. This implies respondents in our sample reside in VDCs that experienced an average of 0.35 violent incidents. Roughly 11% of respondents reside in VDCs that experienced at least one violent incident. INSECURITY2 ranges from 0 to 46 with a mean of 1.72. In this case, roughly 39% of respondents reside in VDCs that experienced at least one violent incident. Frequency distributions for the two insecurity measures are presented in Table 2.

Table 1 Variable list and descriptive statistics

Variable	Description	Mean	Std. Dev.
ANC	Number of antenatal care checkups received during pregnancy	1.714	2.098
AGE	Age of mother in years at time of birth	25.931	6.397
WORK	Whether mother is currently working	0.832	0.374
M_PRIMARY	Whether mother has primary education	0.146	0.353
M_SECONDARY	Whether mother has secondary education	0.132	0.338
M_POST	Whether mother has post-secondary education	0.011	0.104
SURVEY01	Whether interview conducted in 2001 (opposed to 2006)	0.679	0.467
WEALTH	Household wealth index	-0.348	1.659
HH_WOMEN	Number of women in the household	1.469	0.825
HH_CHILDREN	Number of children in the household	1.768	0.946
MALE_HEAD	Whether household head is male	0.851	0.356
HINDU	Whether household is Hindu	0.847	0.360
BRACHH	Whether household is part of the Brahmin or Chhetri caste	0.284	0.451
F_PRIMARY	Whether father has primary education	0.269	0.443
F_SECONDARY	Whether father has secondary education	0.337	0.473
F_POST	Whether father has post-secondary education	0.057	0.232
POPDEN	VDC population density (people/1000 square metres)	0.429	0.585
ln PPHI	Natural log of district-level population per health institution	8.739	0.552
ROADS	Road-density of VDC multiplied by 1000	0.526	0.176
MOUNTAINS	Whether VDC is located in mountains	0.080	0.271
HILLS	Whether VDC is located in hills	0.401	0.490
ln INSECURITY1	Cumulative number of civilian deaths within the respondent's VDC between 1996 and the year of birth	0.130	0.428
ln INSECURITY2	Cumulative number of civilian-directed violent incidents within the respondent's VDC between 1996 and the year of birth	0.526	0.805

Note: A 1 is added to INSECURITY1 and INSECURITY2 when calculating the natural log.

Table 2 Distribution of insecurity measures

Number of violent incidents	Frequency	
	INSECURITY1	INSECURITY2
0	4162	2844
1	213	717
2	84	304
3	65	199
4	14	88
5	20	84
6–10	75	218
11–15	7	93
16–20	14	59
21–25	0	20
26–30	0	5
31–35	0	11
36–40	0	5
41–46	0	7

In addition, district-level data on the population per health institution (PPHI) is obtained from the Nepal Central Bureau of Statistics and assigned to each VDC.⁹ Population density, population per health institution and road density are included

in the analysis as proxy measures for the supply and cost of ANC. Supply-side factors, such as the quantity and availability of ANC practitioners, are important determinants of health care utilization (Yip and Berman 2001; Ensor and Cooper 2004). Unfortunately, direct measures of these factors are often unavailable in low- and middle-income countries. As a result, a proxy measure, usually a dummy variable distinguishing between urban and rural households, is used as a means of controlling for the supply of health services (Yip and Berman 2001). In this analysis, we proxy for the supply of ANC services with VDC population density and district-level population per health institution. It is assumed the quantity and availability of ANC services increase with both variables. Health care costs, which consist of direct costs (e.g. service fees and cost of medicines), travel costs (e.g. price of transport) and opportunity costs (e.g. forgone income), are also an important determinant of ANC utilization. Due to data limitations, empirical analyses often omit measures of direct and opportunity costs, although mother's work status partially captures variation in opportunity costs. In contrast, several studies employ proxy measures to control for travel costs. These measures include distance to the nearest health facility (Pebley *et al.* 1996; Magadi *et al.* 2000), travel time to the nearest health facility (Magadi *et al.* 2000; Shakya 2006) and whether the community receives a regular bus service (Lindstrom and Muñoz-Franco 2006). In this

analysis, we proxy for travel costs with VDC road density.¹⁰ It is assumed the availability and affordability of public transport increases with road density.

