Sociocultural and Geographical Disparities in Child Immunization in Nepal

Sociocultural background of children, their place of residence, parental education, household income, and access to health services do matter in terms of vaccination coverage in Nepal.

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Universal child immunization against vaccine-preventable diseases is recognized as one of the most cost-effective ways of reducing infant/child mortality in developing countries (Westly, 2003; Du Lou and Pison, 1996; Ministry of Health [Nepal], New Era, & ORC Macro, 2002; Department of Health Services/Nepal, 2000/2001). However, a considerable proportion of children

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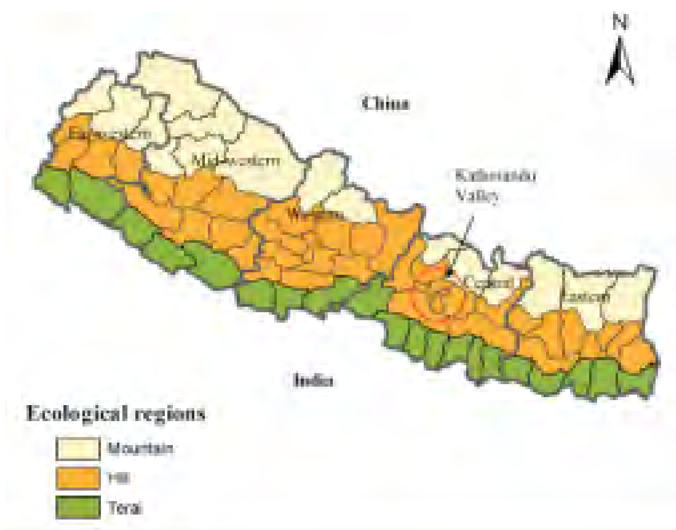
living in many developing countries are deprived of receiving a complete course of immunization (Westly, 2003). In an effort to understand the key determinants of low prevalence of childhood immunization, previous studies have primarily focused on household structures (Gage, Sommerfelt and Piani, 1997; Bronte-Tinkew and Dejong, 2005); household economic resources (Bronte-Tinkew and Dejong, 2005); parental (particularly maternal) education (Desai and Alva, 1998; Streatfield, Singarimbun and Diamond, 1990); community contexts such as access to health services, community social structure and rural-urban residence (Pebley, Goldman and Rodriguez, 1996); access to health infrastructures and insurance (Gore and others, 1999), and political, institutional and organizational factors (Gauri and Khaleghian, 2002) as potential determinants. These studies have focused on Africa (e.g., Jamaica, Trinidad and Tobago), Central America (e.g., Guatemala) and North America and do not reflect the relevance of sociocultural backgrounds and geographical disparities existing in Nepal.

In a multi-ethnic, geographically diverse, economically underdeveloped and socially traditional society such as the one of Nepal, dissemination of knowledge and use of modern health-care technologies and services are found to be strongly correlated with individuals' socio-economic background and the geographical location of their residence (Justice, 1989; Pigg, 1996). In a recent study of Nepal, Matthews and Gubhaju (2004) found an important association between the location of women's place of residence and their ethnicity and the use of antenatal care. In addition, the disparities in social identity based on caste, ethnicity, region of origin (geographic) and gender also determine the access to and control over economic, political and cultural resources (Acharya and Bennet, 1981; Bista, 1991; Pradhan and Shrestha, 2005). Therefore, it is expected that sociocultural background of children and geographical locations they live in are important predictors of child immunization in Nepal.

Recently, the issue of sociocultural and geographical disparity in various aspects of socio-economic development, including health and well-being has received much attention in Nepal (viz. NPC, 2003; Pradhan and Shrestha, 2005; Norwegian Refugee Council/Global IDP Project, 2003; Asian Development Bank, 2002; NESAC, 1998; Lawati, 2001). Socioculturally, people are often discriminated against along caste/ethnicity and gender lines (Pradhan and Shrestha, 2005; Norwegian Refugee Council/Global IDP Project, 2003; Asian Development Bank, 2002; NESAC, 1998; Lawati, 2001). The Norwegian Refugee Council/Global IDP Project (2003), for example, reported a disproportionate distribution of wealth and power in favour of high caste individuals (e.g., Brahmin, Chhetri), while lower castes (also called *Dalits* or untouchables) and minority

ethnic groups (hill and terai ethnic groups) are disproportionately affected by widespread poverty, health problems and lack of public health awareness. Along gender lines, the same project also reported that women in Nepal face reduced opportunities and discrimination at all levels including medical care. The Asian Development Bank (2002) also noted the persistent gender-based exclusion with discrimination against women affecting their survival, health and educational opportunities, ownership of assets and mobility. Similarly, using the Demographic and Health Survey data from developing counties, Hill and Upchurch (1995) reported a gender gap in child immunization and its significant effect on mortality favouring boys.

Figure 1. Nepal: Ecological and political divisions



Geographical disparity in Nepal is another key issue of concern. Ecologically, Nepal can be divided into three prominent regions – the mountains, the hills and the Terai. The Terai region is flat and relatively accessible compared with the hills and the mountains. Geopolitically, the country is divided into five different regions – eastern, central (including the Kathmandu Valley where the capital city is located), western, mid-western and far-western (figure 1). An overwhelming majority of people live in rural areas. For instance, in 2004, only 16 per cent of them lived in urban areas. The Asian Development Bank (2002)

reported a wide gap in socio-economic development across politico-geographical regions, ecological zones and rural-urban areas of Nepal. Historically, the eastern region, particularly the eastern Terai and the central hills especially the Kathmandu Valley, have received much attention from the Government (Gurung, 1998). Ecologically, the mountain region is in most disadvantageous position owing to its rugged terrain compared with the hills and the Terai. Obviously, people living in rural areas have relatively limited access to modern health services and most children do not receive treatment when they get sick (NESAC, 1998). NESAC (1998) also reports a large rural-urban difference in child/infant mortality rate in the country.

