Child Undernutrition and Feeding Practices in Nepal: Trends, Inequities, and Determinants

DHS Further Analysis Reports No. 122

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Additional information about the 2016 NDHS may be obtained from the Ministry of Health and Population, Ram Shah Path, 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 came 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
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The further analysis of the 2016 NDHS was conducted under the aegis of the Public Health Administration Monitoring and Evaluation Division (PHAMED) of the Ministry of Health and Population (MoHP). The United States Agency for International Development (USAID) provided financial support, with technical assistance provided by ICF. Additional support for report production was provided by the United Nations Population Fund (UNFPA). Overall coordination, facilitation, administration, and logistic support were provided by New ERA, a local research firm with extensive experience in conducting similar studies. The secondary analysis of the 2016 NDHS data has been conducted by technical professionals from the MoHP and Department of Health Services, USAID, and other partners who work directly on the given areas, with technical support and facilitation from ICF and New ERA.

I would like to express my deep appreciation for the contributions of many different stakeholders and for their valuable input in the various phases of the study and the final report. My sincere gratitude goes to all members of the National Monitoring and Evaluation Technical Advisory Group at MoHP for their valuable input. I appreciate the leadership of Mr. Giri Raj Subedi, Sr. Public Health Administrator, and the entire team of the Policy Planning and Monitoring Division, PHAMED, and the Child Health Division for their contributions during the different phases of the study.

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ABSTRACT

In the changing governance structure, it is crucial to assess the impact of intensive investment in nutrition policy and programming on improved child nutritional outcome and feeding practices in the country and to guide the government in future policy and programming based on the evidence. This study uses data collected from the 2011 and 2016 Nepal Demographic and Health Surveys (DHS) to examine stunting and minimum acceptable diet as the key nutritional outcomes. We used descriptive analysis to see the change in distribution from 2011 to 2016, chi-square tests to detect association, and applied logistic regression with 2016 data using Stata version 15.1.

Nepal has reduced the prevalence of stunting and improved recommended complementary feeding practices, especially among the disadvantaged groups in the past 5 years. Yet, inequities exist across socioeconomic and sociogeographic areas. The child-intrinsic determinants of stunting are age and low weight of child. Among health and environmental determinants, access to the government health facility is associated with stunting while receiving all basic vaccines, handwashing with soap and water, and access to media protect against stunting. Socioeconomic determinants of stunting are province and household size, while wealth quintile and mother's education are protective factors. For minimum acceptable diet (MAD), the only child-intrinsic determinant is age of child. Maternal determinants of MAD are mothers' age and dietary diversity score. Health and environmental determinants of MAD are open defecation free (ODF); handwashing with soap and water; maternal, infant, and young child nutrition (MIYCN) counselling; and districts with nutrition-intensive programming. The socioeconomic determinants of MAD are province; residence; wealth quintile; caste/ethnicity; and mother's education. Current determinants show there is a need to strengthen and scale up a tailored multisectoral approach with an integrated package of nutrition-specific and nutrition-sensitive interventions across sectors, namely health; water, sanitation, and hygiene (WASH); agriculture; and education.

KEY WORDS: stunting, minimum acceptable diet, inequity, Nepal

ACRONYMS AND ABBREVIATIONS

AFSP	Agriculture and Food Security Project
ANC	antenatal care
aOR	adjusted odds ratio
ARI	acute respiratory infection
BMI	body mass index
CCG	child cash grant
CI	confidence interval
DHS	Demographic and Health Survey
DoHS	Department of Health Services
EA	enumeration area
EBF	exclusive breastfeeding
EHA	essential hygiene actions
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organization
GAFSP	Global Agriculture and Food Security Program
GIS	geographic information system
HAZ	height-for-age z-score
HFIAS	Household Food Insecurity Access Scale
HFP	homestead food production
ICN2	International Conference on Nutrition II
ICT	information and communication technology
IMAM	integrated management of acute malnutrition
IYCF	infant and young child feeding
KISAN	knowledge-based integrated sustainable agriculture in Nepal
M&E	monitoring and evaluation
MAD	minimum acceptable diet
MCH/FP	maternal and child health/family planning
MIYCN	maternal, infant, and young child nutrition
MoHP	Ministry of Health and Population
MSNP	Multi-Sector Nutrition Plan
NDHS	Nepal Demographic and Health Survey
NHSP	Nepal Health Sector Plan
NPC	National Planning Commission
ODF	open defecation free
OR	odds ratio