Results

Results for the negative binomial regression are presented in Table 3. For robustness we estimate several different model specifications. Model 1 is a restricted regression between the number of ANC visits and individual characteristics. Subsequent models incorporate household characteristics (Model 2), community characteristics with INSECURITY1 (Model 3), community characteristics with INSECURITY2 (Model 4) and correct for endogeneity (Model 5). An endogenous relationship may exist if the number of conflict-related deaths is affected by access to ANC. Prior studies have identified economic conditions as a significant determinant of armed conflict (Bohara *et al.* 2006; Do and Iyer 2007). To the extent ANC access reflects local economic conditions

the regression model will exhibit endogeneity. Model 5 corrects for this possibility with an instrumental variable (IV) approach, where INSECURITY2 is instrumentalized using the total number of violent incidents occurring at the district level and dummy variables for the Eastern, Central, Western and Mid-Western regions of the country.¹¹ As per the requirement for IV methods, these variables are correlated with insecurity measures but not correlated with the ANC visits. The AIC (Akaike Information Criterion), also presented in Table 3, is used to compare goodness-of-fit across model specifications.

Findings indicate negative correlations for mother's age, mother's work status and whether the interview was conducted during the 2001 NDHS. The negative relationship between a mother's work status and ANC reflects variation in opportunity costs. Namely, working mothers, who have higher opportunity costs, receive fewer ANC check-ups. The negative coefficient for interviews conducted during 2001 indicates, on average, mothers received fewer ANC check-ups during the period 1996–2000 than the period 2001–03. This difference may reflect

Table 3 Determinants of antenatal care visits (negative binomial regression)^a

Variable	Model 1	Model 2	Model 3	Model 4	Model 5 ^c
Constant	1.363*** (0.09)	1.162*** (0.11)	-3.612*** (0.46)	-3.710*** (0.47)	-4.555*** (0.56)
AGE	-0.024*** (0.00)	-0.024*** (0.00)	-0.022*** (0.00)	-0.022*** (0.00)	-0.023*** (0.00)
WORK	-0.349*** (0.03)	-0.184*** (0.04)	-0.131*** (0.04)	-0.127*** (0.04)	-0.134*** (0.05)
M_PRIMARY	0.558*** (0.04)	0.351*** (0.04)	0.365*** (0.05)	0.367*** (0.05)	0.374*** (0.05)
M_SECONDARY	0.951*** (0.04)	0.466*** (0.04)	0.474*** (0.05)	0.475*** (0.05)	0.485*** (0.05)
M_POST	1.386*** (0.06)	0.595*** (0.08)	0.561*** (0.10)	0.568*** (0.10)	0.604*** (0.11)
SURVEY01	-0.364*** (0.03)	-0.223*** (0.03)	-0.293*** (0.04)	-0.310*** (0.04)	-0.496*** (0.07)
WEALTH		0.130*** (0.01)	0.074*** (0.01)	0.077*** (0.01)	0.088*** (0.01)
HH_WOMEN		0.040** (0.02)	0.047** (0.02)	0.047** (0.02)	0.043** (0.02)
HH_CHILDREN		-0.064*** (0.02)	-0.067*** (0.02)	-0.067*** (0.02)	-0.064*** (0.02)
MALE_HEAD		0.007 (0.04)	-0.046 (0.05)	-0.048 (0.05)	-0.047 (0.05)
HINDU		-0.037 (0.05)	-0.102* (0.05)	-0.099* (0.05)	-0.076 (0.05)
BRACHH		0.025 (0.03)	0.123*** (0.04)	0.123*** (0.04)	0.144*** (0.04)
F_PRIMARY		0.053 (0.05)	0.053 (0.05)	0.056 (0.05)	0.068 (0.05)
F_SECONDARY		0.273*** (0.05)	0.316*** (0.05)	0.319*** (0.05)	0.334*** (0.05)
F_POST		0.335*** (0.07)	0.388*** (0.08)	0.391*** (0.08)	0.417*** (0.08)
ROADS			0.354*** (0.09)	0.339*** (0.09)	0.355*** (0.10)
MOUNTAINS			0.113 (0.09)	0.126 (0.09)	0.215** (0.10)
HILLS			0.066 (0.05)	0.070 (0.05)	0.101* (0.06)
POPDEN			0.114*** (0.02)	0.122*** (0.02)	0.169*** (0.03)
ln PPHI			0.511*** (0.05)	0.525*** (0.05)	0.645*** (0.06)
ln INSECURITY1			-0.059* (0.03)		
ln INSECURITY2				-0.051** (0.02)	-0.282*** (0.08)
ln Alpha ^b	-0.193*** (0.05)	-0.376*** (0.05)	-0.438*** (0.06)	-0.439*** (0.06)	n.a.
N	5702	5702	4654	4654	4654
lnL	-9853.133	-9695.294	-7671.534	-7670.502	n.a.
AIC	19 722.267	19 424.588	15 389.068	15 387.005	n.a.

