Status and determinants of child immunisation coverage in three South Asian countries, India, Bangladesh and Nepal: Evidence from the Demographic and Health Survey

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Abstract

Background: Vaccination is the most cost-effective intervention to improve health and reduce morbidity and mortality due to vaccine-preventable diseases in the child population. The South Asian region was home to 1.8 of the 6 million babies who died within twenty-eight days of birth in 2015.

Objective: To describe the status and its determinants of immunisation coverage in three South Asian countries, India, Bangladesh and Nepal.

Method: The study utilized data from the Demographic Health Surveys of India, Bangladesh and Nepal. We used the principal component analysis (PCA) to compute the wealth index. Descriptive statistics, bivariate analysis and multivariate logistic regression model were utilised to access the status and factors associated with immunisation coverage.

Results: The study found increasing trends in immunisation coverage in India, Bangladesh and Nepal. More than 85% of children from Nepal and Bangladesh were fully immunised in contrast to 43.6% from India. There was a wide variation in child immunisation coverage in terms of socioeconomic and demographic factors. Multivariate logistic regression revealed that factors like mother's age, residence, birth order and religion had minimal impact on complete immunisation coverage. However, mother's education and wealth index appeared as the significant confounding factors of full immunization coverage. Children belonging to the higher educated and rich families were more likely to be fully immunised. Maximum impact of education (AOR=9.833; p<0.01) and wealth index (AOR=8.105; p<0.01) were observed in 2006 and 2011 respectively in Nepal.

Conclusions: More than 85% of children from Nepal and Bangladesh were fully immunised in contrast to 43.6% from India. Mother's education and wealth index appeared to have a significant impact on full immunization coverage.

Introduction

Childhood immunisation is the most cost-effective intervention for improving health and reducing morbidity and mortality due to vaccine-preventable diseases in the child population[1]. Around three million children die annually due to vaccine preventable diseases (VPDs), a large number of these children coming from developing countries[2]. Around 34 million children were not completely vaccinated, nearly 98% of them being from developing countries[2].

Since 1990, there has been a significant improvement in the child immunisation coverage in the South Asian region. However, in India, Bangladesh and Nepal, coverage of childhood immunisation is still far from universal coverage[3]. In 2015, six million children died globally, with more than 30 percent coming from the South Asian region and this is equivalent to eleven children dying every single minute worldwide[4]. The researchers found that deaths from measles fell from more than 535,000 in 2000 to around 139,000 in 2010. Almost half of these deaths occurred in India attributed to lower vaccination rates[5]. As per the United Nations, strengthening routine immunisation is a cornerstone for countries to achieve the Millennium Development Goal 4 (MDG 4), which emphasised reduction of the child mortality by two-thirds between 1990 and 2015[1].

During the last few decades, numerous programmes implemented in the South Asian

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region reduced child morbidity and mortality by increasing child vaccination[4]. Programmes such as Expanded Programmes on Immunisation (EPI), Universal Immunisation Programme (UIP), National Immunisation Programme (NIP), Pulse Polio Campaign (PPC) and Child Survival Programme, were organised in the region by the respective governments with the help of United Nations. "Do these programmes reduce vaccine preventable morbidities and mortality in the South Asian Region?" Evidence shows that despite the extraordinary success of vaccination programmers, still, around 23 million children under one year of age remain unvaccinated, many of them in South Asia[6]. In 2015, the South Asian region was home to 1.8 of the 6 million babies who died within twenty-eight days of birth[4].

Child immunisation is the most important public health intervention to reduce child morbidity and mortality[1]. The South Asian region consists of a number of countries, which are not only poor but also shoulder a significant proportion of the global child mortality[7]. India, Bangladesh and Nepal have large proportions of un-immunised children[7,8]. Although India has spent twice as much per capita as Bangladesh and Nepal on health care, it has worse outcomes in infant mortality[9]. Therefore, there is a need to understand the trends and patterns of child immunisation and its confounding factors, particularly in India where the child mortality and immunisation coverage is low compared to Bangladesh and Nepal[7,8].

