Factors Affecting Vaccination Coverage and Retention of Vaccination Cards in Nepal

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Factors Affecting Vaccination Coverage and Retention of Vaccination Cards in Nepal

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and Population**

This study is a further analysis of the 2016 Nepal Demographic and Health Survey (2016 NDHS). The 2016 NDHS was implemented by New ERA under the aegis of the Ministry of Health and Population of Nepal. Funding for the survey was provided by USAID. ICF provided technical assistance through The DHS Program, a USAID-funded project providing support and technical assistance in the implementation of population and health surveys in countries worldwide.

Additional information about the 2016 NDHS may be obtained from the Ministry of Health and Population, Ramshahpath, Kathmandu; telephone: +977-1-4262543/4262802; internet: http://www.mohp.gov.np; and New ERA, Rudramati Marg, Kathmandu, P.O. Box 722, Kathmandu 44600, Nepal; telephone: +977-1-4413603; email: info@newera.com.np; internet: http://www.newera.com.np.

The DHS Program assists countries worldwide in the collection and use of data to monitor and evaluate population, health, and nutrition programs. Additional information about The DHS Program can be obtained from ICF, 530 Gaither Road, Suite 500, Rockville, MD 20850 USA; telephone: +1 301-407-6500, fax: +1 301-407-6501, email: info@DHSprogram.com, internet: www.DHSprogram.com.

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FOREWORD

The 2016 Nepal Demographic and Health Survey (NDHS) is the fifth nationally representative comprehensive survey conducted as part of the worldwide Demographic and Health Surveys (DHS) Program in the country. The survey was implemented by New ERA under the aegis of the Ministry of Health and Population (MoHP). Technical support for this survey was provided by ICF with financial support from the United States Agency for International Development (USAID) through its mission in Nepal and support for report production from the United Nations Population Fund (UNFPA).

The standard format of the survey final report included only a descriptive presentation of findings and trends, and did not include analytical methods that can ascertain the significance of change and association among variables. Although largely sufficient, the final report is limited, particularly in providing answers to "why" questions – answers that are essential in reshaping important policies and programs. After the dissemination of the NDHS 2016, the MoHP and its partners convened and agreed on key areas that are necessary for assessing progress, gaps, and determinants in high-priority public health programs being implemented by the MoHP. In this context, seven further analysis studies have been conducted by technical professionals from the MoHP and its partners who work directly on the given areas, with technical support and facilitation from research agencies.

The primary objective of the further analysis of the 2016 NDHS is to provide more in-depth knowledge and insights into key issues that emerged from the survey. This information provides guidance for planning, implementing, refocusing, monitoring, and evaluating health programs in Nepal. The long-term objective of the further analysis is to strengthen the technical capacity of local institutions and individuals for analyzing and using data from complex national population and health surveys to better understand specific issues related to country need.

The further analysis of the 2016 NDHS is the concerted effort of many individuals and institutions, and it is with great pleasure that I acknowledge the work involved in producing this useful document. The participation and cooperation of the members of the Technical Advisory Committee in the different phases of the survey are highly valued. I would like to extend my appreciation to USAID/Nepal for providing financial support for the further analyses. I would also like to acknowledge ICF for its technical assistance at all stages. My sincere thanks also go to the New ERA team for the overall management and coordination of the entire process. I would also like to thank the Public Health Administration Monitoring and Evaluation Division, as well as the Policy Planning and Monitoring Division, MoHP, for their efforts and dedication to the completion of this further analysis of the 2016 NDHS.

Dr. Pushpa Chaudhary
Secretary
Ministry of Health and Population

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ABSTRACT

This study assesses the factors associated with vaccination coverage and retention of a vaccination card among children age 12-23 months, using data from the 2016 Nepal Demographic and Health Survey.

This study reveals that children born in health facilities have higher odds of vaccination coverage compared to children born elsewhere. Children who have a vaccination card are more likely to have high vaccination coverage compared to those who have never received a vaccination card.

Children living in rural areas have higher odds of having a vaccination card than children in urban areas. Similarly, children living in the Hill region are more likely to have retained their vaccination card than those in the Mountain region. Children of women and men with any education are more likely to have retained their vaccination card compared with children of parents with no education.

There was a significant decrease in completed vaccinations of children between 2011 and 2016. The cause is a decline in the percentage of children who received their third dose of DPT. Children whose mothers were age 35 and older had higher odds of receiving all DPT vaccinations compared to children whose mother's age was less than 20 years. Other characteristics such as having a mother who worked in the previous 12 months, having a mother who delivered her last baby in a health facility, and having a mother who retained a vaccination card are positively associated with the child receiving all DPT vaccines.

KEY WORDS: vaccination, retention of vaccination card, children age 12-23 months, Nepal

ACRONYMS AND ABBREVIATIONS

ANC	antenatal care
aOR	adjusted odds ratio
BCG	Bacille Calmette-Guérin vaccine against tuberculosis
CHC	child health card
CI	confidence interval
CMYP	comprehensive multiyear plan
DHS	Demographic and Health Survey
DoHS	Department of Health Services
DPT	diphtheria, pertussis, and tetanus vaccine
EA	enumeration area
FCHV	female community health volunteer
FY	fiscal year
GVAP	global vaccine action plan
Hep B	hepatitis B
Hib	*Haemophilus influenzae* type B
HMIS	Health Management Information System
IPV	inactivated polio vaccine
MCH	maternal and child health
MoH	Ministry of Health
MoHP	Ministry of Health and Population
MoV	Missed Opportunity of Vaccination
MR	measles and rubella
NDHS	Nepal Demographic and Health Survey
NHSS	Nepal health sector strategy
NHSS-IP	Nepal health sector strategy implementation plan
NIP	national immunization programme
OPV	oral polio vaccine
OR	odds ratio
PCV	pneumococcal conjugate vaccine
PNC	postnatal care
PSU	primary sampling unit
SDG	sustainable development goal
SLC	school-leaving certificate
U5MR	under-5 mortality rate
UHC	universal health coverage

USAID   United States Agency for International Development

VDCs   village development committees

WHO   World Health Organization

1   INTRODUCTION

Countries with national immunization programs have included the standard World Health Organization (WHO) recommended vaccines to prevent major causes of childhood illness and deaths. With continued development of new and improved vaccines, immunization is more effective and improves lives. Immunization is one of the most cost-effective interventions; it enabled the eradication of smallpox, and it lowered the incidence of polio by 99% and neonatal tetanus by 94% (WHO 2016). Benefits of vaccinations extend beyond prevention to broader social and economic development (Feikin et al.). The risk of mortality is reduced among children with complete immunization compared to children with no vaccinations (McGovern and Canning 2015). Countries that have committed to improving child health and well-being by 2030 and to assessing overall progress towards the Sustainable Development Goals (SDGs) are required to reduce vaccine-preventable illness and deaths, which profoundly rely on immunization (UNESCO 2016; UNICEF 2015).

The National Immunization Programme (NIP) of Nepal initially introduced two vaccines – BCG (Bacille Calmette-Guérin) and DPT (diphtheria, tetanus, pertussis) in 1979 in three districts and in all districts by 1989 (Vandelaer, Partridge, and Suvedi 2009). By 2009, all eight recommended vaccines were included in the immunization schedule. New vaccines, such as pneumococcal conjugate vaccine (PCV) and inactivated polio virus (IPV), were introduced in phases during 2015 (MoH, New ERA, and ICF 2017). In Nepal, the under-5 mortality rate (U5MR) has declined from 118 deaths per 1,000 live births in 1996 to 39 deaths in 2016 (a 4% annual rate of reduction), while continued reductions are targeted (Figure 1). Nepal has made substantial progress in child survival since 1990, when 94,000 children died before reaching their fifth birthday. This number declined to 34,000 in 2011, which was a reduction of 60% in 20 years (UNICEF 2017).

Figure 1   Trends and targets in the under-5 mortality rate
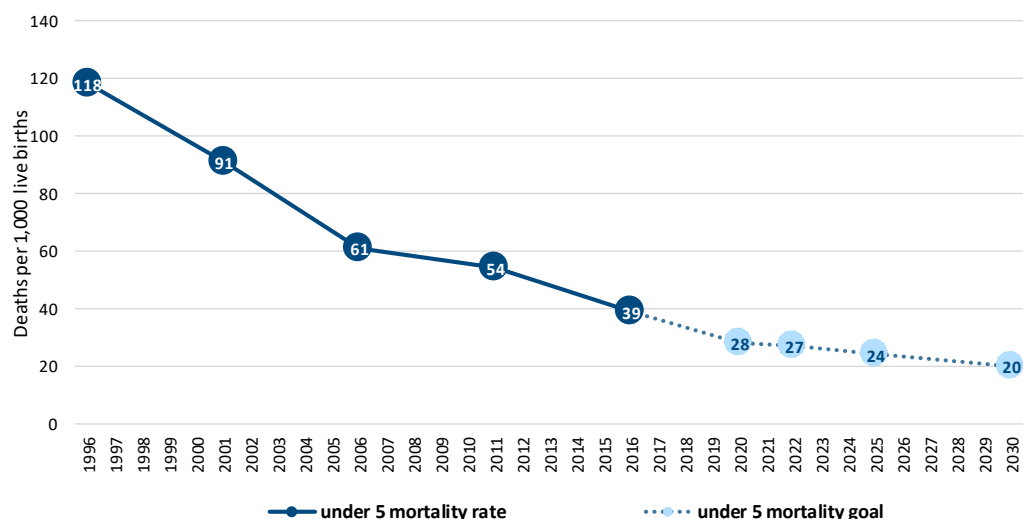
The Global Vaccine Action Plan (2011-2020) is a global mission to improve health by extending the full benefits of immunization to all people, regardless of where they are born, who they are, or where they live. Achieving success with this mission requires that every eligible individual be immunized with all appropriate vaccines – irrespective of geographic location, age, gender, disability, educational level, socioeconomic level, ethnic group, or work condition (WHO 2013). Nepal is committed to improving the health status of all people, regardless of their sex, caste, ethnicity, or socioeconomic status, and is

committed to accelerating universal health coverage that will ensure equitable access to quality health services for the population (MoH 2016).

In 2012, the Government of Nepal declared village development committees (VDC), municipalities, and districts as fully immunized with the aim of searching for and vaccinating never-reached and dropout children, and lessening within-country inequalities (DoHS 2015/2016). The Nepal Health Sector Strategy has identified fully immunized children as an outcome indicator for assessing the equitable utilization of health services. In 2014, the equity gap amongst the wealthiest children and the poorest children who were fully immunized was 10 percentage points. Likewise, the equity gap among mountain residents compared to inhabitants of the Terai was 4 points during the same period. The country needs to recognize and mitigate the barriers that prevent underserved populations, urban poor, and ethnic minorities from accessing services in order to reach the 2020 target of achieving 90% of children being fully immunized (MoH 2016).