Notes: ^aValues in parentheses are heteroskedastic-consistent standard errors and statistical significance is denoted as follows: * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$.

^blnAlpha is the overdispersion parameter. A significant lnAlpha parameter indicates the negative binomial distribution is preferred to the Poisson.

^cModel 5 addresses possible endogeneity using an IV approach where lnINSECURITY2 is instrumentalized. The programme used to estimate this model does not produce values for the lnAlpha, lnL or AIC.

improvements in the availability of, or attitude towards, ANC services. Congruent to prior studies we find a positive correlation between mother's education and utilization of ANC. With respect to household characteristics, ANC visits are positively correlated with the wealth index, the number of women in the household, whether the household is part of the Brahmin or Chhetri caste, and father's education. These results are consistent with those of Halim (2007) and Shakya (2006). In addition, ANC visits are negatively correlated with the number of children in the household and, under some specifications, whether the household is Hindu.

With respect to community characteristics, we find positive correlations for road density, population density and population per health institution, and a negative correlation for insecurity. The positive coefficient for road density reflects the lower travel costs and greater health service accessibility that accompany improved infrastructure. Likewise, the positive coefficients for population density and population per health institution reflect differences in the supply of ANC services; mothers residing in VDCs with a greater supply of services receive more check-ups. In addition, population density may capture variation in attitudes towards ANC between rural and urban areas. The negative coefficient on insecurity indicates that mothers receive fewer ANC check-ups as the number of violent incidents in their VDC increases.¹² This implies that the Maoist insurgency, and subsequent conflict between Maoist and RNA forces, lead to declining demand for ANC services, possibly increasing maternal health risks. The coefficients on INSECURITY1 and INSECURITY2 can be interpreted as elasticities. Depending on model specification, a 1% increase in violent incidents results in a -0.059 , -0.051 or -0.282% decrease in the expected number of ANC visits. It is difficult, however, to conceptualize the relationship between violence and ANC using elasticity. A more straightforward interpretation is obtained by using regression results to predict the average number of ANC visits under different levels of violence. In particular, we predict the average number of ANC visits at the minimum and maximum number of violent incidents. Results for Model 3 indicate that respondents would obtain an average of 1.78 ANC visits if there were 0 conflict-related deaths and 1.49 visits if there were 20 deaths. Thus, under high-intensity conflict conditions women receive an average of 0.29 fewer ANC visits than when there is no conflict. Results for Model 4, which employs a broader definition of insecurity, and Model 5, which accounts for possible endogeneity, indicate women receive an average of 0.33 and 1.49 fewer ANC visits under high-intensity conflict, respectively.

Discussion and conclusions

Numerous factors influence the utilization of maternal health services. These factors include the quantity and quality of health practitioners, the accessibility and cost of services, socio-economic characteristics of individuals and households, and attitudes towards health care (Timyan *et al.* 1993). Mullany *et al.* (2008) demonstrate that access to maternal health services is also affected by direct exposure to human rights violations. Using survey data from eastern Burma, they find households that experience forced displacement or loss of food security

have substantially lower access to ANC services. The findings presented in this paper extend those of Mullany *et al.* (2008); they indicate a negative correlation between the number of ANC check-ups received during pregnancy and the cumulative number of conflict-related deaths within a VDC. This suggests the demand for maternal health care services is partially determined by characteristics of the social environment (e.g. political instability, regional violence, sense of personal insecurity), regardless of whether the household is directly exposed to armed conflict. It is worth noting that this analysis does not distinguish between direct and indirect exposure to armed conflict; leaving open the possibility that the negative correlation between ANC and conflict-related violence is driven by direct exposure. As a result, we cannot definitively state that ANC utilization is affected by environmental conditions. Nevertheless, we argue that the atmosphere of insecurity, as well as the destruction of health infrastructure, resulting from the Maoist insurgency best explains the reduction in ANC utilization.