Method
Sources of data
The study utilised the publicly available data from the Demographic and Health Surveys (DHS) of three South Asian countries namely India, Bangladesh and Nepal. The Indian version of the DHS is the National Family and Health Survey (NFHS). DHS are nationally representative, large scale, stratified, multiple indicator cluster surveys comprising more than 99 percent of the country's population. These surveys provide detailed information on fertility, mortality, family planning practices, demographic and maternal and child health (MCH) related information, including immunisation status and other important aspects of nutrition, health and health care utilisation in the country and state level. The analysis uses data pooled from the second and third wave of NFHS (1998-1999 and 2005-2006) for India and first three round of DHS for Bangladesh (1999-2000, 2007 and 2011) and Nepal (1996, 2006 and 2011) to attain an adequate sample size.

Immunisation status was defined according to either the vaccination card for each living child or when unavailable, as reported by the mother. The study considered children between 12-23 months of age for the analysis because, according to WHO guidelines, children across this age range are not refused vaccination in a field situation[1]. Thus, mothers with kids aged 12–23 months, were extracted from the children's dataset.

Description of Variables
This study utilised various exposure variables, namely, the age of mother (15-24, 25-34 and 35+), birth order (1, 2-3, 4-5, 6+), place of residence (urban, rural), religion (Muslim, Hindu and Other), mother's education (no education, primary, secondary and higher) and wealth index (poorest, poorer, middle, richer and richest). The immunisation status (full, partial and no) was the outcome variable in this study. We used household assets to generate the wealth index using principal component analysis (PCA) due to the nonexistence of household income or consumption data in the NFHS-2 (India), DHS-2 (Bangladesh) and DHS-1 (Nepal).

Operational definitions
- *Full Immunisation*: Fully immunised children included those who had received one dose of BCG and measles, three doses of DPT (Diphtheria, Pertussis and Tetanus) and Polio (excluding Polio 0)[1].
- *Partial Immunisation*: A child who failed to receive at least one dose of the eight recommended vaccines[1].
- *No Immunisation*: The child failed to receive any dose of the eight recommended vaccines[1].

Statistical Analysis
Whole analyses were carried out utilising the SPSS software (20.0 version). We used the principal component analysis (PCA) to compute the wealth index. The descriptive statistics, bivariate analysis and multivariate logistic regression model were presented to give an overview of the level of immunisation coverage by socio-economic and demographic characteristics. The bivariate analysis was applied to investigate the crude association between the explanatory variables and outcome variable. Adjusted Odds Ratio was calculated to determine the impact of various independent variables on immunization coverage. We applied the sample weights to compensate for the unequal probability of selection between the strata that have been geographically defined and for the non-responses. A detailed description of the sampling weights is given in the DHS dataset.

Ethical clearance: Our study is based on secondary data (DHS). The data is available in the public domain and was taken from the Measure

DHS website (http://dhsprogram.com/). Therefore, ethical clearance is not required for this study.

Results

There were increasing trends found in immunisation coverage in the South Asian countries India, Bangladesh and Nepal (Figure 1). In India, the percentage of full immunisation coverage increased by 4.2 percentage points from 1998-99 to 2005-06. However, the performance of Bangladesh and Nepal in the child immunisation was far better than India. More than 85% of

children from Nepal and Bangladesh were fully immunised in 2006-07, whereas it was 43.6% in India. The percentage of non-immunised children was around 20.2 in the year 1996 and this figure came down to less than 3% during the 10-year period in Nepal.

The study found wide variation in child immunization coverage in terms of socioeconomic and demographic factors in the South Asian region (Tables 1, 2 and 3).
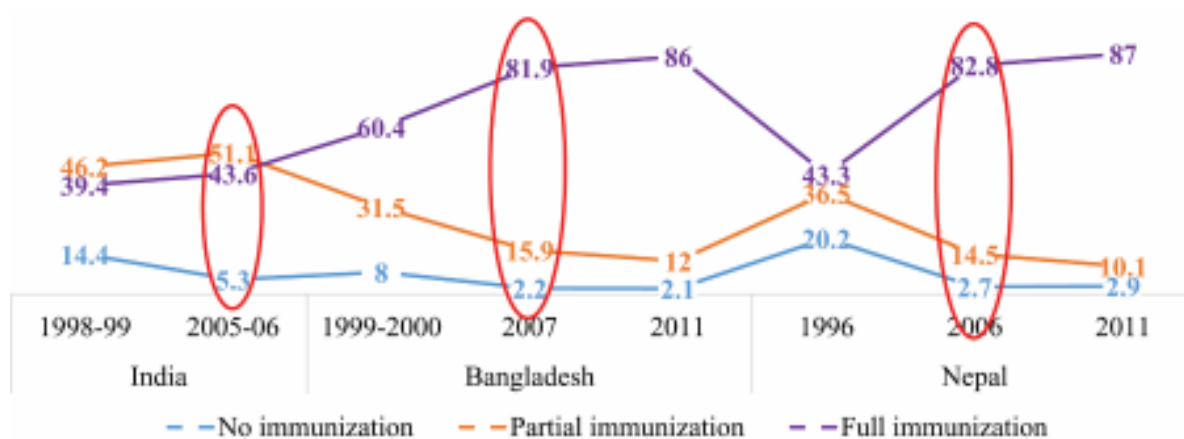