The Department of Health Services (DoHS), in the 2016/2017 annual report from the Health Management Information System (HMIS), analyzed 3 years (FY 2014/15, FY 2015/16 and FY 2016/17) of data on immunization coverage for all antigens. The coverage for all vaccines had increased in FY 2016/17 as compared to earlier years, except for the inactivated polio vaccine, for which there was a global shortage. A total of 54 districts had good accessibility to and utilization of immunization services, with more than 80% children having sufficient immunization service delivery points at which they could utilize the immunization services. The same year, 52,150 children remained unimmunized with third dose of DPT3, which represented a 58% reduction compared to the previous year (DoHS 2016/2017). The Nepal Demographic and Health Survey (NDHS) 2011 reported that 3% of children did not receive any vaccine (MoH 2012). This was reduced to 1% in the NDHS 2016 (MoH 2017). Both national surveys and official reports revealed progress in reaching the target for vaccination of children.

Various immunization strategies have been implemented globally and in Nepal, with the goal of reaching every child. The concepts of "reaching every district" and, more recently, "periodic intensification of routine immunization," were initiated to expand immunization services and to reach the unreached. The "reaching every district" strategic approach, re-formed as "reaching every community," attempted to include every eligible individual, even those beyond government outreach services and geographically defined communities, in order to achieve equitable coverage (WHO 2013). Nepal adopted these strategies to expand services in all districts, including periodic intensification of immunization outreach that could reach the unreached. In addition, Nepal introduced a unique initiative of declaring villages, municipalities, and districts fully immunized – with all the children within the demarcation immunized with all vaccines. The National Immunization Schedule for the vaccines undertaken in this analysis is given below in Table 1.

Table 1   **National Immunization Schedule for study vaccines**

Type of Vaccine	Vaccine Prevents Against	Number of doses	Recommended Age
BCG	Tuberculosis	1	At birth or on first contact with health institution
DPT-HepB-Hib (Pentavalent)	Diphtheria, Pertussis, Tetanus, Hepatitis-B and *Haemophilus Influenzae* serotype b infection	3	6, 10, and 14 weeks
Oral Polio Vaccine (OPV)	Polio	3	6, 10, and 14 weeks
Measles-Rubella (MR)	Measles and Rubella	2	9 and 15 months

1.1   2015 Earthquake and Impact on Health Services

An earthquake of 7.6 magnitude occurred on April 25, 2015, with the epicenter at Barpak in the Gorkha district. The earthquake triggered multiple aftershocks that resulted in 9,000 deaths, more than 23,000 injured, and the displacement of about two million people (Adhikari, Mishra, and Raut 2016). Almost one-third of the population of Nepal, or 8 million people, were affected by the event. Thirty-one districts (out of 75 districts) were affected; 14 were declared as crisis-hit in need of extensive rescue and relief operations, and the remaining 17 neighboring districts were partially affected (National Planning Commission 2015).

The health sector was affected severely by the 2015 earthquake, which caused losses in the health infrastructure and disruption of health-care service delivery. A total of 1,000 health facilities were either destroyed or damaged (Adhikari, Mishra, and Raut 2016). Nearly 84% (375/446) of the completely damaged health facilities were located in the 14 most-affected districts. As a result, the ability of health facilities to respond to health-care needs was diminished and service delivery was disorganized. Vulnerable populations, including the affected population from remote areas, were deprived of health services (National Planning Commission 2015). Sociodemographic impact studies showed that there was a 58% decline in children receiving vaccinations after the earthquake in the 14 severely crisis-hit districts (Mahato et al. 2015; National Planning Commission 2015; Sharma 2015).

1.2   Caste and Ethnicity

Nepal is a multi-ethnic country with diverse languages, religions, and cultural traditions with more than 100 ethnic or caste groups that have distinct languages and cultures. The 1991 and 2001 census showed that nearly 70% of the total population belongs to 10 major groups. The communities with Hill Brahmin, Chhetri, and Thakuri account for 30% of the total population. Most of the Hill and Mountain districts are relatively homogenous when compared to the Terai districts of Nepal (Dahal 2003).

Based on the 2011 census, the population monograph of Nepal 2014 identified 125 ethnicity groups, which were further categorized into 13 broader, more culturally homogeneous groups, and 2 additional groups entitled "other undefined" and "foreigner." Of the total 125 ethnic groups identified by the 2011 census, 38 groups have populations greater than 100,000, while only 9 groups have more than 1 million. Among the remaining 87 groups, 43 groups have populations between 10,000 and 100,000, and 44 have fewer than 10,000 (CBS 2014).

Table 2   Caste and ethnic groups with regional divisions, Nepal 2001 Census

Main Ethnic Groups		Ethnic Groups with Regional Divisions (11) and Social Groups (103), 2001 Census	
Caste Groups	**1. Brahmin/Chhetri**	1.1	**Hill Brahmin** Hill Brahmin
		1.2	**Hill Chhetri** Chhetri, Thakuri, Sanyasi
		1.3	**Terai/Madhesi Brahmin/Chhetri** Madhesi Brahmin, Nurang, Rajput, Kayastha
	2. Terai/Madhesi other	2.	**Terai/Madhesi other** Kewat, Mallah, Lohar, Nuniya, Kahar, Lodha, Rajbhar, Bing, Mali Kamar, Dhuniya, Yadav, Teli, Koiri, Kurmi, Sonar, Baniya, Kalwar, Thakur/Hazam, Kanu, Sudhi, Kumhar, Haluwai, Badhai, Barai, Bhediyar/Gaderi
	3. Dalits	3.1	**Hill Dalit** Kami, Damai/Dholi, Sarki, Badi, Gaine, Unidentified Dalits
		3.2	**Terai/Madhesi Dalit** Chamar/Harijan, Musahar, Dushad/Paswan, Tatma, Khatwe, Dhobi, Baantar, Chidimar, Dom, Halkhor
Adivasi/Janajatis	**4. Newar**	4.	**Newar** Newar
	5. Janajati	5.1	**Hill/Mountain Janajati** Tamang, Kumai, Sunuwar, Majhi, Danuwar, Thami/Thangmi, Darai, Bhote, Baramu/Bramhu, Pahari, Kusunda, Raji, Raute, Chepang,/Praja, Hayu, Magar, Chyantal, Rai, Sherpa, Bhujel/Gharti, Yakha, Thakali, Limbu, Lepcha, Byansi, Jirel, Hyalmo, Walung, Gurung, Dura
		5.2	**Terai Janajati** Tharu, Jhangad, Dhanuk, Rajbanshi, Gangai, Santhal/Satar, Dhimal, Tajpuriya, Meche, Koche, Kisan, Munda, Kusbadiya/Patharkata, Unidentified Adibasi/Janajati
Other	**6. Muslim**	6.	**Muslim** Madhesi Muslim, Churoute (Hill Muslim)
	7. Other	7.	**Other** Marwari, Bangali, Jain, Punjabi/Sikh, Unidentified Others

Source: Bennett, L., Dahal, D.R., and Govindasamy, P. (2008).

1.3   Vaccination Card

The Ministry of Health and Population (MoHP) incorporated child health cards (CHCs) as an integral part of Nepal's health system. The CHCs record growth, Vitamin A supplementation, deworming and other illnesses, and immunization details. The card, which is issued to a child during the first visit to a health facility, serves as a reference for caregivers at home and health workers during consultations. The CHCs provide a record for the caregiver, a method for providing continuous care by health-care workers, a source of individual patient data for national surveys, and a means for avoiding unnecessary revaccination and minimizing missed vaccinations (Kitenge and Govender 2013).

The CHCs are revised periodically, as required by the program, and are managed by the Department of Health Services (DoHS), and more specifically, the Health Management Information System (HMIS)/Management Division in consultation with the Child Health Division. The Nepal Ministry of Health and Population revised the CHC in 2006 (Bhandari, Adhikari, and Khanal 2013). The CHCs were most recently modified in 2015 to accommodate the return date for next vaccination.

Although the CHC has become an integral part of the health system in Nepal, there are operational challenges such as poor visibility of stock levels, stock management, and the use of multiple versions of the CHC in the field due to frequent revisions. The term *vaccination card* is used throughout the report to maintain consistency and to be in line with the 2016 NDHS final report.

1.4   Rationale of the Study

Nepal has the vision of attaining universal health coverage with improved health status of all people through an accountable and equitable health service delivery system by 2020 (MoH 2016). The National

Immunization Programme aims to provide every child and every mother with equitable access to high-quality, safe, affordable vaccines and immunization services (WHO 2017b). Reaching underserved populations is especially challenging, but inequities must be resolved because these populations often carry a heavier disease burden, may lack access to medical care and basic services, and are disproportionally affected economically by disease and illness (WHO 2013).

1.5 Analytical Framework of the Study

This study provides an analysis of the variables potentially associated with vaccination coverage and the retention of a vaccination card among children age 12-23 months. The following analytical framework was constructed and used for analysis, based on a literature review and discussions with the Child Health Division, the Department of Health Services, and the MoHP. Variables were organized by geographic characteristics, sociodemographic factors, maternal and child health care (MCH) utilization statistics, and retention of vaccination card data; all variables are put into the models simultaneously.

Table 3   Analytical framework for potential associated variables affecting vaccination coverage and retention of vaccination card

Variables potentially associated with vaccination coverage and retention of vaccination card	
Geographic characteristics	Place of residence Provinces Ecological zones Earthquake-affected districts
Sociodemographic characteristics	Sex of child Age of mother Mother's education Father's education Caste/ethnicity Household wealth quintile[1] Household size Birth order Mother worked in the last 12 months Media exposure of mother
Maternal and child health-care utilization	ANC visit Place of delivery Postnatal care

The objective of this study is to examine the factors associated with vaccination coverage and retention of vaccination cards in Nepal. Specifically:

- To identify the determinants that affect vaccination coverage.

- To identify the determinants that affect the retention of a vaccination card.

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[1] For information regarding household wealth quintile construction in Demographic and Health Surveys, please visit https://www.dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm.

2   METHODS

This analysis used data sets from the NDHS, 2011 and 2016. The 2016 NDHS is the fifth nationally representative population-based survey of Nepal that provided current estimates of basic demographic and health indicators, which include fertility levels, marriage, fertility preferences, awareness and use of family planning methods, child feeding practices, nutrition, adult and childhood mortality, awareness and attitudes about HIV/AIDS, women's empowerment, and domestic violence. The target groups were women and men age 15-49 who reside in randomly selected households across the country. Women provided detailed information about their children under age 5. In addition to national estimates, the report provides estimates of key indicators for urban and rural areas, and the seven provinces. The survey report with general findings has already been published (MoH, New ERA, and ICF 2017). This report presents further analysis of data on the vaccination of children age 12-23 months in the NDHS 2016.

DHS surveys in Nepal were reviewed and approved by the Institutional Review Board Health Research Council, Nepal; data were publicly available and did not include individual identities, and thus did not require ethics approval.