PAHAL	Promoting Agriculture, Health, and Alternative Livelihoods
PPMD	Policy, Planning and Monitoring Division
PSU	primary sampling unit
SAARC	South Asian Association for Regional Cooperation
SABAL	Sustainable Action for Resilience and Food Security
SDG	sustainable development goal
SUN	scaling up nutrition
UNICEF	United Nations Children's Fund
uOR	unadjusted odds ratio
USAID	United States Agency for International Development
VIP	ventilated improved pit latrine
WASH	water, sanitation, and hygiene
WB	World Bank
WHA	World Health Assembly
WHO	World Health Organization

1 BACKGROUND

1.1 Introduction

Nepal has made a clear commitment to address undernutrition and micronutrient deficiencies. Meanwhile, the prevalence of stunting in children has declined over the past decade (Ministry of Health–MOH/Nepal, New ERA/Nepal, and ICF 2017). In 2012, the World Health Assembly (WHA) established six key nutrition-related targets to be achieved by 2025 when it endorsed a Comprehensive Implementation Plan on Maternal, Infant, and Young Child Nutrition (WHO 2014). The Sustainable Development Goal (SDG) 2.2 targets the end of all forms of malnutrition by 2030, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under age 5, and addressing the nutritional needs of adolescent girls, pregnant and lactating women, and older persons (United Nations 2015). As a signatory of the global Scaling Up Nutrition (SUN) movement and the WHA Assembly Resolution, Nepal endorsed the globally recommended, multi-sector approach for nutrition, which aims to accelerate the reduction in stunting in the next 5 years. The endorsed plan provides policy guidance and a framework for increased attention to and investment in nutrition interventions that can have a great impact on reducing stunting among children younger than age 5 with a targeted focus on the first 1,000 days of life (National Planning Commission 2012). The national Nepalese nutrition targets are aligned with the global nutrition targets (Ministry of Health and Population 2015b).

Nepal placed a high priority on improving child nutrition in its Multi-Sector Nutrition Plan 2013-2017. The country has prioritized implementing and scaling up evidence-based interventions that address undernutrition and micronutrient deficiencies within a multi-sector framework, which involves six key sectors: health; agriculture; education; local development; water, sanitation, and hygiene; and women and child welfare. Nepal has recently reformed its sociopolitical structure to adopt a federal form of governance with seven provinces and 753 rural and urban municipalities. In 2017, Nepal renewed its commitments to nutrition through the endorsement of the Multi-Sector Nutrition Plan II for 2018-22.

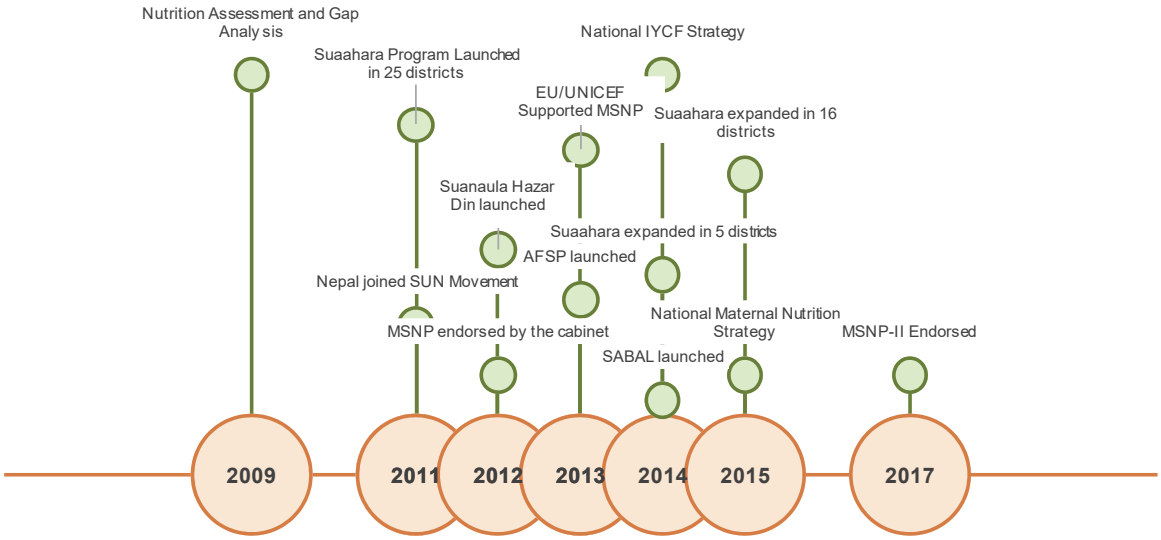
1.2 Policy Landscape for Nutrition in Nepal