Figure 1: *Status of immunization coverage in children aged 12-23 months in India, Bangladesh and Nepal*

Table 1: *Socio-economic & demographic differentials of child immunization in India, 1998-99 & 2005-06*

Background characteristics	1998-99 (n=10,193)			2005-06 (n=10,419)		
	No	Partial	Full	No	Partial	Full
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Mother's age						
15-24 years	459 (8.7)	3004 (56.9)	1816 (34.4)	427 (8.1)	3158 (59.9)	1687 (32)
25-34 years	344 (8.0)	2208 (51.4)	1744 (40.6)	341 (7.5)	2468 (54.2)	1744 (38.3)
35+ years	73 (11.8)	373 (60.2)	173 (27.9)	65 (10.9)	375 (63.1)	154 (26.0)
Birth order						
1	398 (13.3)	1507 (50.3)	1091 (36.4)	196 (6.0)	1669 (51.0)	1407 (43.0)
2-3	786 (17.4)	2345 (51.9)	1387 (30.7)	343 (7.4)	2580 (55.7)	1709 (36.9)
4-5	443 (26.0)	929 (54.6)	330 (19.4)	173 (10.7)	(1047) 64.7	396 (24.5)
6+	359 (36.8)	493 (50.5)	124 (12.7)	117 (13.1)	648 (72.3)	131 (14.6)
Place of residence						
Urban	231 (10.0)	115 (149.9)	925 (40.1)	150(5.5)	1255 (46.1)	1321 (48.5)
Rural	1767 (22.4)	4125 (52.3)	1988 (25.2)	754(9.8)	4418 (57.4)	2532 (32.9)
Religion						
Muslim	445 (27.3)	830 (50.9)	356 (21.8)	209 (11.8)	1024 (57.8)	538 (30.4)
Hindu	1490 (18.5)	4228 (52.5)	2327 (28.9)	642 (7.9)	4413 (54.3)	3072 (37.8)
Other	64 (12.5)	217 (42.6)	228 (44.8)	49 (9.5)	228 (43.8)	243 (46.7)
Mother's education						
No education	1558 (28.3)	2950 (53.6)	1002 (18.2)	547 (11.0)	3364 (67.6)	1065 (21.4)
Primary	229 (15.0)	801 (52.4)	500 (32.7)	111 (7.8)	782 (55.0)	529 (37.2)
Secondary	190 (8.1)	1151 (49.1)	1003 (42.8)	154 (4.5)	1568 (45.7)	1709 (49.8)
Higher	33 (4.0)	378 (46.4)	404 (49.6)	9 (1.5)	203 (34.4)	272 (46.1)
Wealth index						
Poorest	542 (31.3)	970 (56)	220 (12.7)	351 (13.6)	1667 (64.6)	562 (21.8)
Poorer	542 (27.6)	1154 (53.9)	396 (18.5)	246 (10.6)	1420 (61.1)	658 (28.3)
Middle	455 (20.3)	1115 (49.7)	675 (30.1)	154 (7.6)	1086 (53.5)	791 (39.0)
Richer	261 (12.8)	1048 (51.4)	730 (35.8)	101 (5.5)	880 (47.8)	859 (46.7)
Richest	139 (6.8)	981 (48.1)	919 (45.1)	44 (2.7)	607 (36.9)	994 (60.4)

Table 2: *Socio-economic & demographic differentials of child immunization in Bangladesh, 1999-00, 2007 & 2011*