The 2016 NDHS sample was stratified and selected in two stages in rural areas and three stages in urban areas. In the rural areas, wards were the primary sampling units (PSUs), with households selected from the sample PSUs. In urban areas, wards were the PSUs, with one enumeration area (EA) selected from each PSU, and then households selected from the sample EAs.

Each province was stratified into urban and rural areas, which yielded 14 sampling strata. Samples of wards were selected independently in each stratum. Implicit stratification and proportional allocation were achieved at each of the lower administrative levels by sorting the sampling frame within each sampling stratum before the sample selection, according to administrative units at different levels, and by using a probability proportional to size selection during the first stage of sampling. The NDHS final report provides more detail on the sampling and methodology used in this survey (MoH, New ERA, and ICF 2017).

2.1   Data Collected in the NDHS

The 2016 NDHS used five types of questionnaires, based on The DHS Program's standard Demographic and Health Survey (DHS-7) questionnaires, which were adapted to reflect the population and health issues in Nepal. This analysis utilizes information collected with three questionnaires: the Household Questionnaire, Women's Questionnaire, and Men's Questionnaire. Overall, the survey provides disaggregated data from various domains such as ecological region, provinces, and urban and rural areas. Since the 2016 NDHS was the fifth national survey of its kind, there was considerable information available for trend analysis.

The source of information on vaccination coverage comes from the vaccination card shown by mothers to enumerators and the mother's recall of the vaccinations. When the child's health card was available, the date of administration was collected directly from the vaccination card, which contained the dates of all routine vaccinations. If no card was available, the interviewer asked the mother to recall all vaccinations received by her child and, when appropriate, the number of doses received.

2.2 Data Analysis

The 2016 NDHS collected information on vaccination coverage for all living children born in the five years before the survey. Mothers of 4,861 children age 0-59 months were interviewed. The 1,034 children who were age 12-23 months were the unit of analysis because they are youngest children who have reached the age by which they should be fully immunized. A limitation of this study is that the analysis included only children whose mothers were alive and in Nepal for interviews. Antenatal care (ANC) and postnatal care (PNC) are shown only in the descriptive and bivariate analyses because these questions are only asked of the most recent birth, and some children included in the immunization analysis are the second or third most recent birth.

We used the children's recode dataset for those children age 12-23 months. Weighted data have been utilized throughout the analysis.

2.2.1 Constructions of Variables

To examine the factors associated with vaccination coverage and retention of the vaccination card, this study generated two outcome variables: 1) receipt of all vaccinations, and 2) retention of the vaccination card.

In the analysis, children are considered fully immunized (vaccination coverage) when they have received one dose of the vaccine against tuberculosis (BCG), three doses each of the pentavalent (DPT-Hib, Hep-B) and oral polio vaccines, and a first dose of Measles-Rubella (MR) vaccine. For the eight vaccine doses, we recoded the responses to reflect "vaccinated" or "not vaccinated" for each dose and then combined them to reflect "completely vaccinated."

Another outcome variable – the "retention of vaccination card" – is taken from the children's dataset and the variable "has health card or other vaccination document." Responses were recoded as "vaccination card seen" vs. "vaccination card not seen." Vaccination card seen included "has only health card and was seen, has only other document and was seen, has card and other document but only card was seen, and has card/other document and both were seen."

The variables of interest were based on a literature review and the variables available in the dataset. Twenty-one variables were selected for analysis of possible associations with coverage of vaccination, and 20 were identified for the retention of the vaccination card. These predictors included 1) place of residence (urban or rural), 2) province, 3) ecological region, 4) earthquake-affected districts (highly affected, moderately affected, and not affected), 5) sex of child, 6) age of mother, 7) mother's education, 8) father's education, 9) caste/ethnicity, 10) household wealth quintile, 11) household size, 12) mother worked in previous 12 months, 13) decision making of mother, 14) spousal violence, 13) media exposure of mother, 14) birth order, 15) all four ANC visits, 16) place of delivery, 17) postnatal visits (within 2 months), and 18) retention of a vaccination card. All these selected variables were categorized as background, sociodemographic, or maternal and child health care utilization characteristics (Figure 2). The household wealth quintile is based on a composite measure (index) of a household's cumulative living standard. The index is calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles, materials used for housing construction, and types of water access and sanitation facilities (Rutstein and Johnson 2004).

2.2.2 Methods of Data Analysis

Data analysis was conducted with STATA 15.0 software. Frequencies and percentages were calculated for characteristics of children age 12-23 months. Bivariate analysis determined the proportion of different categories with respect to vaccination coverage and retention of a vaccination card. Most variables were included in the multivariate analysis. Excluded were ANC and PNC visits due to the lack of coverage of the population, and the number of living children with its high collinearity with parity. We also examined changes in the covariates on vaccination coverage of the 2011 and 2016 samples and found numerous significant differences (Appendix Table A3).

Multivariate analysis examined the associations of vaccination coverage and retention of a vaccination card simultaneously with other variables. The results are expressed as adjusted odds ratio (OR) with a 95% confidence interval (CI). Due to the complex sampling design, we used the Svyset command to account for inverse probability weighting, clustering, and stratification to provide unbiased estimates of the population parameters.

3   TRENDS AND DESCRIPTIVE RESULTS

3.1   Trends in Vaccination Coverage of Different Antigens

Figure 2 shows the trend from 2006 to 2016 in vaccination coverage of different antigens (BCG, DPT1, 2, and 3, and Measles) among children age 12-23 months. Slight improvement is seen between the two most recent surveys for BCG, DPT1, and Measles, while there is a small decrease in DPT2, and a larger decrease in the percent of children receiving their third dose of DPT from 92% (CI 88.4-94.2) in 2011 to 86% (CI 82.7-88.6) in 2016. Details related to these antigens for three survey periods, 2006, 2011, and 2016, are shown in Appendix Table A1.

Figure 2   Vaccination coverage of different antigens among children age 12-23 months, Nepal DHS 2006-2016
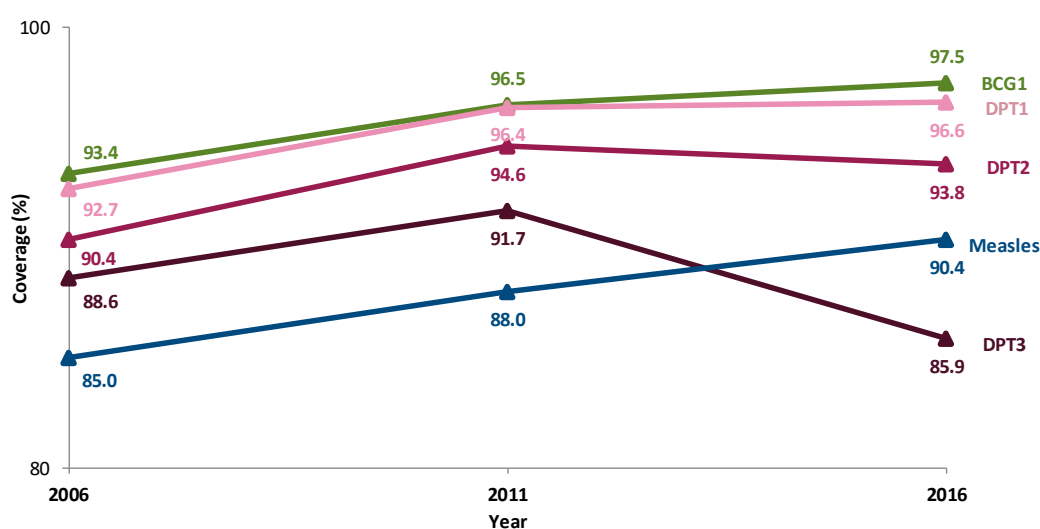
3.1.1 Trends in DPT discontinuation (DPT1 vs. DPT 3), Nepal DHS 2011-2016

DPT discontinuation is the percent of children who received DPT1 but did not receive DPT3.The trend of DPT discontinuation has increased from 5% (CI 3.1-7.6) in 2011 to 11% (CI 8.8-13.8) in 2016 (p-value=0.0009) (Figure 3).

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Figure 3   Trend in DPT discontinuation among children age 12-23 months who had received DPT1, Nepal DHS 2011-2016
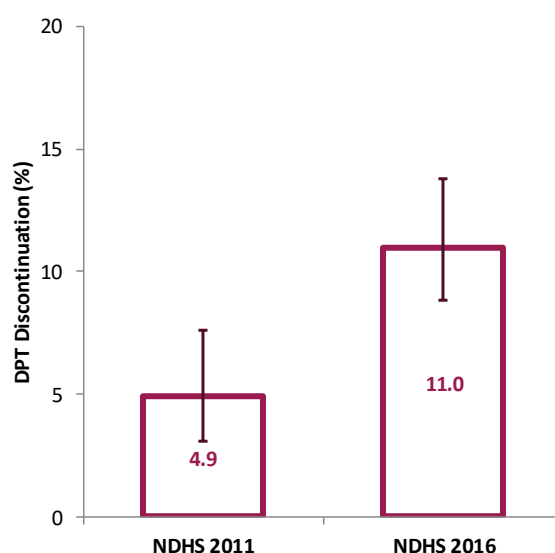
3.2   Distribution of Different Covariates Used for Analysis

3.2.1   Geographical background characteristics of children

Table 4 shows the percent distribution, by geographical background characteristics, of children age 12-23 months. Nearly half of the children are living in rural areas, with the remainder in urban settings. The province with the greatest number of young children is Province 2 (25%), followed by Province 5 (19%). The table shows that more than half of children are from the Terai region, while fewer than 10% are from the Mountain region. Two-thirds (66%) of the children lived in districts that were not directly affected by the earthquake.

Table 4   Distribution of geographical background characteristics of children age 12-23 months

Background characteristics	%	N
Place of residence		
Urban	54.5	564
Rural	45.5	470
Province		
Province 1	16.4	169
Province 2	25.1	259
Province 3	16.3	168
Province 4	9.1	94
Province 5	19.0	196
Province 6	6.1	63
Province 7	8.2	84
Ecological zone		
Mountain	7.2	75
Hill	37.7	390
Terai	55.0	569
Earthquake-affected districts		
Highly affected	14.8	153
Moderately affected	18.9	195
Not affected	66.3	686
Total		**1,034**

3.2.2 Sociodemographic characteristics

Table 5 shows the distribution of children by sociodemographic characteristics. Among all children age 12-23 months, 56% were male and 44% were female. About two-fifths (39%) of mothers were age 20-24 at the time of the interview; 31% were age 25-29, and fewer than 10% of mothers were age 35 and above. Nearly one-third (31%) of the mothers have no education, while 23% had received their school leaving certificate (SLC) by the time of the interview. The fathers had higher levels of education than the mothers. Fewer than 20% of the fathers have no education, while about three-fifths had completed some secondary education by the time of the interview. Nearly one-third (31%) of the castes represented in this study were Janajati/Newar, followed by Hill Brahmin/Chhetri (25%) and Terai Brahmin/Chhetri/other caste (21%). The children were evenly distributed across the household wealth quintiles. More than half of the children lived in a household with six or more household members, while fewer than 20% lived in a household with only one to three members. More than two-fifths of the children are the second- or third-born (43%), while 41% are the first-born child. Nearly three-fifths (57%) of the mothers worked in the previous 12 months. Almost a quarter of the mothers (24%) had no exposure to media, while 46% had exposure of less than once a week, and 30% had media exposure at least once a week.