There are several mechanisms through which violence affects ANC utilization; they can be broadly classified as demand- or supply-side effects. For instance, violent conflict, particularly when a large proportion of casualties are non-combatants, may increase the risks in travel. As risk increases, a mother's willingness to travel, and consequently the demand for ANC, will decrease. Conflict may also increase the direct, travel and opportunity costs of health care services, which in turn reduce demand. In particular, direct costs increase as the flow of medical personnel and supplies are disrupted. Travel costs increase as mothers use alternative transport routes to reach medical facilities. Mothers may choose to use alternative routes if they reduce risk and if customary roadways are damaged or blocked. Opportunity costs increase with the time needed to obtain an ANC check-up. This increase results from additional travel time or an extended waiting period at the medical facilities, due to reduced medical personnel. On the supply side, violence will reduce ANC utilization if health care facilities are shut down or health practitioners are prevented from offering ANC. The presence of demand and supply effects during the Maoist insurgency is evidenced by the destruction of several dozen health-posts, intimidation of health workers and frequent disruption of transportation services (Sharma *et al.* 2002; Ghimire and Pun 2006; Orbinski *et al.* 2007).

Demand for maternal health care services may have also been affected by population displacement and changes in fertility patterns. An estimated 200 000 individuals were internally displaced as a result of the Maoist insurgency, while an additional 2 million individuals emigrated to India (Orbinski *et al.* 2007). Such large-scale migration alters the composition of local populations and reduces total demand for maternal health care in conflict areas. Likewise, evidence indicates that fertility rates often decline during periods of armed conflict (Caldwell 2004; Agadjanian *et al.* 2008). If true in the Nepalese context, declining fertility would reduce total demand for maternal health care. Reductions in total demand resulting from changes in population and fertility do not invalidate the findings presented in this paper, which imply that for women who are pregnant, the number of ANC visits declines as conflict-related violence within their VDC increases.

From a policy perspective, findings from this study suggest health care providers need to revise maternal health strategies in conflict-affected areas. The nature of these revisions will depend upon the mechanism through which violence affects health care utilization. Several case studies examine maternal health interventions within particular conflict-affected areas. A brief review of these studies is an essential foundation for a discussion of health care strategies. Giacaman *et al.* (2005) evaluate maternal health care policy in the Occupied Palestinian Territories (OPT). Health care policy in the OPT is determined by the Palestinian Ministry of Health. Efforts to establish a comprehensive maternal health care policy have been hampered by political instability and factors outside Palestinian control. Giacaman *et al.* (2005) argue such a policy vacuum is inevitable within the current political climate, and suggest decentralization of health care services as a possible short-term solution. In particular, they emphasize developing district-level health systems that are capable of responding to the health care needs and political realities of a certain location.

Lee (2008) describes the experience of health care providers amid a prolonged conflict between insurgent and state forces in the Philippines. The article is primarily concerned with the provision of maternal health care services through local government–non-governmental organization (NGO) partnerships, which are generally spared from direct attacks. Lee (2008) argues that strong local connections, positive attitudes towards maternal health care and a non-discriminatory stance (i.e. a willingness to treat patients regardless of their political ideology) allow providers to operate within areas of intense conflict. Teela *et al.* (2009) and Varley (2010) reach similar conclusions in their analyses of maternal health services in Burma and Pakistan. Teela *et al.* (2009) evaluates the Mobile Obstetric Maternal Health Worker (MOM) project in eastern Burma. The MOM project works closely with local governments to train three tiers of health providers: traditional birth attendants, lay health workers and maternal health workers. These providers are responsible for maternal health care within multiple villages. This strategy emphasizes the need to develop flexible, locally available health care where traditional methods of provision (e.g. hospital and health clinics) are unfeasible due to violent conflict. Varley (2010) evaluates the under-provision of health services amid sectarian violence in northern Pakistan. Recommendations for improving services include legislative action allowing women in labour to bypass roadblocks and curfews, development of mobile health clinics and training of local health practitioners.

Health care providers may also need to revise maternal health strategies for the post-conflict period. Chandrasekhar *et al.* (2011) compare utilization of maternal health care services in pre- and post-conflict Rwanda. Results indicate the likelihood of childbirth occurring at a health facility was significantly lower, for several years, in the post-conflict period. In contrast, results indicate the likelihood of childbirth occurring at home with professional assistance increased in the post-conflict period, which suggests health care providers may need to redouble their efforts, or change tactics, following a period of heightened violence and insecurity.