Given this background, the present study examines whether children were disadvantaged in receiving immunization because of sociocultural factors such as caste, ethnicity, gender and place of residence (e.g., residence in the eastern or western region, in the hills, mountains or Terai, or residence in rural or urban areas of the country). In addition, this study also examined the effects of parental education and occupation, household economic status, perceived access to health services, and various child characteristics on immunization. Since childhood immunization is an important public service supposedly available free of cost to everyone, it is expected that no child is left behind in receiving immunization service due to his/her sociocultural (caste/ethnicity and gender) background, place of residence, and other socio-economic characteristics.

Significance

Reducing child mortality under the age of 5 by two thirds is one of the United Nations Millennium Development Goals (United Nations, 2005). The United Nations (2005) reported that almost 30,000 children die each day worldwide from preventable diseases before their fifth birthday. Most of these children live in developing countries, particularly in sub-Saharan Africa and South Asia. Achieving this particular Goal by 2015, therefore, requires a significant reduction in child mortality in sub-Saharan African and South Asian countries, where child mortality from communicable diseases predominates (United Nations, 2005). Nepal has a high level of infant and child mortality. For instance, infant mortality in Nepal was reported to be 64 deaths per 1,000 live births in 2005 (PRB, 2005). This has contributed to a high level of under-5 year mortality in the country, which was recorded at 91 deaths per 1,000 live births in 2002 (Westly, 2003; NPC, 2003). It is well recognized that most child deaths are attributed to easily preventable or treatable causes (United Nations, 2005; Bonanni, 1999; NESAC, 1998).

Universal immunization of infants before their first birthday against six vaccine-preventable diseases (tetanus, pertusis, measles, acute respiratory tract infection, polio, tuberculosis and diarrhoea) is one of the most cost-effective ways of reducing infant/child mortality in developing countries (Westly, 2003; Du Lou and Pison, 1996; Ministry of Health [Nepal], New Era, & ORC Macro, 2002; Department of Health Services/Nepal, 2000/2001). The 1990 World Summit for Children, therefore, sets a goal to achieve full immunization coverage of at least 90 per cent of children under the age of one by 2000. However, none of the countries in South Asia that are covered by the Demographic Health Surveys (Bangladesh, India, Nepal, and Pakistan) have met this target (Westly, 2003). In Nepal, only 60 per cent of the children were fully immunized by 12 months of age in 2001 (Ministry of Health [Nepal], New Era, & ORC Macro, 2002; Suvedi, 2003). Therefore, an understanding of the factors contributing to low childhood immunization against vaccine-preventable diseases and implementation of policies targeting appropriate groups at the local level is critical to achieve the related Millennium Development Goal by 2015.

Sociocultural disadvantages in childhood immunization

Caste/ethnicity and gender are two important loci of sociocultural structures of the Nepalese society (NESAC, 1998). Nepal is characterized by an admixture of various caste, sub-caste and ethnic groups. The 2001 census reported 100 such caste/ethnic groups in Nepal (Dahal, 2003; also see annex 3.1 for details regarding the ethnic/caste composition of Nepal based on the 2001 census). The hierarchical caste system is fundamental to the Hindu religion. High caste Hindus (e.g., Brahmin and Chhetri) are at the top of the social hierarchy and are presumed to be socioculturally, economically and politically advantaged as compared with other caste/ethnic groups (Dahal, 2003; Levine, 1987). Low caste Hindus (also called *Dalits* e.g., Kami, Sunar, Damai, Sarki) – considered as untouchables and positioned at the bottom of the social hierarchy – are historically disadvantaged in many respects. Ethnic categories (e.g., Gurung, Tamang, Magar, Newar also called *Janjatis*) basically Mongoloids may also have hierarchy within their system, but the social hierarchy is not as distinct as in other caste groups. Although discriminatory practices based on caste/ethnicity were legally abolished in 1962, such practices are pervasive in Nepal. It is believed that lower caste Hindus and ethnic minorities are discriminated upon or excluded from mainstream socio-economic development (NPC, 2003). Disparities can also be expected among ethnic groups in receiving immunization services owing to differences in access, information and cultural norms. Health services and immunization campaigns are usually based in communities that are relatively privileged.

Gender is equally important in the sociocultural system of Nepal. Since Nepal has a patrimonial societal structure, gender-based exclusion is persistent and deep-rooted (Asian Development Bank, 2002). The high value attached to sons compared with daughters are the root causes of gender-segregated discrimination resulting in differential involvement of men and women in terms of use and access to household productive resources, income, employment and household decision-making (NESAC, 1998; Pradhan and Shrestha, 2005; Norwegian Refugee Council/Global IDP Project, 2003; Asian Development Bank, 2002). Gender bias in nutrition and health is also well documented in India (viz, Das Gupta, 1987; Booth and Verma, 1992; Sen, George and Ostlin, 2002). It is reported that girls and boys, and women and men often do not receive equal treatment with regard to nutrition and health care, in favour of males.

A wide disparity in infant and child mortality between sons and daughters is reported in Nepal. There is significantly higher female child mortality in the country as compared with their male counterparts (NESAC, 1998; Ministry of Health [Nepal], New Era & ORC Macro, 2002). According to the 2001 Demographic Health Survey, the under-5 mortality for girls was estimated to be at 112.4; whereas, it was 104.8 for boys. As regards immunization, 67.5 per cent of male children aged 12-23 months received complete immunization as against 63.9 per cent of girls. Whether these differences still exist after accounting for other important factors such as household resources, parental education and sociocultural and geographic differences are, however, not clear.