Background characteristic	1999-00 (n=1316)			2007 (n=1146)			2011 (n=1547)		
	No No. (%)	Partial No. (%)	Full No. (%)	No No. (%)	Partial No. (%)	Full No. (%)	No No. (%)	Partial No. (%)	Full No. (%)
Mother's age (years)									
15-24	94 (13.5)	270 (38.7)	333 (47.8)	32 (04.7)	196 (28.5)	459 (66.8)	53 (06.1)	217 (25.1)	597 (68.9)
25-34	70 (13.7)	175 (34.0)	268 (52.3)	19 (05.0)	93 (23.9)	277 (71.0)	30 (04.9)	112 (18.6)	462 (76.5)
35+	19 (18.0)	35 (32.8)	52 (49.2)	04 (05.5)	15 (22.0)	50 (72.5)	04 (05.6)	12 (15.6)	61 (78.8)
Birth order									
1	41 (10.7)	141 (37.0)	200 (52.3)	17 (13.9)	106 (24.9)	302 (71.2)	23 (04.2)	119 (21.3)	415 (74.5)
2-3	72 (12.5)	210 (36.3)	296 (51.2)	21 (04.2)	131 (26.5)	341 (69.3)	38 (05.2)	157 (21.6)	533 (73.3)
4-5	40 (16.9)	85 (35.9)	112 (47.1)	11 (06.7)	40 (25.1)	109 (68.2)	15 (08.2)	37 (20.1)	133 (71.7)
6+	29 (24.3)	40 (33.4)	50 (42.3)	07 (10.0)	21 (30.2)	41 (59.8)	09 (11.4)	21 (27.0)	48 (61.6)
Place of residence									
Urban	24 (10.6)	68 (30.4)	132 (59.0)	03 (01.1)	34 (12.4)	238 (86.5)	04 (01.1)	46 (12.3)	322 (86.7)
Rural	162 (14.8)	406 (37.2)	524 (48.0)	22 (02.5)	148 (17.0)	701 (80.5)	27 (02.3)	140 (11.9)	1009 (85.8)
Religion									
Muslim	170 (14.5)	426 (36.4)	575 (49.1)	25 (02.4)	167 (15.8)	862 (81.8)	28 (01.8)	178 (12.7)	1200 (85.6)
Hindu	48 (10.5)	47 (35.7)	71 (53.8)	0 (0.0)	16 (20.3)	64 (79.7)	08 (05.9)	08 0(5.8)	124 (89.2)
Other	01 (07.6)	02 (18.2)	10 (74.2)	0 (0.0)	01 (07.1)	11 (92.9)	0 (0.0)	0 (0.0)	06 (100.0)
Mother's education									
No education	107 (17.6)	235 (38.8)	264 (43.6)	18 (07.1)	76 (30.3)	158 (62.6)	28 (10.8)	61 (23.1)	174 (66.2)
Primary	48 (13.1)	129 (34.9)	192 (52.0)	18 (05.0)	91 (25.6)	247 (69.4)	26 (05.4)	108 (22.5)	346 (72.1)
Secondary	26 (09.1)	98 (33.7)	166 (57.2)	16 (03.4)	111 (23.6)	343 (73.0)	26 (03.8)	150 (21.5)	520 (74.7)
Higher	02 (04.6)	13 (25.0)	37 (70.4)	02 (03.4)	18 (26.0)	50 (73.2)	02 (02.0)	15 (13.5)	91 (84.4)
Wealth index									
Poorest	53 (19.1)	119 (43.0)	105 (37.9)	14 (05.7)	64 (26.6)	163 (67.7)	13 (04.0)	62 (19.2)	250 (76.8)
Poorer	37 (16.5)	81 (36.2)	106 (47.2)	12 (05.3)	67 (29.4)	150 (65.3)	11 (03.5)	38 (11.6)	276 (84.9)
Middle	37 (13.4)	99 (35.8)	140 (50.8)	12 (05.3)	59 (25.8)	158 (68.9)	02 (0.7)	38 (12.4)	269 (86.9)
Richer	33 (11.8)	103 (37.1)	141 (51.0)	10 (04.5)	52 (23.7)	156 (71.7)	06 (01.9)	29 (09.3)	275 (88.8)
Richest	24 (09.0)	77 (29.1)	163 (61.9)	08 (03.3)	54 (23.7)	167 (72.9)	0 (0.0)	18 (06.4)	261 (93.6)