The descriptions and recommendations presented in these studies provide a useful foundation for developing ANC policy

for reaching vulnerable populations amid political unrest. Although policy particulars will depend upon specific cultural and political contexts, a few basic strategies can be gleaned. First, established health care institutions, such as hospitals and clinics, should cultivate ties with local authorities and, whenever possible, maintain a neutral and non-discriminatory stance towards the provision of maternal health services. In doing so, they may reduce the likelihood of disruption or shutdown. In Nepal, an increasingly politicized situation, including a government directive to health practitioners to refuse Maoist insurgents treatment, hampered the efforts of health practitioners to remain neutral (Ghimire and Pun 2006). This non-neutral stance may be partially responsible for insurgent-caused destruction of health posts and intimidation of health practitioners (Orbinski *et al.* 2007). Second, conflict-affected areas will require greater flexibility in the provision of ANC and other maternal health services. Temporarily decentralizing health services, which allows institutions to tailor services to local conditions, is one method of achieving this flexibility. Third, given that conflict reduces ability and willingness to travel, it may be possible to improve maternal health by strengthening local health care services. For example, Teela *et al.* (2009) suggest that village health care workers, with proper training, could provide emergency obstetric care in the home when formal services are unavailable. Taken together, these strategies suggest the role for properly designed and implemented policy. Such policies, whether initiated by government agencies or NGOs, can mitigate the effect of violent conflict on maternal health care utilization.

Acknowledgements

We thank the Informal Sector Service Centre (INSEC, Nepal) for data on conflict-related violence. We thank the Nepal Study Center at the University of New Mexico and Michael Milligan for access to research materials and data on road density, forest coverage, population and poverty rates.

Conflict of interest

None declared.

Endnotes

- ¹ Values are calculated from the database maintained by the Uppsala Conflict Data Program at <http://www.pcr.uu.se/research/UCDP/>.
- ² Two prior studies, Brentlinger *et al.* (2005) and Pebley *et al.* (1996), find a statistical correlation between maternal health care utilization and conflict. Neither study, however, had access to detailed measures of conflict at a sub-national level.
- ³ Calculation based on information collected by the INSEC.
- ⁴ Nepal is divided into 75 districts. These districts are further subdivided into 3914 VDCs.
- ⁵ We consider the possibility that varying summation periods bias regression results. We compare results using varying summation periods to an alternate specification of ‘insecurity’ with a constant three-year summation period. Results are not dramatically different.
- ⁶ Type-1 and type-2 negative binomial distributions assume slightly different functional forms, which result in different variance–mean

- ratios. Under a type-1 distribution there is a constant variance-mean ratio. Under a type-2 distribution there is a linear variance-mean ratio. Variance for a type-2 distribution is equal to $\mu + \mu^2/\alpha$.
- ⁷ Halim (2007) holds that pregnancy values and norms vary across castes. We partially control for these differences through the BRACHH variable, which captures the most privileged castes.
- ⁸ Each type of violence is given equal weight when calculating the proxy variable for insecurity. Although individuals, in reality, respond differently to each violence type, this variable adequately captures relative insecurity across VDCs.
- ⁹ A correlation matrix is used to check for high correlation between independent variables. Results show that correlations are within acceptable levels, indicating that multicollinearity is not a major concern.
- ¹⁰ VDC road density values are developed using Nepal road maps and a geographic information system (GIS). Values are calculated as the ratio of total kilometres of roads to square kilometres.
- ¹¹ Model 5, which accounts for possible endogeneity, is estimated using a variant of the generalized linear model described in Hardin et al. (2003).
- ¹² We conduct regressions using alternate definitions of insecurity. First, we evaluate whether individuals respond to non-civilian conflict-related deaths. The coefficient is negative but insignificant. Second, we evaluate whether the use of non-cumulative measures of violence drastically alters results. Specifically, we match birth records with the number civilian deaths, abductions, rapes and threats for the year of birth. The resulting coefficient, not accounting for possible endogeneity, is negative (−0.107) and significant. Third we evaluate whether results are driven by data outliers. To do this we decompose INSECURITY2 into three dummy variables, indicating VDCs with no violence (0 incidents), minimal violence (1–5 incidents) and moderate to high violence (>5 incidents). The coefficient on minimal violence is insignificant while the coefficient on moderate to high violence is negative (−0.182) and significant.