Table 5   Distribution of sociodemographic characteristics of children age 12-23 months

Sociodemographic characteristics	%	N
Sex of child		
Male	55.8	577
Female	44.2	457
Age of mother (years)		
Less than 20	11.3	117
20-24	38.6	399
25-29	30.5	315
30-34	14.0	145
35 +	5.6	58
Mother's education		
No education	31.1	321
Primary	20.5	212
Some secondary	25.8	267
SLC and above	22.6	234
Father's education[1]		
No education	13.4	138
Primary	23.6	243
Some secondary	44.7	460
SLC and above	18.3	188
Caste/ethnicity		
Hill Brahmin/Chhetri	25.2	260
Terai Brahmin/ Chhetri/Other caste	20.8	215
Jananjati/Newar	30.9	319
Dalit	15.5	160
Muslim/Others	7.6	79
Household wealth quintile		
Poorest	20.8	215
Poorer	22.1	229
Middle	22.9	237
Richer	21.8	226
Richest	12.4	128
Household size		
1 - 3	13.3	138
4 - 5	32.2	333
6 +	54.5	564
Birth order		
1	40.6	420
2 - 3	42.9	443
4+	16.5	171
Mother worked in previous 12 months		
Worked	57.2	591
Not worked	42.8	443
Media exposure of mother		
Not at all	23.8	246
Less than once a week	46.3	479
At least once a week	29.9	309
Total		**1,034**

[1] Two unweighted cases and one "don't know" case were excluded.

3.2.3   Maternal and child health service utilization characteristics of mother

Table 6 presents the distribution of the children in the study by the maternal health service utilization by their mothers. A total of 55% of the children had all four ANC visits. Health facilities were the most popular place of delivery (63%). More than one-third (36%) of the mothers attended PNC visits within 2 months of giving birth.

Table 6   **Distribution of maternal and child health service utilization characteristics of mother of children age 12-23 months**

Maternal health service utilization characteristics	%	N
All 4 ANC visits[1]		
Yes	55.1	*530*
No	44.9	*432*
Place of delivery		
Health facility	63.1	*652*
Elsewhere	36.9	*382*
Postnatal care visits (within 2 months)[2]		
Yes	36.0	*359*
No	64.0	*637*
Total		*1,034*

[1] 75 unweighted cases are not included because mother has given birth again, and ANC is only asked of the most recent birth.

[2] 37 unweighted cases are not included because mother has given birth again, and Postnatal Care is only asked of the most recent birth.

3.3 Status of Vaccination Coverage (All Vaccinations) and Retention of Vaccination Card

3.3.1 Trend analysis of vaccination coverage of all basic vaccines, 2011-2016

In the NDHS 2016, the vaccination coverage is 78% (74.2-81.1) compared with 87% (82.3-90.6) in the NDHS 2011. As shown in Figure 4, this difference is statistically significant (p=0.002).

Figure 4   **Trend in status of vaccination coverage among children age 12-23 months, Nepal DHS 2011-2016**
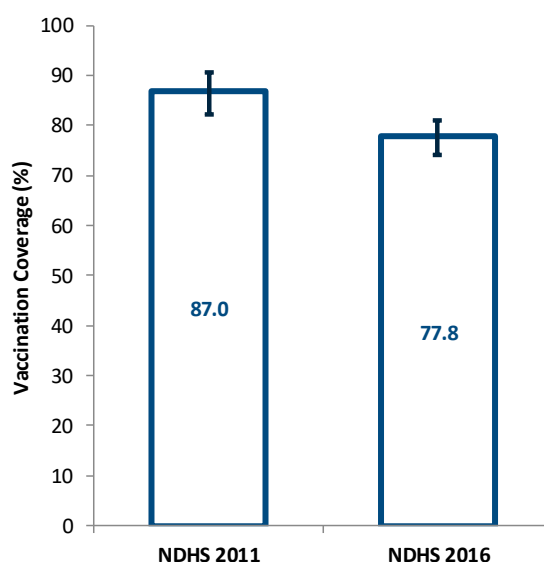
3.3.2 Trend analysis of retention of a vaccination card, 2011-2016

We consider a child to have a vaccination card if they have a government-issued vaccination card, booklet, or other home-based record. A vaccination card is considered "retained" if the interviewer sees the card at the time of the interview.

The vaccination card retention has increased from 34% (29.0-39.1) in the NDHS 2011 to 52% (47.8-56.8) in 2016. As shown in Figure 5, this difference is statistically significant (p=0.000).

Figure 5   Trend in retention of vaccination card among children age 12-23 months, Nepal DHS 2011-2016
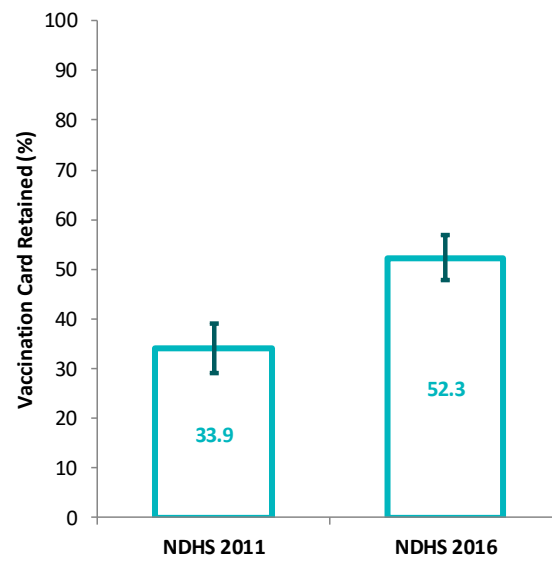
4   BIVARIATE ANALYSIS

4.1   Factors Associated with Vaccination Coverage among the Children Age 12-23 Months

Results from the bivariate analysis on vaccination coverage show that the status of full vaccination among children age 12-23 months differed significantly by province, ecological zone, earthquake and non-earthquake affected districts, mother's and father's education, caste, household wealth quintile, mother's employment, media exposure of mother, birth order, all four ANC visits, place of delivery, and vaccination card retention.

4.1.1   Vaccination coverage by geographical background characteristics

Table 7 shows that vaccination coverage is highest in Province 4 (93%), followed by Province 3 (85%) and Province 7 (83%). Children in the Hill zone have greater vaccination coverage when compared to those in the Mountain and Terai zones. The vaccination coverage in districts that were highly affected and moderately affected by the earthquake is higher than in districts that were not directly affected. We find no difference in vaccination coverage by place of residence.

Table 7   Vaccination coverage among children age 12-23 months by geographical background characteristics

Background characteristics	%	95% CI	p-value
Place of residence			
Urban	78.5	73.3-83.0	
Rural	77.0	71.7-81.6	
Province			
Province 1	79.4	72.4-85.1	
Province 2	65.2	56.4-73.0	
Province 3	85.3	74.7-91.9	
Province 4	92.7	86.5-96.2	
Province 5	78.3	68.8-85.5	
Province 6	74.9	64.7-82.9	
Province 7	83.4	74.9-89.4	***
Ecological zone			
Mountain	74.1	64.1-82.1	
Hill	88.0	83.6-91.4	
Terai	71.3	66.1-76.0	***
Earthquake-affected districts			
Highly affected	87.6	78.3-93.2	
Moderately affected	87.3	79.2-92.6	
Not affected	73.0	68.5-77.0	***
Total	**77.8**	**74.2-81.1**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.1.2   Vaccination coverage by sociodemographic characteristics

Table 8 shows that education of both mothers and fathers is related to the vaccination coverage of their children. With higher levels of the education, we see higher levels of coverage (p<0.001). Children in the Hill Brahmin/Chhetri castes have the highest coverage of vaccination, followed by those in the Janajati/Newar castes. Vaccination coverage is highest among children of the richer wealth quintile, followed by richest quintile. The vaccination coverage is lowest in middle wealth quintile. First-born children age 12-23 months have higher vaccination coverage followed by the second- or third-order

children. Children whose mothers worked in previous 12 months have higher vaccination coverage than children whose mothers did not work. Vaccination coverage is lowest for children whose mothers have no media exposure. Those children with mothers who were exposed to media less than once a week have higher vaccination coverage than those whose mothers were exposed to media at least once a week.

Table 8   Vaccination coverage among children age 12-23 months by sociodemographic characteristics

Sociodemographic characteristics	%	95% CI	p-value
Sex of child			
Male	77.4	72.8-81.5	
Female	78.4	73.5-82.5	
Age of mother			
Less than 20	77.6	68.6-84.6	
20-24	77.9	72.8-82.3	
25-29	77.3	71.1-82.5	
30-34	79.0	68.7-86.6	
35 +	78.1	65.3-87.0	
Mother's education			
No education	67.8	61.0-73.9	
Primary	75.8	68.2-82.1	***
Some secondary	79.8	74.0-84.6	
SLC and above	91.2	86.7-94.3	
Father's education			
No education	63.5	53.3-72.6	
Primary	71.9	65.1-77.9	***
Some secondary	82.8	78.4-86.4	
SLC and above	84.8	78.4-89.5	
Caste/ethnicity			
Hill Brahmin/Chhetri	87.9	82.9-91.5	
Terai Brahmin/ Chhetri/Other caste	64.3	55.5-72.3	***
Jananjati/Newar	83.3	77.8-87.6	
Dalit	73.2	65.1-80.0	
Muslim/Others	69.0	56.9-78.9	
Household wealth quintile			
Poorest	76.6	69.7-82.4	
Poorer	77.2	69.6-83.3	
Middle	70.9	63.7-77.2	*
Richer	84.8	78.2-89.7	
Richest	81.6	70.8-89.1	
Household size			
1 - 3	83.8	76.0-89.4	
4 - 5	78.9	72.9-83.9	
6 +	75.8	70.6-80.2	
Birth order			
1	84.0	79.7-87.5	
2 - 3	75.6	69.9-80.5	***
4+	68.6	60.1-76.1	
Mother worked in previous 12 months			
Worked	81.3	77.2-84.9	**
Not worked	73.2	67.4-78.2	
Media exposure of mother			
Not at all	65.3	57.6-72.2	
Less than once a week	84.1	79.4-87.8	***
At least once a week	78.2	72.4-83.0	
Total	**77.8**	**74.2-81.1**	

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

4.1.3 Vaccination coverage by maternal and child health service utilization characteristics

Vaccination coverage varies by place of delivery, with children of those mothers delivering in facilities having higher vaccination coverage than those born outside of facilities. Vaccination coverage is also higher among children who had four or more ANC visits. We do not find a statistically significant difference in vaccination coverage by whether or not the child received a postnatal visit (Table 9).