Table 3: *Socio-economic and demographic differentials of child immunization in Nepal, 1996, 2006 & 2011*

Background Characteristics	1996 (N=1379)			2006 (N=984)			2011 (N=1000)		
	No No. (%)	Partial No. (%)	Full No. (%)	No No. (%)	Partial No. (%)	Full No. (%)	No No. (%)	Partial No. (%)	Full No. (%)
Mother's age (years)									
15-24	94 (16.1)	229 (39.2)	261 (44.7)	10 (02.0)	64 (12.8)	427 (85.2)	08 (01.6)	39 (7.8)	450 (90.5)
25-34	134 (22.1)	215 (35.4)	258 (42.5)	11 (02.8)	53 (13.7)	325 (83.5)	14 (03.4)	56 (13.6)	343 (83.1)
35+	51 (27.0)	59 (31.2)	79 (41.8)	11 (05.3)	25 (26.6)	64 (68.1)	07 (07.9)	06 (06.7)	77 (85.4)
Birth order									
1	56 (17.9)	104 (33.2)	153 (48.9)	06 (01.9)	26 (8.1)	289 (90.1)	03 (0.9)	28 (8.0)	317 (91.1)
2-3	73 (13.7)	214 (40.2)	245 (46.1)	07 (01.8)	57 (14.5)	330 (83.7)	14 (03.0)	40 (8.5)	415 (88.5)
4-5	76 (25.3)	105 (35.0)	119 (39.7)	09 (04.8)	40 (21.3)	139 (73.9)	02 (01.8)	13 (11.9)	94 (86.2)
6+	74 (31.6)	80 (34.2)	80 (34.2)	04 0(4.9)	20 (24.7)	57 (70.4)	11 (14.9)	19 (25.7)	44 (59.5)
Place of residence									
Urban	10 (11.8)	15 (17.6)	59 (70.6)	04 (03.3)	13 (10.7)	104 (86.1)	0 (0.0)	10 (10.3)	87 (89.7)
Rural	270 (20.8)	489 (37.7)	538 (41.5)	22 (02.5)	130 (15.1)	711 (82.4)	29 (03.2)	91 (10.1)	783 (86.7)
Religion									
Muslim	28 (35.9)	38 (48.7)	12 (15.4)	01 (02.2)	09 (19.6)	37 (78.3)	12 (13.6)	25 (28.4)	52 (58.0)
Hindu	216 (18.5)	436 (37.3)	516 (44.2)	17 (02.1)	118 (14.3)	692 (83.7)	13 (01.6)	70 (08.8)	709 (89.5)
Other	34 (25.8)	29 (22.0)	69 (52.3)	08 (07.2)	15 (13.5)	87 (79.3)	04 (03.4)	06 (05.0)	109 (91.6)
Mother's education									
No education	264 (23.8)	422 (38.0)	423 (38.1)	33 (05.9)	157 (28.4)	363 (65.7)	43 (09.4)	93 (20.6)	316 (70)
Primary	13 (09.2)	49 (34.8)	79 (56.0)	06 (03.0)	49 (26.6)	131 (70.4)	08 (03.9)	40 (19.8)	153 (76.4)
Secondary	01 (0.9)	30 (26.1)	84 (73.0)	04 (01.8)	46 (21.4)	166 (76.8)	06 (02.2)	64 (22.1)	220 (75.7)
Higher	0 (0.0)	0 (0.0)	0 (0.0)	01 (03.1)	05 (18.8)	23 (78.1)	01 (01.4)	16 (27.5)	41 (71.1)
Wealth index									
Poorest	133 (30.1)	208 (47.2)	100 (22.7)	15 (05.9)	66 (26.0)	173 (68.1)	13 (05.2)	26 (10.5)	208 (84.3)
Poorer	23 (23.7)	54 (54.3)	22 (22.0)	04 (02.0)	31 (15.6)	164 (82.4)	04 (01.8)	32 (14.2)	191 (84.1)
Middle	97 (29.0)	138 (41.1)	100 (29.9)	01 (0.5)	26 (12.7)	178 (86.8)	12 (05.6)	22 (10.2)	183 (84.3)
Richer	54 (23.7)	100 (43.7)	74 (32.6)	02 (01.2)	14 (08.3)	153 (90.5)	0 (0.0)	15 (08.2)	168 (91.8)
Richest	41 (14.8)	115 (41.7)	119 (43.4)	05 (03.2)	06 (03.8)	146 (93.0)	0 (0.0)	05 (04.0)	121 (96.0)