References

- AbouZahr C, Wardlaw T. 2003. *Antenatal Care in Developing Countries. Promises, achievements and missed opportunities: an analysis of trends, levels and differentials, 1990–2001*. Geneva: World Health Organization.
- Agadjanian V, Dommaraju P, Blick J. 2008. Reproduction in upheaval: ethnic-specific fertility responses to societal turbulence in Kazakhstan. *Population Studies* **62**: 211–33.
- Barber S. 2006. Does the quality of prenatal care matter in promoting skilled institutional delivery? A study in rural Mexico. *Maternal and Child Health Journal* **10**: 419–25.
- Bohara A, Mitchell N, Nepal M. 2006. Opportunity, democracy, and the exchange of political violence: a subnational analysis of conflict in Nepal. *Journal of Conflict Resolution* **50**: 108–28.
- Brentlinger P, Sánchez-Pérez H, Cedeño M et al. 2005. Pregnancy outcomes, site of delivery, and community schisms in regions affected by the armed conflict in Chiapas, Mexico. *Social Science and Medicine* **61**: 1001–14.
- Caldwell J. 2004. Social upheaval and fertility decline. *Journal of Family History* **29**: 382–406.
- Carroli G, Rooney C, Villar J. 2001. How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence. *Paediatric and Perinatal Epidemiology* **15**: 1–42.
- Chandrasekhar S, Gebreselassie T, Jayaraman A. 2011. Maternal health care seeking behavior in a post-conflict HIPC: the case of Rwanda. *Population Research and Policy Review* **30**: 25–41.
- Community Information and Epidemiological Technologies (CIET). 1998. Nepal multiple indicator surveillance fifth cycle: care during pregnancy and delivery: implications for protecting the health of mothers and their babies. CIET international.
- Unpublished. Online at: http://www.ciet.org/en/documents/projects_cycles/20062814724.asp, accessed 20 April 2010.
- Do Q, Iyer L. 2007. Poverty, social divisions and conflict in Nepal. Policy Research Working Paper 4228. Washington, DC: World Bank. Unpublished.
- Ensor T, Cooper S. 2004. Overcoming barriers to health service access: influencing the demand side. *Health Policy and Planning* **19**: 69–79.
- Filmer D, Pritchett L. 2001. Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of India. *Demography* **38**: 115–32.
- Ghimire L, Pun M. 2006. Health effect of Maoist insurgency in Nepal. *The Lancet* **368**: 1494.
- Giacaman R, Wick L, Abdul-Rahim H, Wick L. 2005. The politics of childbirth in the context of conflict: policies or de facto practices? *Health Policy* **72**: 129–39.
- Greene W. 2003. *Econometric Analysis* (5th edn). New Jersey: Prentice Hall, Inc.
- Halim N. 2007. Healthy mothers, healthy children: does mothers' demand for antenatal care matter for child health in Nepal? MA thesis, University of New Mexico, Albuquerque, NM.
- Hardin J, Schmiediche H, Carroll R. 2003. Instrumental variables, bootstrapping, and generalized linear models. *The Stata Journal* **3**: 351–60.
- Hill K, Thomas K, AbouZahr C et al. 2007. Estimates of maternal mortality worldwide between 1990 and 2005: an assessment of available data. *The Lancet* **370**: 1311–9.
- Kogan M, Alexander G, Kotelchuck M, Nagey D. 1994. Relation of the content of prenatal care to the risk of low birth weight: maternal reports of health behavior advice and initial prenatal care procedures. *Journal of the American Medical Association* **271**: 1340–5.
- Lee R. 2008. Delivering maternal health care services in an internal conflict setting in Maguindanao, Philippines. *Reproductive Health Matters* **16**: 65–74.
- Lilford R, Chard T. 1983. Problems and pitfalls of risk assessment in antenatal care. *British Journal of Obstetrics and Gynaecology* **90**: 507–10.
- Lindstrom D, Muñoz-Franco E. 2006. Migration and maternal health services utilization in rural Guatemala. *Social Science and Medicine* **63**: 706–21.
- Magadi M, Madise N, Rodrigues R. 2000. Frequency and timing of antenatal care in Kenya: explaining the variations between women of different communities. *Social Science and Medicine* **51**: 551–61.
- Mathers C, Boerna T, Ma Fat D. 2008. *The Global Burden of Disease: 2004 update*. Geneva: World Health Organization.
- Matsumura M, Gubhaju B. 2001. Women's status, household structure and utilization of maternal health services in Nepal. *Asia-Pacific Population Journal* **16**: 23–44.
- Mullany L, Lee C, Yone L et al. 2008. Access to essential maternal health interventions and human rights violations among vulnerable communities in Eastern Burma. *PLoS Medicine* **5**: 1689–98.
- Murray C, King G, Lopez A, Tomijima N, Krug E. 2002. Armed conflict as a public health problem. *British Medical Journal* **324**: 346–9.
- Nepal Demographic and Health Survey (NDHS). 2002. Nepal Demographic and Health Survey: 2001. Nepal Ministry of Health. Online at: http://www.measuredhs.com/pubs/pub_details.cfm?ID=359&srchTp=advanced, accessed 12 March 2010.
- Nepal Demographic and Health Survey (NDHS). 2007. Nepal Demographic and Health Survey: 2006. Nepal Ministry of Health. Online at: http://www.measuredhs.com/pubs/pub_details.cfm?ID=669&srchTp=advanced, accessed 20 April 2010.
- Norwegian Refugee Council and Internal Displacement Monitoring Centre. 2005. *Internal Displacement: Global overview of trends and developments in 2004*. Geneva: Norwegian Refugee Council.