Table 9   Vaccination coverage among children age 12-23 months by maternal and child health service utilization characteristics

Maternal health service utilization characteristics	%	95% CI	p-value
All 4 ANC visits			
Yes	85.8	82.2-88.8	***
No	69.0	63.4-74.1	
Place of delivery			
Health facility	83.9	80.5-86.8	***
Elsewhere	67.5	61.1-73.2	
Postnatal care visits (within 2 months)			
Yes	81.2	75.8-85.6	
No	75.9	71.5-79.8	
Total	**77.8**	**74.2-81.1**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.1.4 Vaccination coverage by retention of vaccination card

Highest levels of vaccination coverage are seen among children whose mothers retained their vaccination cards (91%). The lowest level of vaccination coverage is among children who never received a vaccination card (50%). This result is statistically significant at a p-value of <0.05 (Table 10).

Table 10   Vaccination coverage among children age 12-23 months by retention of vaccination card

Vaccination coverage	%	95% CI	p-value
Vaccination card retention			
Yes	91.3	88.1-93.8	***
No	65.0	59.4-70.2	
Never received	49.5	35.7-63.4	
Total	**77.8**	**74.2-81.1**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.2   Factors Associated with Retention of Vaccination Card among Children Age 12-23 Months

As illustrated above, retention of a vaccination card is associated with much higher rates of vaccination coverage compared to those children who formerly or never had a card. In the next section, we examine which covariates are associated with obtaining and retaining a vaccination card. The bivariate analysis of retention of a vaccination card among children age 12-23 months shows significant differences by province, ecological zone, level of earthquake affectedness, mother's and father's education, caste, wealth, household size, mother's employment, mother's media exposure, birth order, receipt of all four ANC visits, and place of delivery.

4.2.1   Retention of vaccination card by geographical background characteristics

Table 11 shows that retention of a vaccination card is highest in Province 4, followed by Province 3 and Province 5 (p<0.001). Children in the Hill zone are more likely to have a card at time of interview

compared to those in the Mountain and Terai zones. Having a vaccination card is more likely in the highly affected and moderately affected earthquake districts than the nonaffected districts. There is no significant difference in possession of a vaccination card by place of residence.

Table 11   Retention of vaccination card among children age 12-23 months by geographical background characteristics

Background characteristics	%	95% CI	p-value
Place of residence			
Urban	52.0	45.5-58.5	
Rural	52.7	46.2-59.2	
Province			
Province 1	55.1	42.9-66.7	
Province 2	30.6	23.6-38.7	
Province 3	65.2	50.1-77.8	
Province 4	71.9	63.3-79.2	***
Province 5	58.8	48.4-68.5	
Province 6	45.7	35.3-56.6	
Province 7	55.9	44.8-66.5	
Ecological zone			
Mountain	42.6	30.5-55.8	
Hill	68.8	61.8-75.1	***
Terai	42.3	36.9-47.9	
Earthquake-affected districts			
Highly affected	69.5	53.7-81.8	
Moderately affected	65.2	57.2-72.5	***
Not affected	44.9	39.8-50.1	
Total	**52.3**	**47.8-56.8**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.2.2   Retention of vaccination card by sociodemographic characteristics

Table 12 shows that the education of both the mother and father is positively related to the retention of a vaccination card. Thus, parents with higher education are more likely to have children with vaccination cards. Among the different castes, the Janajati/Newar have the highest vaccination card retention, followed by the Hill Brahmin/Chhetri caste. By household wealth quintiles, retention of a vaccination card is highest among the richest quintile, followed by the richer wealth quintile. The retention of a vaccination card is lowest among the middle wealth quintile. The vaccination card retention is lower in larger households. Children age 12-23 months who are first-born have a higher vaccination card retention than the higher-parity children. The children whose mothers worked in the last 12 months have higher vaccination card retention than those with mothers who did not work. Retention of a vaccination card is highest among children with mothers who have media exposure less than once a week, compared to those with no exposure and those with exposure more than once a week.

Table 12   Retention of vaccination card among children age 12-23 months by sociodemographic characteristics

Sociodemographic characteristics	%	95% CI	p-value
Sex of child			
Male	53.4	47.9-58.9	
Female	51.0	45.4-56.5	
Age of mother			
Less than 20	50.3	40.9-59.6	
20-24	52.2	46.0-58.5	
25-29	51.0	43.5-58.5	
30-34	56.0	45.1-66.3	
35 +	55.3	39.9-69.8	
Mother's education			
No education	34.2	27.5-41.7	
Primary	56.9	49.3-64.2	***
Some secondary	61.3	54.3-67.9	
SLC and above	62.8	53.6-71.2	
Father's education			
No education	24.4	17.0-33.6	
Primary	51.7	43.6-59.7	***
Some secondary	60.5	55.3-65.4	
SLC and above	55.0	45.7-64.0	
Caste/ethnicity			
Hill Brahmin/Chhetri	60.4	52.1-68.2	
Terai Brahmin/ Chhetri/Other caste	33.1	24.2-43.4	***
Jananjati/Newar	62.7	55.8-69.1	
Dalit	52.4	44.0-60.7	
Muslim/Others	36.2	24.4-50.0	
Household wealth quintile			
Poorest	53.8	46.2-61.1	
Poorer	53.2	44.5-61.8	
Middle	41.1	33.4-49.2	*
Richer	56.5	48.4-64.3	
Richest	61.8	48.4-73.7	
Household size			
1 - 3	62.2	52.2-71.2	
4 - 5	55.9	48.8-62.7	*
6 +	47.9	42.1-53.7	
Birth order			
1	58.8	53.2-64.2	
2 - 3	50.0	43.4-56.6	**
4+	42.4	33.6-51.7	
Mother worked in previous 12 months			
Worked	56.2	51.3-61.1	*
Not worked	47.1	40.3-54.1	
Media exposure of mother			
Not at all	37.9	30.0-46.6	
Less than once a week	60.9	55.5-66.0	***
At least once a week	50.6	43.1-58.0	
Total	**52.3**	**47.8-56.8**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.2.3   Retention of vaccination card by maternal and child health service utilization characteristics

Vaccination card retention is higher among the children whose mothers had all four ANC visits than those who had fewer than four visits. Children who were born in health facilities are more likely to obtain and retain a vaccination card than children who are born elsewhere (Table 13).

Table 13   Retention of vaccination card among children age 12-23 months by maternal health and child health service utilization characteristics

Maternal health service utilization characteristics	%	95% CI	p-value
All 4 ANC visits			
Yes	58.4	53.0-63.5	***
No	46.1	40.1-52.1	
Place of delivery			
Health facility	57.2	52.0-62.2	***
Elsewhere	44.1	37.9-50.5	
Postnatal care visits (within 2 months)			
Yes	54.9	48.1-61.5	
No	51.1	45.8-56.4	
Total	**52.3**	**47.8-56.8**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.3   Factors Associated with Children Who Received DPT3 after Being Given a DPT1 Injection

Figure 2 shows that the decline in overall vaccination coverage is driven by a large decline in DPT3 coverage. In this section, we examine the factors associated with receiving a DPT3 injection, among children who received a DPT1 injection, which has near-universal coverage. The data show that receiving DPT3 after being given DPT1 differed significantly by province, ecological zone, earthquake and non-earthquake affected districts, mother's and father's education, caste, mother's employment, media exposure of mother, ANC visits, place of delivery, and vaccination card retention.

4.3.1   Receipt of DPT3 by geographical background characteristics

Table 14 shows that among children who received DPT1, receiving DPT3 is highest in Province 4, followed by Province 7 and Province 3. Children in the Hill zone have greater receipt of DPT3, compared to those in the Mountain and Terai zones. The DPT3 administration was higher in districts that were highly and moderately affected by the earthquake than in districts that were not directly affected.

Table 14   Receipt of DPT3 among children age 12-23 months who had received DPT1 by geographical background characteristics

Background characteristics	%	95% CI	p-value
Place of residence			
Urban	88.1	83.8-91.3	
Rural	90.0	86.2-92.9	
Province			
Province 1	91.5	86.1-94.9	
Province 2	79.2	71.6-85.1	
Province 3	93.9	85.7-97.5	
Province 4	96.8	91.5-98.8	***
Province 5	90.5	83.2-94.8	
Province 6	85.4	77.4-90.9	
Province 7	94.2	87.7-97.4	
Ecological zone			
Mountain	87.1	78.5-92.6	
Hill	96.1	93.3-97.7	***
Terai	84.2	79.8-87.7	
Earthquake-affected districts			
Highly affected	95.5	87.6-98.5	
Moderately affected	94.5	89.2-97.3	**
Not affected	85.9	82.2-88.9	
Total	**89.0**	**86.2-91.2**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.3.2 Receipt of DPT3 by sociodemographic characteristics

Table 15 shows that the education of both mothers and fathers is related to the children receiving DPT3 after they received DPT1. With higher levels of education, there are higher levels of coverage. Children in the Hill Brahmin/Chhetri castes have the highest coverage of DPT3, followed by the Dalit and Janajati/Newar castes. Children whose mothers worked in previous 12 months have higher coverage of DPT3, after receiving DPT1 injection, than those whose mothers did not work. Receiving DPT3 is lowest when children's mothers have no media exposure. Those whose mothers are exposed to media at least once a week have higher vaccination coverage than those whose mothers are exposed less than once a week.

Table 15   Receipt of DPT3 among children age 12-23 months who had received DPT1 by sociodemographic characteristics

Sociodemographic characteristics	%	95% CI	p-value
Sex of child			
Male	87.9	84.2-90.9	
Female	90.3	86.4-93.2	
Age of mother			
Less than 20	84.6	76.2-90.4	
20-24	87.8	83.7-91.0	
25-29	89.2	84.3-92.8	
30-34	92.4	85.3-96.3	
35 +	96.4	86.8-99.1	
Mother's education			
No education	84.9	78.6-89.6	
Primary	89.3	83.3-93.4	*
Some secondary	88.7	83.6-92.4	
SLC and above	94.1	90.1-96.6	
Father's education			
No education	83.0	74.0-89.4	
Primary	84.9	78.4-89.7	**
Some secondary	91.6	88.3-93.9	
SLC and above	92.7	87.9-95.7	
Caste/ethnicity			
Hill Brahmin/Chhetri	94.0	90.1-96.5	
Terai Brahmin/ Chhetri/Other caste	77.5	69.1-84.2	***
Jananjati/Newar	92.2	88.1-94.9	
Dalit	92.6	87.3-95.8	
Muslim/Others	82.5	71.4-89.9	
Household wealth quintile			
Poorest	89.9	84.6-93.5	
Poorer	88.9	82.3-93.2	
Middle	84.0	77.5-88.9	
Richer	91.7	86.3-95.1	
Richest	91.6	81.9-96.4	
Household size			
1 - 3	93.4	86.3-96.9	
4 - 5	89.0	84.3-92.4	
6 +	87.8	83.6-91.1	
Birth order			
1	90.6	87.0-93.3	
2 - 3	88.6	84.0-92.0	
4+	85.5	77.3-91.2	
Mother worked in previous 12 months			
Worked	92.5	89.6-94.6	***
Not worked	84.2	79.2-88.1	
Media exposure of mother			
Not at all	81.6	74.0-87.3	
Less than once a week	90.4	85.5-93.7	**
At least once a week	91.6	88.0-94.2	
Total	**89.0**	**86.2-91.2**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.3.3 Receipt of DPT3 by maternal and child health service utilization characteristics

Of children with any DPT injection, receiving the final dose varies by place of delivery, with those delivered in health facilities having higher coverage of DPT3 than those born outside of facilities. The coverage is also higher among children who had four or more ANC visits. We do not find a statistically significant difference in the coverage of receiving DPT3 (given receipt of DPT1) by whether or not the child received a PNC visit (Table 16).