Results showed that in the South Asian countries India, Bangladesh and Nepal, the percentage of non-immunised children was lower among older women. A greater percentage of women in the younger age group in Nepal (90.5%, 2011), in the middle age group in India (38.3%, 2005-06) and in the higher age group in Bangladesh (78.8%, 2011) fully immunised their children. There is an inverse relationship between full immunization coverage and increasing birth order of children. The full

immunization coverage among first-born children was 43% in India (2005-06), 74% in Bangladesh (2011) and 91% in Nepal (2011). The full immunization coverage among children residing in urban areas of India was 15% more than in children residing in rural areas of India in 1998-99 and 2005-06. However, there were no differences between the place of residence and full immunization coverage in Bangladesh and Nepal. The utilization of immunization coverage was very

high among Hindu children compared to Muslim children in Nepal (89.5% vs 58% in 2011) and slightly high among Hindu children compared to Muslim children in India (37.8% vs 30.4% in 2005-06). However, the utilization of immunisation coverage did not vary among Hindu and Muslim children in Bangladesh. The immunisation coverage largely varied according to the mother's education attainment and wealth index. Child immunisation rates were higher in families with better-educated and richer mothers. In 2011, more than 70% of children from higher educated families were fully immunised in Nepal and Bangladesh, but this percentage was 46% in India in 2005-06. Almost 95% of children of wealthier mothers were fully immunised in Bangladesh and Nepal in 2011.

Determinants of child immunization
Result revealed that factors such as mother's age, residence, birth order and religion had minimal impact on complete immunisation coverage in India, Bangladesh and Nepal in all the periods studied (Table 4). However, mother's education and wealth index were significantly associated with the complete immunization coverage. Children belonging to higher educated and richer families were more likely to be fully immunised. Maximum impact of education (AOR=9.833; p<0.01) and wealth index (AOR=8.105; p<0.01) were observed in 2006 and 2011 respectively in Nepal.

Table 4: Odds Ratio (OR) showing factors influencing the utilization of skilled birth attendant in South Asian Region

Background characteristics	India		Bangladesh			Nepal		
	1998-99	2005-06	1999-00	2007	2011	1996	2006	2011
Mother's age (years)								
15-24®								
25-34	1.419***	1.309***	1.35**	1.154*	1.448***	1.408**	1.568***	1.132
35+	1.822***	1.687***	1.315*	1.480***	2.250***	2.779***	1.941***	1.355**
Birth order								
1®								
2-3	0.463***	0.504***	0.679***	0.648***	0.527***	0.450***	0.353***	0.484***
4-5	0.306***	0.310***	0.560***	0.466***	0.331***	0.280***	0.235***	0.327***
6+	0.226***	0.201***	0.425***	0.317***	0.162***	0.195***	0.254***	0.228***
Place of residence								
Urban®								
Rural	0.398***	0.554***	0.468***	0.586***	0.506***	0.212***	0.693***	0.530***
Religion								
Islam®								
Hindu	1.081**	1.220***	1.521***	1.313**	1.798***	0.575*	0.941	1.054
Other	1.100*	0.765***	3.210***	2.216**	1.068	0.396***	1.035	0.737
Mother's education								
No education®								
Primary	1.737***	1.555***	1.008*	1.192*	1.391***	2.038***	1.430***	1.482***
Secondary	2.800***	2.569***	1.597***	2.039***	2.226***	3.303***	2.793***	1.244**
Higher	5.976***	8.501***	4.411***	4.154***	6.041***	8.680***	9.833***	1.272
Wealth index								
Poorest®								
Poorer	1.362***	1.433***	0.961	1.006	1.012	1.588	2.178***	1.929***
Middle	1.874***	2.264***	1.235*	1.000	1.360***	1.543**	2.178***	2.771***
Richer	2.705***	3.530***	1.176	1.598***	1.916***	1.188	3.172***	3.830***
Richest	4.659***	6.948***	2.429***	2.848***	3.195***	3.967***	6.383***	8.105***

*P values-*** Significant at 1 percent; ** Significant at 5 percent; * Significant at 10 percent. (R)=Reference Category.*

Discussion
The fact that substantial reductions in child mortality are associated with increases in vaccination coverage is well established[10,11]. Immunisation has been considered to be the most important public health intervention to prevent the child morbidity and mortality[12]. Hence, there is a need to understand the factors associated with immunisation coverage. An attempt was made to assess the status of immunisation and its confounding factors in the South Asian region which has the leading child mortality rate in the world as well as being one of the poorest regions concerning childhood immunisation coverage in the world[6,7,13].