Geographic disparity in childhood immunization

Another source of diversity in Nepal is geography. From an ecological perspective, the country is divided into three regions – the mountains, the hills and the Terai. These north-south ecological belts represent three major climatic regions. Significant differences are observed among these regions in terms of climate, biological production and physical infrastructure development. The climate in the Terai region varies from tropical to sub-tropical; whereas, it is mostly sub-tropical to alpine in the hills, and mostly alpine in the mountains. Physical infrastructure such as transportation and communication is relatively well developed in the Terai followed by the hills. The mountain region has little infrastructure development. Geopolitically, the country is divided into five different regions – eastern, central, western, mid-western and far-western. These political divisions, which extend from east to west, were created to even out the socio-economic disparities existing in the country. Only a small proportion of the population lives in urban areas.

Persistent inequalities across various geographical regions, ecological zones and rural urban areas are reported (Asian Development Bank, 2002). Historically, the eastern region, particularly the eastern Terai and the central hills (particularly the Kathmandu Valley) have received priority from the Government (Gurung, 1998). Ecologically, the Terai region is relatively privileged compared with the hills and the mountains in terms of infrastructure development, food production and access to public services. The mountain region is disadvantaged owing to its rugged terrain and poor production potential. The incidence of poverty is high in the mid- and far-western regions, rural areas, as well as in the mountains (Asian Development Bank, 2002; NESAC, 1998).

Disparity in child mortality is also observed across ecological and geopolitical regions and rural-urban areas of Nepal. According to the 2001 Demographic and Health Survey, the mountain region has an under-5 mortality of 157.4 followed by the Terai region (112.8) and the hill (93.9). In terms of geopolitical division, the under-5 mortality is estimated at 149.2, 111.0, 110.9, 104.8, and 83.7, for far-western, mid-western, central, eastern and western region of the country, respectively. Similarly, it is estimated at 111.9 in rural areas and 65.9 in urban areas. Comparable patterns have been reported in terms of receiving a complete course of vaccination by children. Therefore, this study also examines whether geographical differences in childhood immunization remain even after accounting for other factors.

Data and variables

This study utilized the 2001 Nepal Demographic and Health Survey data to examine sociocultural and spatial differences in childhood immunization. Two dependent variables are whether a child received: a) a complete course of immunization; and b) a complete course of each type of vaccine. A complete course of immunization constitutes eight vaccines: 1 dose of Bacillus of Calmette and Guérin (BCG) – a vaccine against tuberculosis; 3 doses of DPT – a mixture of three vaccines to immunize against diphtheria, pertussis and tetanus; 3 doses of polio; and 1 dose of measles.

The immunization outcome variable is differently used in various studies. Desai and Alva (1998) used this as a continuous measure, a count of the number of vaccinations received by the index child aged 12 months and over. Streatfield, Singarimbun and Diamond (1990), by contrast, used this variable as a dichotomy – whether a child received two or three DPT injections and three polio injections versus any less than that. Bronte-Tinkew and Dejong (2005) and Gage, Sommerfelt and Piani (1997) also used this variable as a dichotomy for children

aged 12-35 months receiving all eight vaccinations (BCG at birth, 3 doses of DPT and polio each, and 1 dose of measles) within 12 months of their birth. The authors followed the measure used by Bronte-Tinkew and Dejong (2005) and Gage, Sommerfelt and Piani (1997) as whether a child was fully immunized= '1,' versus '0' = otherwise for children of ages 12-23 months as used by the 2001 Nepal Demographic and Health Survey (Ministry of Health [Nepal], New Era, & ORC Macro, 2002).

Two broad categories of explanatory variables of interest include sociocultural backgrounds of children and their place of residence. Sociocultural variables included caste/ethnicity and gender. Children are grouped into five broad caste/ethnic groups: upper caste Hindu; low caste Hindu (or *Dalits*); hill ethnic groups, Terai ethnic groups and others (available upon request). High caste Hindu children are treated as the reference group as they are presumed to be privileged as compared to children from all other ethnic groups. Gender of a child is coded as '1' for boy and '0' for girl. Three different geographic variables relevant to Nepal are used. Those include (a) ecologicaly – the mountains (a reference category), the hill and the Terai; (b) geopolitical – eastern (a reference category), central, western, mid-western, and far-western; and (c) rural-urban residence (rural as a reference category). In addition, this study also examines the effects of child characteristics such as age, age-squared and birth order; parental characteristics such as mother's and father's education, their occupations, mother's report of distance to health facility; and household characteristics such as age and sex of the household head, and household wealth in order to net out the effects of sociocultural and geographical factors.

Analytical strategy

Logistic regression was used as a multivariate tool to analyse the data. Results are presented as odds ratios for ease of interpretation. For a continuous independent variable, an odds ratio greater than 1 indicates that the odds of a child being immunized increases when the independent variable increases; while an odds ratio of less than 1 indicates that the odds of a child being immunized decreases when the independent variable increases, as suggested by Menard (1995:49). For a categorical independent variable, "an odds ratio greater than 1 indicates an increased chance of an event occurring versus not, while an odds ratio less than 1 indicates a decreased chance of an event occurring versus not occurring" (Liao, 1994:15).

For a complete immunization model, first, the effects of sociocultural variables (Model I) and geographic variables (Model II) were estimated separately.

Then, both of these variables were included simultaneously in the equation to examine their overall effects (Model III). The full (or final) model (Model IV) estimated the effects of these variables net of child, parental and household characteristics. Similar strategy was followed to examine the sociocultural and geographical differences according to specific vaccine coverage. Only the results of the full model (similar to final or Model IV for complete immunization) that included all the variables used in the analysis are provided, however.