Table 16   Receipt of DPT3 among children age 12-23 months who had received DPT1 by maternal and child health service utilization characteristics

Maternal health service utilization characteristics	%	95% CI	p-value
All 4 ANC visits			
Yes	94.0	91.3-95.9	
No	82.6	77.7-86.7	***
Place of delivery			
Health facility	91.8	88.9-94.0	
Elsewhere	83.9	78.4-88.3	**
Postnatal care visits (within 2 months)			
Yes	91.1	87.1-93.9	
No	87.9	84.3-90.8	
Total	**89.0**	**86.2-91.2**	

*** p < 0.001, ** p < 0.01, * p < 0.05

4.3.4 Receipt of DPT3 by retention of a vaccination card

The highest levels of children who received DPT3, after receiving DPT1, are those whose mothers retained their vaccination cards. The lowest level of DPT3 coverage is among children who never received a vaccination card. This result is statistically significant at a p-value <0.05 (Table 17).

Table 17   Receipt of DPT3 among children age 12-23 months who had received DPT1 by vaccination card retention

Received DPT1 and DPT 3	%	95% CI	p-value
Vaccination card retention			
Yes	98.2	96.3-99.2	
No	78.6	73.6-82.8	***
Never received	74.5	59.7-85.2	
Total	**89.0**	**86.2-91.2**	

*** p < 0.001, ** p < 0.01, * p < 0.05

5 MULTIVARIATE LOGISTIC REGRESSIONS

We used multivariate logistic regression models for two outcome variables: vaccination coverage and retention of a vaccination card. We examined the independent effects of covariates, after taking into consideration a number of other variables that might influence the outcome of interest. The results are presented as odds ratios, which express the magnitude – whether greater (OR>1.00) or less (OR<1.00) – in relation to the reference category in the odds of the variable of interest occurring for a given value of the explanatory variable. In this model, all factors were included in analysis and the results were compared to those of bivariate (unadjusted) models.

5.1 Effect of Covariates on Vaccination Coverage of Children Age 12-23 Months

The logistic regression (Table 18) that tested the effect of covariates on the odds of the vaccination coverage finds no influence of geographical background characteristics and sociodemographic characteristics.

Table 18   Adjusted model for the effect of covariates on vaccination coverage among children age 12-23 months

Covariates	aOR	CI
Geographical background characteristics		
Place of residence		
Urban	Ref	
Rural	1.1	0.7 - 1.6
Province		
Province 1	Ref	
Province 2	1.2	0.6 - 2.5
Province 3	1.1	0.5 - 2.2
Province 4	1.9	0.8 - 4.4
Province 5	1.0	0.5 - 2.0
Province 6	0.8	0.3 - 1.8
Province 7	1.1	0.5 - 2.5
Ecological zone		
Mountain	Ref	
Hill	1.6	0.8 - 3.5
Terai	1.0	0.5 - 2.3
Sociodemographic characteristics		
Sex of child		
Male	Ref	
Female	1.1	0.7 - 1.5
Age of mother		
Less than 20	Ref	
20-24	0.9	0.5 - 1.8
25-29	0.9	0.4 - 1.8
30-34	1.1	0.4 - 2.9
35 +	1.2	0.4 - 3.6
Mother's education		
No education	Ref	
Primary	1.0	0.6 - 1.7
Some secondary	0.8	0.4 - 1.4
SLC and above	1.7	0.7 - 3.8

(Continued…)

Table 18—Continued

Covariates	aOR	CI
Father's education		
No education	Ref	
Primary	0.9	0.5 - 1.7
Some secondary	1.1	0.6 - 2.2
SLC and above	1.1	0.5 - 2.3
Caste/ethnicity		
Hill Brahmin/Chhetri	Ref	
Terai Brahmin/ Chhetri/Other caste	0.5	0.3 - 1.2
Jananjati/Newar	0.8	0.4 - 1.4
Dalit	0.5	0.2 - 1.0
Muslim/Others	0.7	0.3 - 1.7
Household Wealth quintile		
Poorest	Ref	
Poorer	1.2	0.6 - 2.2
Middle	0.9	0.5 - 1.8
Richer	1.6	0.8 - 3.3
Richest	0.8	0.3 - 2.3
Household size		
1 - 3	Ref	
4 - 5	1.1	0.6 - 2.1
6 +	1.3	0.7 - 2.5
Birth order		
1	Ref	
2 - 3	0.8	0.5 - 1.4
4+	0.7	0.4 - 1.5
Mother worked in previous 12 months		
Not worked	Ref	
Worked	1.3	0.8 - 2.0
Media exposure of mother		
Not at all	Ref	
Less than once a week	1.4	0.8 - 2.2
At least once a week	1.1	0.7 - 1.8
Maternal and child health service utilization		
Place of delivery		
Elsewhere	Ref	
Health facility	1.9***	1.3 - 2.7
Vaccination card retention		
Never received	Ref	
Yes	5.7***	2.9 - 11.3
No	1.3	0.7 - 2.4

*** p < 0.001, ** p < 0.01, * p < 0.05

Figure 6   Effect of maternal and child health service utilization on vaccination coverage among children age 12-23 months
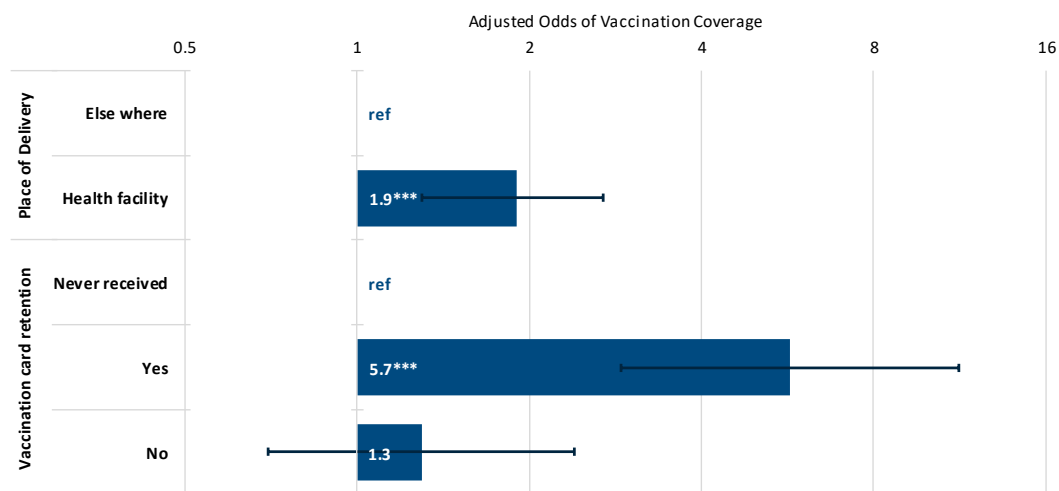
*** p<0.001, ** p<0.01, * p<0.05

The findings show that place of delivery and retention of vaccination cards have highly significant effects on the odds of vaccination coverage (Figure 6). Children born in a health facility have 1.9 times higher odds of having complete vaccination coverage compared to those born elsewhere (aOR=1.9, 95% CI=1.3-2.7). Children who have a vaccination card have 5.7 times higher odds of having complete vaccination coverage compared to those who have never received a vaccination card (aOR=5.7, 95% CI=2.9-11.3). After repeating the analysis with vaccination card retained as the reference category, we find that the odds of completed vaccination coverage are statistically lower (aOR=0.2, 95% CI=0.1-0.4) for children who received but no longer retained a card, compared to children who retained their card.

5.2 Effect of Covariates on Retention of Vaccination Card among Children Age 12-23 Months

The logistic regression (Table 19) that tested the effect of variables on the likelihood of the retention of vaccination card finds an influence of place of residence and ecological zone. Children age 12-23 months who live in a rural area have 1.4 times higher odds of having a vaccination card than urban children (aOR=1.4, 95% CI=1.0-2.0). Similarly, children living in the Hill region are more likely to have a vaccination card compared to those from the Mountain region (aOR=2.4, 95% CI=1.2-4.6).

Table 19   **Adjusted model for the effect of covariates on retention of vaccination card among children age 12-23 months**

Covariates	aOR	CI
Geographical background characteristics		
Place of residence		
Urban	Ref	
Rural	1.4*	1.0 - 2.0
Province		
Province 1	Ref	
Province 2	0.8	0.4 - 1.7
Province 3	1.3	0.6 - 2.5
Province 4	1.3	0.7 - 2.4
Province 5	1.4	0.7 - 2.6
Province 6	0.7	0.3 - 1.3
Province 7	1.2	0.6 - 2.2
Ecological zone		
Mountain	Ref	
Hill	2.4**	1.2 - 4.6
Terai	1.3	0.7 - 2.4
Sociodemographic characteristics		
Sex of child		
Male	Ref	
Female	0.8	0.6 - 1.1
Age of mother		
Less than 20	Ref	
20-24	1.0	0.6 - 1.7
25-29	1.1	0.7 - 2.0
30-34	1.6	0.8 - 3.4
35 +	2.3	1.0 - 5.5
Mother's education		
No education	Ref	
Primary	1.9*	1.2 - 3.1
Some secondary	1.9*	1.1 - 3.1
SLC and above	1.7	1.0 - 3.1
Father's education		
No education	Ref	
Primary	2.7***	1.5 - 4.8
Some secondary	3.0***	1.7 - 5.2
SLC and above	2.1*	1.1 - 4.2
Caste/ethnicity		
Hill Brahmin/Chhetri	Ref	
Terai Brahmin/ Chhetri/Other caste	0.9	0.4 - 1.6
Jananjati/Newar	1.3	0.8 - 2.1
Dalit	1.1	0.6 - 1.9
Muslim/Others	1.0	0.5 - 2.2
Household wealth quintile		
Poorest	Ref	
Poorer	1.2	0.7 - 2.0
Middle	0.8	0.5 - 1.4
Richer	1.1	0.7 - 2.0
Richest	1.2	0.6 - 2.7
Household size		
1 - 3	Ref	
4 - 5	0.9	0.6 - 1.5
6 +	0.9	0.5 - 1.5
Birth order		
1	Ref	
2 - 3	0.8	0.6 - 1.2
4+	0.8	0.5 - 1.5

(Continued…)

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Table 19—Continued

Covariates	aOR	CI
Mother worked in previous 12 months		
Not worked	Ref	
Worked	1.2	0.8 - 1.7
Media exposure of mother		
Not at all	Ref	
Less than once a week	1.3	0.9 - 2.1
At least once a week	1.0	0.6 - 1.6
Maternal and child health service utilization		
Place of delivery		
Elsewhere	Ref	
Health facility	1.4	1.0 - 1.9

*** p < 0.001, ** p < 0.01, * p < 0.05

The model shows that the mothers' and fathers' education are significantly related to card retention. As shown in Figure 7, children with mothers who have primary and some secondary education are more likely to have a vaccination card compared to those whose mothers have no education (aOR=1.9, 95% CI=2.9-11.3). Similarly, compared to children whose fathers have no education, children with fathers who have all other levels of education are statistically more likely to have a vaccination card.