- Orbinski J, Beyrer C, Singh S. 2007. Violations of human rights: health practitioners as witnesses. *The Lancet* **370**: 698–704.
- Pallikadavath S, Foss M, Stones R. 2004. Antenatal care: provision and inequality in rural north India. *Social Science and Medicine* **59**: 1147–58.
- Pant P, Suvedi B, Pradhan A *et al.* 2008. Improvements in maternal health in Nepal: Further analysis of the 2006 Nepal Demographic and Health Survey. Calverton MD: Macro International, Inc.
- Pebley A, Goldman N, Rodriguez G. 1996. Prenatal and delivery care and childhood immunization in Guatemala: do family and community matter? *Demography* **33**: 231–47.
- Pettersson K, Christensson K, Gomes de Freitas E, Johansson E. 2004. Adaptation of health care seeking behavior during childbirth: focus group discussions with women living in the suburban areas of Luanda, Angola. *Health Care for Women International* **25**: 255–80.
- Shakya S. 2006. Factors influencing utilization of maternal neonatal child health (MNCH) services among ethnic groups in Nepal. M.A. thesis, Mahidol University, Bangkok.
- Sharma G, Osti B, Sharma B. 2002. Physicians persecuted for ethical practice in Nepal. *The Lancet* **359**: 1519.
- Teela K, Mullany L, Lee C *et al.* 2009. Community-based delivery of maternal care in conflict-affected areas of eastern Burma: perspectives from lay maternal health workers. *Social Science and Medicine* **68**: 1332–40.
- Timyan J, Brechin S, Measham D, Ogunleye B. 1993. Access to care: more than a problem of distance. In: Koblinsky M, Timyan J, Gay J (eds). *The Health of Women: A Global Perspective*. Boulder, CO: Westview Press, pp. 217–34.
- Villar J, Ba'aqel H, Piaggio G *et al.* 2001. WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care. *The Lancet* **357**: 1551–64.
- Varley E. 2010. Targeted doctors, missing patients: obstetric health services and sectarian conflict in Northern Pakistan. *Social Science and Medicine* **70**: 61–70.
- Wee D, Mullany L, Katz J *et al.* 2010. Pregnancy-related mortality in Southern Nepal between 2001 and 2006: independent estimates from a prospective, population-based cohort and a Direct Sisterhood Survey. *American Journal of Epidemiology* **172**: 855–60.
- World Bank. 2009. Nepal at a glance. Online at: http://devdata.worldbank.org/AAG/npl_aag.pdf, accessed 3 May 2011.
- World Health Organization. 2005. *The World Health Report 2005: Make every mother and child count*. Geneva: World Health Organization.
- Yip W, Berman P. 2001. Targeted health insurance in a low income country and its impact on access and equity in access: Egypt's school health insurance. *Health Economics* **10**: 207–20.