Results

Table 1 presents mean, standard deviation, minimum and maximum values for all the explanatory variables used in the analysis. The results in table 2 present the bivariate distribution of immunization coverage across sociocultural and geographic domains of interest. As presented in table 2, over two third of children (66 per cent) aged 12- 23 months received all eight vaccines (the complete course). Despite a remarkable achievement in immunization coverage in a short period of time, from 36 per cent in 1996 to over 60 per cent in 2001 (Westly, 2003), the present level of immunization coverage is still far below the target set by the 1990 World Summit for Children of covering at least 90 per cent of children under age 1 by 2000. When disaggregated by type of vaccine, 91 per cent of children received the full course of polio, followed by BCG (83 per cent), DPT (72 per cent), and measles (71 per cent) suggesting a differential use of vaccines by their types. There is a wide range in child immunization by type of vaccine (from 71 per cent measles to 91 per cent polio), which contributes to the low level of child immunization coverage in the country.

Table 1. Descriptive statistics of explanatory variables (N=1,213)

Explanatory variables	Mean	Standard Deviation	Min	Max
Sociocultural characteristics				
Ethnicity				
Upper caste Hindu (=0)	0.40	0.49	0	1
Lower caste Hindu *(Dalits)*	0.14	0.35	0	1
Hill (ethnic) Tibeto-Burmese	0.25	0.43	0	1
Terai ethnic	0.12	0.33	0	1
Others	0.09	0.28	0	1
Sex				
Male (=1)	0.49	0.50	0	1
Geographical characteristics				
Ecological				
Mountain (=0)	0.14	0.35	0	1

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Table 1 *(Continued)*

Explanatory variables	Mean	Standard Deviation	Min	Max
Hill	0.39	0.49	0	1
Terai	0.47	0.50	0	1
Geopolitical regions				
Eastern (=0)	0.22	0.42	0	1
Central	0.27	0.45	0	1
Western	0.15	0.36	0	1
Mid-western	0.15	0.36	0	1
Far-western	0.20	0.40	0	1
Rural-urban residence				
Urban (=1)	0.09	0.28	0	1
***Control*s**				
Child characteristics				
Age	17.51	3.42	12.00	23.0
Age-squared	318.38	119.94	144.00	529.0
Birth order	3.27	2.18	1	12
Parental characteristics				
Mother's education				
No education (=0)	0.71	0.45	0	1
Primary	0.15	0.36	0	1
Secondary or higher	0.14	0.35	0	1
Mother's occupation				
Self-employed (agriculture) (=0)	0.34	0.47	0	1
Not working	0.27	0.44	0	1
Else (Don't know, missing)	0.37	0.48	0	1
Partner's education				
No education (=0)	0.02	0.13	0	1
Primary	0.81	0.39	0	1
Secondary or higher	0.14	0.34	0	1
Else (don't know, missing)	0.05	0.23	0	1
Partner's occupation				
Self-employed (agriculture) (=0)	0.54	0.50	0	1
Professional/ business/ clerk/ service	0.24	0.43	0	1
Skilled manual	0.08	0.28	0	1
Unskilled manual	0.10	0.30	0	1
Else (Don't know, missing)	0.04	0.19	0	1
Mother's report of distance to health service				
Not a big problem	0.22	0.41	0	1
Small problem	0.22	0.41	0	1
A big Problem	0.53	0.50	0	1
Missing information	0.03	0.18	0	1
Household characteristics				
Sex of household head (female = 1)	0.11	0.31	0	1

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Table 1 *(Continued)*

Explanatory variables	Mean	Standard Deviation	Min	Max
Age of household head (years)	40.66	14.42	17	90
Wealth index				
Lowest quintile (=0)	0.27	0.45	0	1
Second quintile	0.22	0.41	0	1
Middle quintile	0.18	0.39	0	1
Fouth quintile	0.12	0.38	0	1
Highest quintile	0.15	0.36	0	1

Table 2. Share of childhood immunization coverage (N=1,213)

Variables	Vaccinations				
	All	BCG	DPT	Polio	Measles
Total	66.1	83.3	72.1	91.0	71.4
Sociocultural characteristics					
Caste/ethnicity					
Upper caste Hindu	67.8	81.4	72.1	90.9	73.3
Lower caste Hindu (*Dalit*)	62.1	82.8	69.0	88.5	69.0
Hill ethnic	72.3	86.7	78.0	91.3	76.3
terai ethnic	66.9	88.5	77.7	93.9	70.9
Others	46.7	76.6	52.3	90.7	53.3
Child's gender					
Male	67.8	85.1	74.1	91.7	73.3
Female	64.8	81.6	70.0	90.4	69.5
Geographical characteristics					
Ecological regions					
Mountain	64.4	78.2	67.2	85.6	73.0
Hills	68.4	81.0	74.5	89.7	71.7
terai	64.8	86.9	71.5	93.8	70.6
Geopolitical regions					
Eastern	73.7	91.1	80.4	95.6	78.5
Central	64.3	87.1	70.9	92.2	68.5
Western	64.3	84.3	72.4	93.5	67.0
Mid-western	66.1	81.4	72.1	86.9	74.9
Far-western	61.6	70.2	64.0	85.5	68.2
Rural-urban					
Rural	65.1	82.9	71.2	90.6	70.3
Urban	76.9	89.4	80.8	95.2	82.7

The findings revealed differences in childhood immunization by ethnicity (table 2). The complete immunization coverage ranged from 47 per cent among children belonging to the other minority groups (e.g., Bangali, Musalman, Rajbhar, Raute, Raji, and other minorities of the hill and Terai) to over 72 per cent for hill ethnic groups. However, contrary to the authors' expectations, high caste Hindu children were not always advantaged as compared with those of other ethnic groups. Over 72 per cent of children of hill ethnic group received complete course of immunization compared with only 68 per cent of those belonging to the high caste Hindu. The children of other minority groups (e.g., Bangali, Musalman, Rajbhar, Raute, Raji, and other minorities of the hill and Terai) seemed to be most disadvantaged. Interestingly, while about 91 per cent of the children of minority group received a polio vaccine, slightly over 52 per cent of them received a DPT and a measles vaccine. By gender, female children seemed to be disadvantaged in terms of receiving a complete course of immunization as well as receiving each type of vaccine. This distribution provides some indication of caste/ethnicity and gender disadvantages in childhood immunization coverage. Whether those differences still remain after accounting for other factors is important to understand and is described below.