Figure 7   Effect of parental education on retention of vaccination card among children age 12-23 months

Adjusted Odds of Vaccination Card Retention
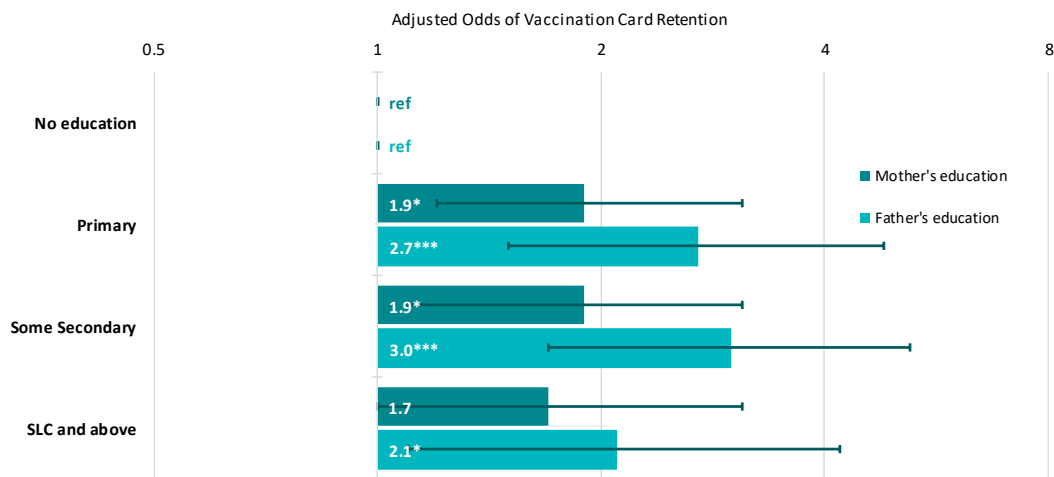
*** p < 0.001, ** p < 0.01, * p < 0.05

6   DISCUSSION AND CONCLUSION

This study using NDHS data examined vaccination trends over the 10-year period from 2006 to 2016, vaccination discontinuation between first and third dose of DPT3, and factors that affect vaccination coverage. Given the importance of vaccination cards in achieving full vaccination coverage, we examined the factors associated with retaining the vaccination cards.

6.1   Vaccination Coverage

The NDHS 2016 showed that the National Immunization Programme (NIP) could reach 99% of the children, highlighting 1% of children yet to reach, compared to 3% in NDHS 2006 and NDHS 2011 (MoH, New ERA, and ICF 2017). This clearly demonstrates the commitment of the immunization program ,in improving access of immunization services, to reach every child. Looking at the coverage of individual antigens from 2006 to 2016, national coverage of BCG, DPT1, DPT2, and MR1 are increasing significantly, and are already above 90%, meeting the goal of the Comprehensive Multi-Year Plan, 2017-2022 (CMYP) of the National Immunization Programme of Nepal. However, the dropout rate of DPT1 versus DPT3 has increased from 2011 to 2016 – demonstrating that use of immunization services is not optimal. Previous studies have found that the factors associated with utilization of outreach immunization services include community mobilization prior to the session, and caregivers aware of benefits of childhood immunization (Oryema et al. 2017). The female community health volunteer (FCHV) program in Nepal was established in FY 1988/89 to support community-based services, including immunization services, with an objective of increasing participation of communities in health services (DoHS 2015/2016). The National Immunization Programme can create suitable strategies through the deployment of FCHV to advocate to caregivers at the community level about immunization and the importance of completing all vaccination series.

Coverage of all basic vaccines (12-23 months children) reached 77.8%, meaning significant effort will be required to reach the national target of 90% – the current key concern of the immunization program. Trend analysis of individual vaccines demonstrates the cause of decrease in all basic coverage is largely due to the third dose of DPT. Higher coverage for MR1 than DPT3 points towards missed opportunity for vaccination of DPT3 at 9 months. Bridging the missed opportunity gap could improve DPT3 Coverage by 10 percentage points, depending on the country (WHO 2017a). Reducing Missed Opportunity of Vaccination (MoV) can contribute towards achieving the NHSS goal of "Improved health status of all people through accountable and equitable health service delivery system" by reaching 90% of children fully immunized with all vaccines in the national immunization schedule.

Coverage of all basic vaccines is significantly associated with place of delivery and vaccination card retention. Children born in health facilities are more likely get all basic vaccines than those born elsewhere. Children of the caregivers who retain a vaccination card are also more likely to get all basic vaccinations than children without vaccination cards. Our analysis could not find evidence of significant association of children receiving all basic vaccines with geographic determinants (place of residence, province, ecological zone, earthquake-affected districts) or with sociodemographic determinants (sex of child, age of mother, education level of parents, ethnicity, household wealth quintile, household size, birth order, mother worked in previous 12 months, media exposure). However, studies conducted in other countries identified geographic and socioeconomic factors such as travel time, mother's age, and mother's education influencing vaccination status of children (Ibnouf, Van den Borne, and Maarse 2007). Focused intervention on hard-to-reach and disadvantaged populations has resulted in improvement in coverage along with reduced equity gap; however, disparities still exist in Nepal (KC

et al. 2017). Strategies for increasing "institutional delivery" and "vaccination card retention" will be inadequate to increase childhood vaccination coverage and address disparities. Continued effort in program management will be crucial for delivering quality immunization services, for sharing responsibilities with communities, for better immunization outcomes, and for reducing disparities in the current context. This includes strengthening of procurement, supply chain management, human resource management, monitoring and evaluation, information management, and quality service delivery at service site.

6.2   Retention of Vaccination Card

The vaccination card plays a crucial role in documenting immunization services received, yet currently these tools are too often underutilized. When properly used, child health cards are a cost-effective measure in the promotion of health and the early detection and prevention of disease in infants and children (Donald and Kibel 1984). Cards are an inexpensive tool promoting childhood immunization. They also facilitate the caregivers' awareness of immunization status and timing, thus reducing Missed Opportunity of Vaccination (MoV).

The vaccination card retention rate in Nepal is currently only 52.3% (MoH, New ERA, and ICF 2017). Our study showed card retention is significantly associated with place of residence, ecological zone, and education level of parents. Children from rural communities, from mountain and Terai, with parents with no education are less likely to retain cards. In rural Nepal, vaccination cards are more likely to be retained in households with young children, those closer to a health facility, those who have knowledge of the card's purpose, and those who were informed about the importance of retention (Pahari, Bastola, and Paudel 2011). In a study in the Kaski district of Nepal, card retention was associated with receiving counseling by health workers (Pahari, Bastola, and Paudel 2011). Gaps in knowledge of the value of the cards need to be addressed in communities residing in rural, mountain, and hill areas, and parents with no education, in order to improve card retention.

A study from Gorkha (Western Hill) and Nawalparasi (Western Terai), two districts in Nepal, found that the availability of new child health cards was insufficient in health facilities. The study found that only 1 of 14 facilities had sufficient stock, although the study showed the card retention rate as high as 82% (Paudel, Bajracharya, and Karki 2016). Vaccination cards increase visits for different vaccines, remind mothers to avoid dropout doses, and encourage the completion of all vaccinations (Ibnouf, Van den Borne, and Maarse 2007). Shortages or stock-outs of vaccination cards at health facilities will primarily hinder the purpose of issuing the cards – to empower the caregivers to seek out health services. It is especially important to monitor the stock and forecast the future need to avoid vaccination card shortages at the health facility level.

6.3   Conclusion

Immunization plays a crucial role in reducing under-five mortality. The National Health Sector Strategy (NHSS), 2016-2021, aims to prevent such deaths by improving vaccination coverage to achieve "Improved health status of all people through accountable and equitable health service delivery system," aligning with the Sustainable Development Goals. It is essential to understand vaccination coverage trends and identify geographic and social determinants affecting the coverage trend analysis of vaccination coverage to accelerate the progress towards SDG. Our study shows improvement in vaccination coverage when looked at individually and by percentage of children unreached based on three consecutive NDHSs, showing commitment of Nepal to improve childhood immunization services. Basic vaccine coverage has declined due to the third dose of DPT coverage. Strategies to address missed

opportunity of vaccination and improve utilization of services will be required in order to increase vaccination coverage, as none of the conventional disparity indicators such as household wealth quintile, geopolitical divide, gender, family size, and ethnicity significantly influence vaccination coverage. Continued effort in program management will be crucial for delivering quality immunization services, to reduce disparities and improve immunization outcomes. To improve card retention, gaps in knowledge of the value of the card need to be addressed to communities residing in rural, mountain, and hill areas, and parents with no education. It is especially important to monitor the stock and forecast the future need to avoid vaccination card shortages at the health facility level.