Recent years have seen a concerted effort by the Government of Nepal to review, revise, and develop relevant sector policies for nutrition that ensure coherent, coordinated actions at all levels (National Planning Commission 2017). In 2011, Nepal officially joined the global SUN movement. This led the National Planning Commission (NPC), with the support of development agencies, to develop a comprehensive Multi-sector Nutrition Plan (MSNP) that included five key ministries. The MSNP was approved and endorsed by the Council of Ministers in June 2012. The longer-term, 10-year vision of the MSNP is to significantly reduce chronic malnutrition and to ensure overall socioeconomic development in Nepal.

The Government of Nepal, with support from its development partners, also initiated the implementation of many large-scale, multi-sector, integrated nutrition projects and programs under the common framework of the MSNP. In 2011, 2012, and 2013, Nepal began projects entitled Suaahara, KISAN (Knowledge-based Integrated Sustainable Agriculture in Nepal), and SABAL (Sustainable Action for Resilience and Food Security), which are supported by USAID; Sunaula Hazar Din (supported by the World Bank); Maternal and Young Child Nutrition Security Initiative in Asia (2011-2015) and Partnership for Improved Nutrition (*Poshanka Lagi Hatemalo*) in Nepal (2016-2019), supported by the European Union and UNICEF; and the Agriculture and Food Security Project, which

is funded by the Global Agriculture and Food Security Program (GAFSP) (National Planning Commission 2014). Simultaneously, the health sector prioritized nutrition and emphasized the need for a multi-sector approach to implementing policies and strategies (Ministry of Health and Population 2015a, 2017). In 2015, the Ministry of Health and Population (MoHP) approved the establishment of a National Nutrition Center; however, it has not been established yet. In addition, the health sector drafted two key national strategies, Infant and Young Child Feeding (IYCF) and Maternal Nutrition, which focus on the crucial window from conception until age 2.

Figure 1 Major milestones for nutrition policies and programs in Nepal, 2009-2016



The health sector has implemented priority interventions such as IYCF counseling, integrated management of severe malnutrition, and the distribution of multiple micronutrient powder for children, and has also strengthened the nutrition indicators in the routine health management information system (Department of Health Services 2017). In all policies and programs, the Government of Nepal, with support from its development partners, has focused on strengthening the community service delivery mechanism, improving local governance, enhancing coordination and leadership, and improving monitoring and evaluation. The Government has also demonstrated its explicit commitment to addressing disparities and inequities in concurrence with the SDG 2030 agenda of '*Leave no one behind*' through the implementation of nutrition interventions that reduce stunting.

The 2009-10 Nutrition Assessment and Gap Analysis Report recommended adopting a multi-sector approach that involved key sectors in improving nutritional status. In response, a landmark commitment was made by the Government of Nepal and its development partners in the Multi-sector Nutrition Plan 2012-17. This plan identified nutrition as a key factor for socioeconomic and human capital development and established the importance of nutrition investments that created integrated, large-scale, multi-sector projects with high-impact nutrition programs throughout the country. More than 200 million U.S. dollars have been invested in Nepal for nutrition programs during the past 5 years (National Planning Commission 2017). Thus, it is important to assess the impact of nutrition activities on child nutritional and feeding status in the country and to understand the factors that influenced any change.

1.3 Approach for the Study

Stunting is an indicator in the monitoring framework for the National Development Plan, the WHA target, and SDG number 2. Further reduction in stunting and improvement in the coverage of nutrition interventions are necessary to continue improving early childhood growth and development. A clear identification of what worked and where it worked helps the implementing agencies devise appropriate strategies, determine investments, and track results.