Our study revealed that the coverage of vaccination in India, Bangladesh and Nepal is far from complete despite the commitment for universal coverage in the Millennium Development Goals (MDG-4). Only 43.6%, (2005-06), 81.9% (2011) and 87% (2011) children were fully immunised in India, Bangladesh and Nepal respectively in our study. Previous studies also reported similar observations of poor immunisation coverage in the selected region[13,14]. The present study revealed that Indian children had low immunisation coverage as compared to other two selected countries[7,8]. We found that around 80% of children from Nepal and Bangladesh (2006-07) were fully immunised compared to 43.6% in India (2005-06).

Results of the study indicate a huge variation in the coverage of immunisation among different socio-economic groups. A higher percentage of immunisation coverage was found among children

belonging to better economic and educated group, urban resident, low birth order and mothers with advanced age groups (25-34 years) compared to their counterparts[15-17]. There were also differences owing to religious affiliation. We observed that the coverage of full immunisation among children born in Muslim religion was lower as has been found by other studies[18,19]. This finding is comparable with a study done in Bangladesh, which reported that children from Muslim religion were more fully immunised compared to other religious groups[20].

An attempt was made not only to access the levels and trends in child immunisation coverage in the South Asian region but also to examine its associated factors. We calculated the adjusted odds ratio to identify the independent predictors. The multivariate logistic regression highlighted that education of mothers and economic status of the family were the most important confounding factors affecting the immunisation coverage in the South Asian region[21,22].

Results confirmed that the children who belonged to higher educated and wealthier families were more likely to be fully immunised than the economically and educationally backward groups. There was enough evidence to show that the immunisation coverage substantially varied with the economic and educational status of the household[16,17,18]. We observed that mother's age, place of residence, birth order and religion appeared to have minimal impact on child immunisation coverage in the study[23].

The likelihood of immunisation was different for different birth orders, which were statistically significant. The likelihood of vaccination decreased with increased birth order. Children were more likely to be immunised with a low number of birth order and this could be due to more children constraining resources and negatively affecting health care utilization[23]. In this study, religion did not show significant association with the completion of immunisation among children aged between 12-23 months in Nepal (2006 to 2011). This finding is consistent with previous studies[15].

The reasons for the poor immunization coverage in the South Asian region have been discussed in several studies. Some of them revealed that lack of knowledge concerning the vaccine preventable diseases, the purpose of immunization, the age at which the child starts and finishes immunization were associated with the lower immunization coverage in this region[18,19]. Some studies considered children delivered at health facilities and mother's utilization of antenatal care were the main reasons for low accessing of child immunization[17,24]. Besides its relation with

institutional delivery as well as mother's utilization of antenatal care, complete immunization coverage of children, showed statistically significant association with exposure to mass media[16,17,25].

There are a few limitations of the study. The results of the study are based on cross sectional data from different countries and hence there can be no proper comparisons of child immunization status between countries. The years of data also differ among the countries hindering comparisons. The data on childhood immunization were obtained from the vaccination card and mother's reporting. The quality of data acquired from the mother's report on immunisation status of their children may not as reliable as that of vaccination card due to recall bias resulting from either overestimation or underestimation. This study failed to incorporate the potential factors like vaccine management system and service delivery related factors that could determine the full immunisation coverage due to data constraints. In spite of this limitations, the study made an effort to access the predictors for full immunization coverage in the leading child mortality region due to vaccine preventable diseases using the best data sources of population based information in low-and middle-income countries

Conclusions

More than 85% of children from Nepal and Bangladesh were fully immunised in contrast to 43.6% from India. Mother's education and wealth index appeared to have a significant impact on full immunization coverage.

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