The results of the multivariate logistic regression (table 3) suggest that caste/ethnicity does matter, although weakly, in receiving a complete course of immunization. Children of all other caste groups except those belonging to hill ethnic groups (e.g., Gurung, Magar, Newar) were found to be relatively disadvantaged compared with high caste Hindu groups (Model I, table 3). However, the difference was statistically significant only for those belonging to the other category (e.g., Bangali, Musalman, Rajbhar, Raute, Raji, and other minorities of the hill and Terai). Children belonging to this category were about 58 per cent less likely to receive a complete course of immunization compared with those belonging to the upper caste Hindu group (odds ratio = 0.412; $p<0.000$, Model I). These relationships are consistent even after controlling for the effects of geographic, child, parental and household characteristics (full model or Model IV). When the multivariate analysis was performed by disaggregating types of vaccines received by a child, a different scenario emerged (table 3). For instance, net of all other factors, while children belonging to the Terai ethnic group were found to be significantly more likely to receive DPT (odds ratio = 1.708; $p<0.05$), those belonging to lower caste Hindu were significantly more likely to receive a Measles vaccine (odds ratio = 1.427; $p<0.10$), whereas children of other minorities were significantly less likely to receive a DPT, a BCG and a measles vaccine compared with those of high caste Hindu. However, caste/ethnic groups were found to be indifferent in receiving a complete course of polio vaccine.

By gender, although male children were observed to be more likely to be fully immunized as compared with their female counterparts, the multivariate results did not show a strong evidence of gender bias against female children. However, by vaccine types, controlling for all other variables, males were significantly more likely to receive a DPT, a BCG, and a measles vaccine than female children.

The results of childhood immunization coverage by geographic regions revealed that a fewer proportion of children living in the mountains (64 per cent) were fully immunized compared with those living in the hills (68 per cent) and the terai (65 per cent). However, the coverage for measles vaccine was slightly greater in the mountains (73 per cent) than two other regions. Moreover, a fewer proportion of children were fully immunized in the western regions of Nepal compared with the eastern region. Results also show a rural disadvantage.

The multivariate results show a strong evidence of east-west (geopolitical) disadvantage in immunization coverage than by ecological (north-south) regions and rural-urban locations. Although the preliminary results (model II and Model III, table 3) indicated a strong rural-urban difference in using a complete course of vaccination favouring urban children, the difference was reduced and turned out to be statistically non-significant when other factors particularly parental education, household wealth and access to health services were controlled for. This could be because people living in urban areas are mostly educated and wealthy relative to their rural counterparts. Other reason could be the relative better access to health services in urban areas. Analysis performed by disaggregating vaccine types also revealed similar results.

By geopolitical regions, children who are living in the central (odds ratio = 0.615; $p<0.01$), western (odds ratio = 0.644; $p<0.01$), mid-western (odds ratio = 0.691; $p<0.10$), and far-western (odds ratio = 0.546; $p<0.01$) regions were significantly less likely to be fully immunized as compared with those living in the eastern region of the country, net of other geographic characteristics (Model II, table 3). With the exception of the mid-western region, the coefficients remained significant even after controlling for the effects of all other variables (Model IV), suggesting a strong evidence of eastern regional bias in vaccination coverage. Similar differences were observed by type of vaccine as well. Those results suggest an evidence of east-west rather than north-south or rural-urban disadvantage in childhood immunization coverage in Nepal.

In addition, the findings suggest that the effects of parental education, particularly those of mother's, were quite important in determining child immunization. The children of mothers with primary (odds ratio = 2.422; $p<0.001$)

Table 3. Odds ratio estimates predicting the effects of sociocultural and geographical factors on child (12-23 months) immunization in Nepal (N=1,213)

Variables	Full immunization				Immunization by type			
	Model I	**Model II**	**Model III**	**Model IV**	**DPT**	**BCG**	**Polio**	**Measles**
Sociocultural								
Ethnicity: Upper caste Hindu (=0)								
Lower caste Hindu (*Dalits*)	0.774		0.798	1.129	1.323	1.579	0.862	1.115
Hill (ethnic) Tibeto-Burmese	1.241		1.069	1.405	1.429	1.082	0.616	1.427+
Terai ethnic	0.843		0.915	1.151	1.708*	1.144	0.819	0.941
Others	0.412***		0.340***	0.564*	0.506*	0.413*	0.466	0.514*
Gender: Male (=1)	1.184		1.198	1..129	1.362*	1.443*	1.257	1.269+
Geographical characteristics								
Ecological: Mountain (=0)								
Hill		1.113	1.109	0.888	1.066	0.821	0.934	0.682+
Terai		0.924	1.151	0.782	0.842	1.288	1.754	0.804
Geopolitical region: Eastern (=0)								
Central		0.615**	0.591**	0.649*	0.591*	0.596+	0.517+	0.569**
Western		0.644*	0.629*	0.411***	0.406***	0.269***	0.337*	0.353***
Mid-western		0.691+	0.661+	0.961	0.787	0.488*	0.272**	1.121
Far-western		0.546**	0.499***	0.607*	0.418***	0.180***	0.198***	0.601
Rural-urban residence: Urban (=1)		1.901**	1.799**	0.715	0.258	0.757	1.172	0.946
Controls								
Child characteristics								
Age				1.105	0.963	1.236	0.748	1.057
Age-squared				0.999	1.002	0.994	1.015	1.000
Birth order				0.958	0.949	0.880***	0.946	0.960
Parental characteristics								
Mother's education: No education (=0)								
Primary				2.422***	2.728***	2.762**	1.900	1.927**
Secondary and higher				3.663***	6.487***	6.914**	4.245+	4.475***
Mother's occupation: Self-employed (agriculture) (=0)								