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APPENDICES

Appendix Table A1   Vaccination coverage of different antigen among children age 12-23 months, Nepal DHS 2006-2016

Year	BCG1	95% CI	DPT1	95% CI	DPT2	95% CI	DPT3	95% CI	Measles	95% CI
2006	93.4	90.3-95.5	92.7	89.6-94.9	90.4	87.1-93.0	88.6	85.2-91.4	85.0	81.0-88.3
2011	96.5	94.7-97.7	96.4	94.6-97.6	94.6	91.9-96.5	91.7	88.4-94.2	88.0	83.3-91.6
2016	97.5	96.2-98.3	96.6	95.1-97.7	93.8	91.3-95.6	85.9	82.7-88.6	90.4	88.0-92.4

Appendix Table A2   Distribution of covariates of children age 12-23 months between two consecutive surveys, Nepal DHS 2011-2016

	Children age 12-23 months					
	Nepal DHS 2016			Nepal DHS 2011		
Covariates	**%**	**95% CI**	**N**	**%**	**95% CI**	**N**
Geographical background characteristics						
Place of residence						
Urban	54.5	48.4-60.5	564	9.7	8.2-11.5	97
Rural	45.5	39.5-51.6	470	90.3	88.5-91.8	903
Province						
Province 1	16.4	13.9-19.2	169	20.0	15.3-25.7	200
Province 2	25.1	21.9-28.5	259	23.9	16.9-32.5	239
Province 3	16.3	12.8-20.5	168	13.5	10.3-17.6	135
Province 4	9.1	7.6-10.7	94	10.6	6.8-16.2	106
Province 5	19.0	16.0-22.3	196	15.0	11.0-20.1	150
Province 6	6.1	5.1-7.3	63	6.9	4.7-10.0	69
Province 7	8.2	6.7-9.9	84	10.1	8.3-12.2	101
Ecological zone						
Mountain	7.2	4.9-10.7	75	7.5	6.3-8.9	75
Hill	37.7	32.1-43.5	390	40.2	35.4-45.2	402
Terai	55.0	49.4-60.6	569	52.3	47.0-57.6	523
Earthquake-affected districts						
Highly affected	14.8	11.2-19.2	153	11.6	9.4-14.1	116
Moderately affected	18.9	14.6-24.1	195	21.2	16.3-27.1	212
Not affected	66.3	61.3-71.1	686	67.3	61.1-72.9	672
Sociodemographic characteristics						
Sex of child						
Male	55.8	52.5-59.1	577	50.1	46.4-53.8	501
Female	44.2	40.9-47.5	457	49.9	46.2-53.6	499
Age of mother						
Less than 20	11.3	9.4-13.5	117	9.8	7.8-12.1	98
20-24	38.6	35.0-42.2	399	39.9	36.2-43.7	399
25-29	30.5	27.2-34.0	315	28.4	24.5-32.6	284
30-34	14.0	11.8-16.5	145	13.0	10.7-15.6	130
35 +	5.6	4.2-7.5	58	9.0	7.0-11.4	90
Mother's education						
No education	31.1	27.2-35.2	321	45.2	39.4-51.2	452
Primary	20.5	17.6-23.8	212	20.0	16.6-23.8	200
Some secondary	25.8	22.4-29.5	267	21.1	17.4-25.3	211
SLC and above	22.6	19.0-26.7	234	13.7	11.0-16.9	137
Father's education						
No education	13.4	10.9-16.5	138	23.8	19.4-28.8	237
Primary	23.6	20.5-27.0	243	22.1	18.6-26.0	220
Some secondary	44.7	40.9-48.6	460	45.9	40.7-51.1	456
SLC and above	18.3	15.5-21.5	188	8.3	6.4-10.5	82

(Continued…)

Appendix Table A2—Continued

Covariates	Children age 12-23 months					
	Nepal DHS 2016			Nepal DHS 2011		
	%	95% CI	N	%	95% CI	N
Caste/ethnicity						
Hill Brahmin/Chhetri	25.2	21.5-29.2	260	25.7	21.3-30.7	257
Terai Brahmin/Chhetri/Other caste	20.8	16.8-25.6	215	12.2	8.1-17.9	122
Jananjati/Newar	30.9	26.5-35.6	319	36.2	29.2-43.7	361
Dalit	15.5	12.5-19.0	160	16.9	12.8-21.9	169
Muslim/Others	7.6	5.0-11.5	79	8.9	3.6-20.3	89
Household wealth quintile						
Poorest	20.8	17.2-24.8	215	24.8	20.8-29.1	247
Poorer	22.1	19.0-25.6	229	22.7	19.0-26.8	227
Middle	22.9	19.8-26.4	237	21.7	17.6-26.6	217
Richer	21.8	18.5-25.6	226	18.3	15.2-21.8	183
Richest	12.4	9.7-15.7	128	12.6	9.4-16.6	126
Household size						
1	13.3	11.1-15.8	138	12.3	9.6-15.6	123
2 - 3	32.2	29.0-35.5	333	35.6	31.7-39.7	356
4+	54.5	50.9-58.1	564	52.1	47.3-56.9	521
Mother worked in previous 12 months						
Worked	57.2	52.5-61.7	591	65.3	59.5-70.6	652
Not worked	42.8	38.3-61.7	443	34.7	29.4-40.5	347
Media exposure of mother						
Not at all	23.8	20.3-27.7	246	16.4	12.5-21.1	164
Less than once a week	46.3	42.5-50.2	479	58.3	53.4-63.1	583
At least once a week	29.9	26.5-33.5	309	25.3	21.9-29.1	253
Parity characteristics						
Birth order						
1	40.6	36.9-44.4	420	34.8	31.4-38.4	348
2 - 3	42.9	39.3-46.5	443	46.9	43.3-50.6	469
4+	16.5	13.6-19.9	171	18.2	15.2-21.8	182
Number of living children						
1	40.1	36.5-43.8	414	34.7	30.7-38.9	347
2 - 3	45.3	41.9-48.8	468	48.9	45.0-52.8	489
4+	14.6	12.1-17.6	151	16.4	13.5-19.8	164
Maternal and child health utilization characteristics						
Place of delivery						
Health facility	63.1	58.6-67.3	652	41.0	35.9-46.4	410
Elsewhere	36.9	32.7-41.4	382	59.0	53.6-64.1	589
Vaccination card retention						
Yes	52.3	47.8-56.8	541	33.9	29.0-39.1	339
No	41.5	37.3-45.9	429	57.4	52.3-62.5	574
Never received	6.1	4.3-8.7	63	8.7	5.5-13.4	87

Appendix Table A3   Significance differences of different covariates on vaccination coverage of children aged 12-23 months between two consecutive surveys, Nepal DHS 2011-2016

	Children age 12-23 months						
	Nepal DHS 2016			Nepal DHS 2011			
Covariates	%	95% CI	N	%	95% CI	N	p-value
Geographical background characteristics							
Place of residence							
Urban	78.5	73.3-83.0	564	90.0	84.2-93.8	97	**
Rural	77.0	71.7-81.6	470	86.6	81.4-90.5	903	***
Province							
Province 1	79.4	72.4-85.1	169	87.3	75.7-93.9	200	*
Province 2	65.2	56.4-73.0	259	79.3	64.8-88.8	239	***
Province 3	85.3	74.7-91.9	168	91.3	83.0-95.8	135	
Province 4	92.7	86.5-96.2	94	92.6	75.2-98.1	106	
Province 5	78.3	68.8-85.5	196	91.0	86.0-94.3	150	***
Province 6	74.9	64.7-82.9	63	76.5	60.1-87.5	69	
Province 7	83.4	74.9-89.4	84	93.7	88.1-96.8	101	*
Ecological zone							
Mountain	74.1	64.1-82.1	75	88.2	76.8-94.4	75	*
Hill	88.0	83.6-91.4	390	89.5	84.6-92.9	402	
Terai	71.3	66.1-76.0	569	84.8	76.6-90.5	523	***
Earthquake-affected districts							
Highly affected	87.6	78.3-93.2	153	90.4	81.1-95.4	116	
Moderately affected	87.3	79.2-92.6	195	92.4	84.5-96.4	212	
Not affected	73.0	68.5-77.0	686	84.6	78.3-89.4	672	***
Sociodemographic characteristics							
Sex of child							
Male	77.4	72.8-81.5	577	88.2	82.8-92.1	501	***
Female	78.4	73.5-82.5	457	85.7	80.5-89.7	499	***
Age of mother							
Less than 20	77.6	68.6-84.6	117	85.5	73.1-92.7	98	
20-24	77.9	72.8-82.3	399	91.8	87.0-95.0	399	***
25-29	77.3	71.1-82.5	315	81.9	74.9-87.2	284	
30-34	79.0	68.7-86.6	145	85.7	70.2-93.8	130	
35-49	78.1	65.3-87.0	58	84.8	71.6-92.5	90	
Mother's education							
No education	67.8	61.0-73.9	321	78.1	70.4-84.2	452	***
Primary	75.8	68.2-82.1	212	94.6	88.6-97.5	200	***
Some secondary	79.8	74.0-84.6	267	95.2	89.4-97.9	211	***
SLC and above	91.2	86.7-94.3	234	92.4	85.1-96.3	137	
Father's education							
No education	63.5	53.3-72.6	138	72.9	62.3-81.3	237	
Primary	71.9	65.1-77.9	243	86.6	80.2-91.2	220	***
Some secondary	82.8	78.4-86.4	460	92.8	88.6-95.5	456	***
SLC and above	84.8	78.4-89.5	188	95.4	88.0-98.3	82	**
Caste/ethnicity							
Brahmin/Chhetri-Hill	87.9	82.9-91.5	260	91.3	85.9-94.7	257	
Terai caste	64.3	55.5-72.3	215	81.6	68.2-90.1	122	***
Janajati	83.3	77.8-87.6	319	93.5	88.4-96.4	361	***
Dalit	73.2	65.1-80.0	160	85.7	76.4-91.7	169	***
Muslim/Others	69.0	56.9-78.9	79	57.4	48.0-66.4	89	
Household wealth quintile							
Poorest	76.6	69.7-82.4	215	84.5	78.0-89.4	247	*
Poorer	77.2	69.6-83.3	229	83.9	75.8-89.6	227	
Middle	70.9	63.7-77.2	237	84.0	72.4-91.4	217	***
Richer	84.8	78.2-89.7	226	91.5	83.4-95.9	183	*
Richest	81.6	70.8-89.1	128	95.7	88.8-98.4	126	***

(Continued…)

Appendix Table A3—Continued

Covariates	Children age 12-23 months						p-value
	Nepal DHS 2016			Nepal DHS 2011			
	%	95% CI	N	%	95% CI	N	
Household size							
1 - 3	83.8	76.0-89.4	138	93.8	87.8-97.0	123	**
4 - 5	78.9	72.9-83.9	333	89.5	83.3-93.6	356	***
6 +	75.8	70.6-80.2	564	83.6	75.4-89.4	521	***
Birth order							
1	84.0	79.7-87.5	420	91.1	84.9-94.9	348	***
2 - 3	75.6	69.9-80.5	443	88.3	83.6-91.8	469	***
4+	68.6	60.1-76.1	171	75.4	63.9-84.2	182	
Mother worked in previous 12 months							
Worked	81.3	77.2-84.9	591	88.6	84.7-91.6	652	***
Not worked	73.2	67.4-78.2	443	83.9	74.7-90.1	347	***
Media exposure of mother							
Not at all	65.3	57.6-72.2	246	74.2	63.3-82.8	164	
Less than once a week	84.1	79.4-87.8	479	90.2	84.8-93.8	583	***
At least once a week	78.2	72.4-83.0	309	87.8	80.8-92.5	253	***
Maternal and child health utilization characteristics							
Place of delivery							
Health facility	83.9	80.5-86.8	652	89.2	82.1-93.7	410	*
Elsewhere	67.5	61.1-73.2	382	85.4	78.9-90.1	589	***
Vaccination card retention							
Never had card	49.5	35.7-63.4	63	46.2	34.8-58.1	87	
Vaccination card retained	91.3	88.1-93.8	541	90.5	84.9-94.2	339	
Vaccination card not retained	65.0	59.4-70.2	429	91.0	85.9-94.4	574	***

*** p < 0.001, ** p < 0.01, * p < 0.05