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Table 3. *(Continued)*

Variables	Full immunization				Immunization by type			
	Model I	Model II	Model III	Model IV	DPT	BCG	Polio	Measles
Not working				0.669+	0.782	0.732	0.746	0.709
Else (Don't know, missing)				0.790	0.622	0.648	0.361	0.995
Father's education: No education (=0)								
Primary				1.252	1.295	1.422+	1.679*	1.338+
Secondary and higher				2.061***	2.016***	1.992**	2.661**	1.930***
Else (Don't know, missing)				1.632	1.544	1.870	1.193	1.287
Father's occupation: Self-employed (agriculture) (=0)								
Professional/business/clerk/service				1.796***	1.912**	1.197	1.144	1.722**
Skilled manual				1.567	1.212	1.241	1.454	1.742+
Unskilled manual				1.117	1.093	0.942	1.554	0.871
Else (Don't know, missing)				2.922	2.069	1.452	1.564	2.078
Distance to health service (Not a problem = 0)								
Small problem				0.790	0.966	0.713	1.584	0.833
A big problem				0.466***	0.534**	0.364***	0.632	0.519**
Missing information				0.452+	0.390*	0.243**	-	0.515
Household characteristics								
Sex of household head (female = 1)				0.938	1.095	1.832+	0.843	1.166
Age of the household head (years)				0.997	0.999	1.004	0.997	0.997
Wealth index: Lowest quintile (=0)								
Second quintile				1.534*	1.478*	1.417	1.307	1.383+
Middle quintile				2.142***	2.043**	2.583**	2.120+	1.919**
Fourth quintile				2.370***	2.208***	1.774*	1.992+	2.186***
Highest quintile				1.543	1.468	1.212	1.257	1.069
Intercept	1.941***	2.715***	2.680***	0.544	2.127	1.778	31.130	1.382
Model Chi-square	26.007***	19.626**	45.199***	242.463***	245.930***	216.632***	146.937***	204.249***
Model degree of freedom	5	7	12	35	35	35	35	35
-2 Log likelihood	1527.254	1533.635	1508.062	1310.798	1191.364	875.892	586.233	1247.938
Pseudo R-square (%)	1.7	1.3	2.9	15.6	17.1	19.8	20.0	14.1
Per cent correctly classified/ predicted	66.7	66.1	67.6	71.1	75.2	83.8	91.0	74.7

t-statistic   *** = p<0.001;   ** = p<0.01;   * = p<0.05;   + = p<0.10

and secondary (odds ratio = 3.663; $p<0.001$) education were significantly more likely to receive a complete course of vaccination as compared with those whose mothers were illiterate. The effect of mother's education was observed to be linear, i.e., the odds of vaccination coverage increased with the increase of mother's education, which contradicts the findings of Streatfield, Singarimbun and Diamond (1990). These authors reported a nonlinear effect of mother's education on vaccination coverage in Indonesia, and found that the children of mothers with no education and those with secondary education were more likely to receive a complete course of vaccination than those of mothers with primary education. Moreover, the children whose fathers had completed secondary education were significantly more likely to have received a vaccine than those whose fathers had had no education.

Household income also influenced child immunization coverage. The results revealed that children living in wealthy households were significantly more likely to be fully immunized than those living in the lowest quintile (poorest households). These results are consistent with the findings of Bronte-Tinkew and Dejong (2005) in their study of Jamaica and Trinidad and Tobago. However, surprisingly, children from wealthiest households (belonging to highest quintile of wealth index) were significantly not different from those belonging to the lowest quintile in terms of receiving a complete course as well as a specific type of vaccine. In addition, the access to health service was an important contributing factor of child immunization in Nepal. Children of mothers who perceived the distance to health service as a big problem were least likely to be immunized compared with those whose mothers did not perceive it as a problem.

Discussion and implications

This study examined whether children in Nepal were socioculturally and geographically disadvantaged in receiving immunization. These issues are quite important in the context of the widely discussed sociocultural (particularly caste/ethnicity and gender) and geographic disparities (ecological, geopolitical, and rural-urban) in the socio-economic development of the country. Since childhood immunization is an important public service which should be globally available free of cost to everyone, it was expected that no child would be left behind in receiving immunization owing to her/his sociocultural background, geographic place of residence and other reasons.

The results, however, indicated some evidence of caste/ethnicity disadvantages. Children of other minority groups (e.g., Bangali, Musalman, Rajbhar, Raute, Raji, and other minorities of the hill and Terai) were found to be

less likely to be fully immunized compared with those children of upper caste Hindu families. However, children of all other ethnic groups seemed to be equally likely to be fully immunized as those of upper caste Hindu. These findings slightly depart from others. For instance, Matsuda (2002) reported no significant difference in the frequency of immunization use among mothers by caste in Nepal. Similarly, Niraula (1994:151) reported no difference by caste/ethnicity in using health services in the hill villages of Nepal and mentioned that "contrary to expectation, caste is not important." These results suggest a need for further understanding of possible reasons of caste/ethnicity disadvantages in childhood immunization existing among a couple of minority ethnic groups.

By gender, although male children seemed to be more likely to be fully immunized compared with female children, the statistical difference was weak to support the gender bias argument. Bronte-Tinkew and Dejong (2005) also reported a similar result from Jamaica, Trinidad and Tobago. However, when the analysis was performed by type of vaccine, a statistically significant difference was observed between a male and a female child in receiving a DPT, BCG and a measles vaccine, favouring boys, thus, leaving a little room for the gender bias argument.

Geographically, the differences in child immunization coverage were strong among political division (east-west) as compared with ecological domain (north-south) and rural-urban locations. Children living in the eastern region of Nepal were relatively advantaged as compared with those living in the western part of the country. Particularly, those living in the western, far-western and central regions were relatively disadvantaged in receiving a complete course of immunization, as well as a specific course of vaccine compared with children living in the eastern region.

Rural-urban difference in childhood immunization coverage was not important, however. Although the bivariate results showed a strong rural-urban difference so that children living in urban areas were about two times more likely than their rural counterparts to be fully immunized, the difference disappeared after controlling for important variables such as parental education, household wealth and perceived access to health services, perhaps suggesting that rural-urban difference was mediated through these factors. It could be because relatively more educated and economically affluent people live in urban areas, are aware of the benefits of immunization, and can afford the direct and indirect costs associated with it. The hill-Terai (north-south) difference was also statistically not significant. It is interesting to note that despite the high level of coverage for polio vaccine (over 85 per cent across sociocultural and geographic domains), the

coverage for other vaccines is low across sociocultural and geographic domains. What factors might have contributed to such a differential coverage of vaccines across sociocultural and geographic domains remains to be seen.

Parental education is quite important in improving child health (Glewwe, 1996; Cleland, 1989) and, thus, in determining childhood immunization coverage (Streatfield, Singarimbun and Diamond, 1990). The education of parents, particularly of mothers', in consistent with this notion, played a significant role in increasing child immunization coverage. This is a strong evidence for putting more emphasis on women's education in developing countries such as Nepal. Moreover, campaigns related to immunization could also enhance the knowledge of vaccination in a situation where a large number of mothers are illiterate. The findings also revealed that household income, in fact, does matter in child immunization despite the fact that vaccines are provided free of cost and assumed to be available everywhere. These results again confirm the findings of Bronte-Tinkew and Dejong (2005) that children living in wealthy families were more likely to be immunized than those living in poor families. Nevertheless, the perceived access to health services was an important contributing factor of child immunization, thus, suggesting the need for an increased access to vaccination coverage. This implies that access to service is still a barrier to immunization in Nepal although vaccines are provided through mobile clinics and immunization campaigns are organized to promote vaccination coverage.

In conclusion, sociocultural background of children, their place of residence, parental education, household income, and access to health services do matter in terms of vaccination coverage in Nepal. From a policy perspective, focus on ethnic communities particularly minorities (e.g., Bangali, Musalman, Rajbhar, Raute, Raji, and minorities of the hill and Terai) would minimize the gap across caste/ethnicity in childhood immunization coverage. Although these minority groups do not constitute a significant proportion of the population of Nepal, the present finding strongly suggests focusing on them for their well-being. Similarly, putting more emphasis on a girl child in providing DPT, BCG and measles vaccines would, to some extent, help reduce the possible gender gap in specific vaccine coverage. Moreover, provision of specific vaccines in the western part of Nepal may reduce the east-west gap in immunization coverage. For example, the coverage for most vaccines is relatively low in the far-western region and there is a wide gap between the eastern and the western regions of the country. At the same time, the reason why the coverage for vaccines such as DPT, measles and BCG is different across sociocultural and geographic domains, despite a high level of acceptance of polio, is another important question that needs attention. Finally,

putting more emphasis on parental education, particularly illiterate women from economically vulnerable households, and increasing the access to services is expected to help increase the immunization coverage. This should ultimately reduce the child mortality occurring from vaccine-preventable diseases in Nepal.

References

Acharya, M. and L. Bennet (1981). *The Status of Women in Nepal: The Rural Women of Nepal*, Kathmandu: Tribhuvan University.

Asian Development Bank (2002). "Poverty reduction in Nepal: Issues, findings, and approaches", http://www.adb.org/Documents/Reports/Poverty_Reduction_NEP/ poverty_analysis.pdf (retrieved on September 20, 2005).

Bista, D. B. (1991). *Development and Fatalism: Nepal's Struggle for Modernization,*

Calcutta: Orient Longman Limited.

Bonanni, P. (1999). "Demographic impact of vaccination: A review", *Vaccine,* vol. 17, pp. S120-S125.

Booth, B. and M. Verma (1992). "Decreased access to medical care for girls in Punjab, India: The roles of age, religion, and distance", *American Journal of Public Health,* vol. 82, pp. 1155-1157.

Bronte-Tinkew, J. and G. F. Dejong (2005). "Do household structure and household economic resources predict childhood immunization? Evidence from Jamaica and Trinidad and Tobago", *Population Research and Policy Review,* vol. 24, pp. 27-57.

Cleland, J. (1989). "Maternal education and child survival: Further evidence and explanations", paper presented at the Rockefeller Foundation Health Transition Workshop, Australian National University, Canberra, 15-19 May.

Dahal, D. R. (1995). Ethnic cauldron, demography and minority politics: A case study of

Nepal, In Dhruba Kumar, ed. *State, Leadership and Politics in Nepal.* Kathmandu.

Dahal, D. R. (2003). "Social composition of the population of caste/ethnicity and religion", *Population Monograph of Nepal 2003*. Central Bureau of Statistics, Kathmandu, Nepal.

Das Gupta, M. (1987). "Selective discrimination against female children in rural Punjab, India", *Population and Development Review,* vol. 13, No. 1, pp. 77-100.

Department of Health Services/Nepal. (2000/2001). "Annual report." His Majesty's Government of Nepal, Ministry of Health, Kathmandu, Nepal.

Desai, S. and S. Alva (1998). "Maternal education and child health: is there a strong causal relationship?", *Demography,* vol. 35, No. 1, pp. 71-81.

Du Lou, A. D. and G. Pison (1996). "The role of vaccination in the reduction of childhood mortality in Senegal", *Population: An English Selection,* vol. 8, pp. 95-121.205.

Gage, A. J., A. E. Sommerfelt and A. L. Piani (1997). "Household structure and childhood immunization in Niger and Nigeria", *Demography,* vol. 34, No. 2, pp. 295-309.

Gauri, V. and P. Khaleghian (2002). "Immunization in developing countries: its political and organizational determinants", *World Development,* vol. 30, No. 12, pp. 2109-2132.

Glewwe, P. (1996). "How does schooling of mothers improve child health? Evidence from Morocco", Living Standards Measurement Study Working Paper No. 128, The World Bank, Washington, D.C.

Gore, P. and others (1999). "Predictors of childhood immunization completion in a rural population", *Social Science & Medicine,* vol. 48, pp. 1011-1027.

Gurung, H. (1998). "*Nepal: Social Demography and Expressions*", Kathmandu: New Era.

Hill, K. and D. M. Upchurch (1995). "Gender differences in child health: Evidence from the Demographic and Health Surveys", *Population and Development Review,* vol. 21, No. 1, pp. 127-151.

Justice, J. (1989). *Policies, Plans, and People: Foreign Aid and Health Development,* University of California Press.

Lawati, M. L. (2001). "Racial discrimination toward the indigenous people in Nepal. A non-government report for the third world conference against racism (WCAR)", paper presented at the National Conference on the NPC in Kathmandu, 26 April 2001. (http://www.mtnforum.org/resources/library/lawom01a.htm, accessed on 11 September 2005).

Levine, N. E. (1987). "Caste, state, and ethnic boundaries in Nepal", *The Journal of Asian Studies,* vol. 46, No. 1, pp. 71-88.

Liao, T. F. (1994). "*Interpreting Probability Models: Logit, Probit, and Other Generalized Models*", California, London, New Delhi: SAGE Publications.

Matsuda, D. (2002). "Beliefs about immunization and children's health among childbearing mothers in Nepal", Unpublished Senior Honors Thesis Submitted to the Program in Human Biology, Stanford University.

Matthews, S. A., and B. Gubhaju (2004). *Contextual Influences on the Use of Antenatal Care in Nepal,* DHS Geographic Studies 2. Calverton, Maryland USA: ORC Macro.

Menard, S. (1995). "*Applied Logistic Regression Analysis*", California: Sage Publications, International Educational and Professional Publisher.

Ministry of Health [Nepal], New Era, & ORC Macro (2002). "*Demographic and Health Survey 2001*", Calverton, Maryland, USA: Family Health Division, Ministry of Health; New ERA; and ORC Macro.

Nepal South Asia Centre (NESAC) (1998). "*Nepal Human Development Report 1998*", Nepal South Asia Centre, Kathmandu, Nepal.

Niraula, B. B. (1994). "Use of health services in hill villages in central Nepal", *Health Transition Review,* vol. 4, pp. 151-166.

Norwegian Refugee Council/Global IDP Project (2003). "Profile of internal displacement: Nepal", Compilation of the Information Available in the Global IDP Database of the Norwegian Refugee Council. Geneva, Switzerland.

National Planning Commission (NPC) (2003). "*The Tenth Plan. Poverty Reduction Strategy Paper 2002-2007*", His Majesty's Government of Nepal, National Planning Commission, Kathmandu.

Pampel, F. C. (2000). "*Logistic Regression a Primer",* California: Sage Publications, International Educational and Professional Publisher.

Pebley, A.R., N. Goldman and G. Rodriguez (1996). "Prenatal and delivery care and childhood immunization in Guatemala: Do family and community matter?", *Demography,* vol. 33, pp. 231-247.

Pigg, S. L. (1996). "The credible and the credulous: The question of "villagers' beliefs" in Nepal", *Cultural Anthropology,* vol. 11, No. 2, pp. 160-201.

Population Reference Bureau (2005). "*2005 World Population Data Sheet*", Population Reference Bureau, Washington, D.C.

Pradhan, R. and A. Shrestha (2005). "Ethnic and Caste Diversity: Implications for Development", Working Paper Series No. 4, Nepal Resident Mission, Asian Development Bank.

Sen, G., A. George and P. Ostlin (2002). "Engendering Health Equality: A Review of Research and Policy", Working Paper Series, vol. 12, No. 2, Harvard Center for Population and Development Studies.

Streatfield, K., M. Singarimbun and I. Diamond (1990). "Maternal education and child immunization", *Demography,* vol. 27, No. 3, pp. 447-455.

Suvedi, B. K. (2003). "Immunization programme of Nepal: An update", *Kathmandu University Medical Journal,* vol. 2, No. 3, pp. 238-243.

United Nations (2005). "*The Millennium Development Goals Report 2005*", UN Millennium Development Goals (MDG). United Nations. (http://www.un.org/milleniumgoals/)

Westly, S. B. (2003). "Child survival and healthcare in developing countries", *Asia-Pacific Population and Policy,* East-West Center, Population and Health Studies, No. 67 (www.eastwestcenter.org).