In this context, the MoHP of the Government of Nepal commissioned further analysis of NDHS data related to nutrition. This further analysis study was planned in consultation with government agencies and key nutrition development partners to determine its scope and to identify the appropriate indicators for analysis. This study examines stunting and minimum acceptable diet (MAD) as key nutritional outcomes. Stunting was selected unanimously as an outcome because the Government of Nepal has identified stunting as the key outcome indicator for the Multi-sector Nutrition Plan II. It is also the main indicator for the 2025 WHA nutrition target. This report is intended for policymakers, program managers, and concerned stakeholders who are working in the field of child nutrition in Nepal.

2 DATA AND METHODS

2.1 DHS Data

This further analysis uses data collected from the Nepal 2011 and 2016 Demographic and Health Surveys (DHS). The NDHS is a nationally representative, cross-sectional survey that provides regular, periodic estimates of maternal and child health, nutrition, fertility, family planning, malaria, HIV/AIDS, and other country-specific health and population issues. The DHS Program, funded by the USAID, is globally recognized for its collection and dissemination of health and population trends in over 90 developing countries. The DHS Program is implemented worldwide by ICF, while the Nepal DHS is implemented in-country by New ERA with technical support from ICF. The DHS Survey in Nepal is part of a national survey conducted by the MoHP of the Government of Nepal.

The DHS survey in Nepal used multi-stage cluster sampling to obtain a nationally representative sample of households. The methodology for the DHS surveys is detailed elsewhere (Ministry of Health – MOH/Nepal, New ERA/Nepal, and ICF 2017; Ministry of Health Population – MOHP/Nepal, New ERA/Nepal, and ICF International 2012). In the 2011 survey, the country was divided into 13 domains[1] with 5 development regions and 3 ecological zones. Both surveys have used the primary sampling unit (PSU) as sub-ward, ward, or group of wards in the rural areas, and sub-wards in the urban areas. During the 2011 survey, at the first stage of sampling, 289 PSUs (95 in urban areas and 194 in rural areas) were selected by systematic sampling with probability proportional to size. In the second stage, 40 households per PSU in rural areas and 35 households per PSU in urban areas were randomly selected. In contrast, the 2016 DHS used seven provinces in rural and urban areas, which yielded 14 domains. Wards in the rural areas and the wards and sub-wards (old-ward) in the urban areas were used as the PSU. One enumeration area (EA) was selected from each PSU in urban areas. In the first stage, 383 PSUs were selected with the probability proportional to ward size and with independent selection in each sampling stratum. Due to the large size of the urban wards, a ward, an EA, or a segment of a ward was considered a cluster. In the last stage of selection, a fixed number of 30 households per cluster was selected with an equal probability of systematic selection from the newly created household listing.

Since Nepal has recently transitioned to a federal governance structure, trend analysis of outcomes by provinces is useful. We created a province variable for the 2011 DHS data set by merging a newly created data file. This involved using geographic information system (GIS) coordinates with technical support from the GIS expert at ICF. It is important to note that samples from the 2011 survey were not designed to provide estimates for the new provinces. Therefore, the samples created after the data were merged may not be representative of the population in the new provinces. However, any concerns about representativeness are mitigated by the fact that the sample size for each survey is large and robust, and this supports using province at the analytical unit level.

All women of reproductive age (age 15-49) who were members of a sampled household or who had slept there the night before the survey were eligible for an interview. All children age 0-59 months and women of reproductive age in the households were measured for height and weight. Well-trained field staff measured the recumbent length of children age 2 or younger, or those who were shorter than 85 cm, and the standing height of the older children.

[1] Due to the small population size in the mountain regions, the Western, Mid-western, and Far-western mountain regions are combined into one domain, which yielded a total of 13 domains.

We restrict our analysis to children with complete anthropometric measurements and other relevant variables. Data for children younger than age 59 months are pooled from both 2011 and 2016 NDHS. The final total weighted sample is 4,906 children age 0-59 months, with 2,485 children in 2011 and 2,421 children in 2016 included in the stunting analysis. For the analysis related to MAD, the total weighted sample is 2,936 children age 6-23 months, with 1,439 children in 2011 and 1,497 children in 2016.

Table 1 Analytical sample of children for analysis of stunting and minimum acceptable diet, Nepal DHS 2011-2016

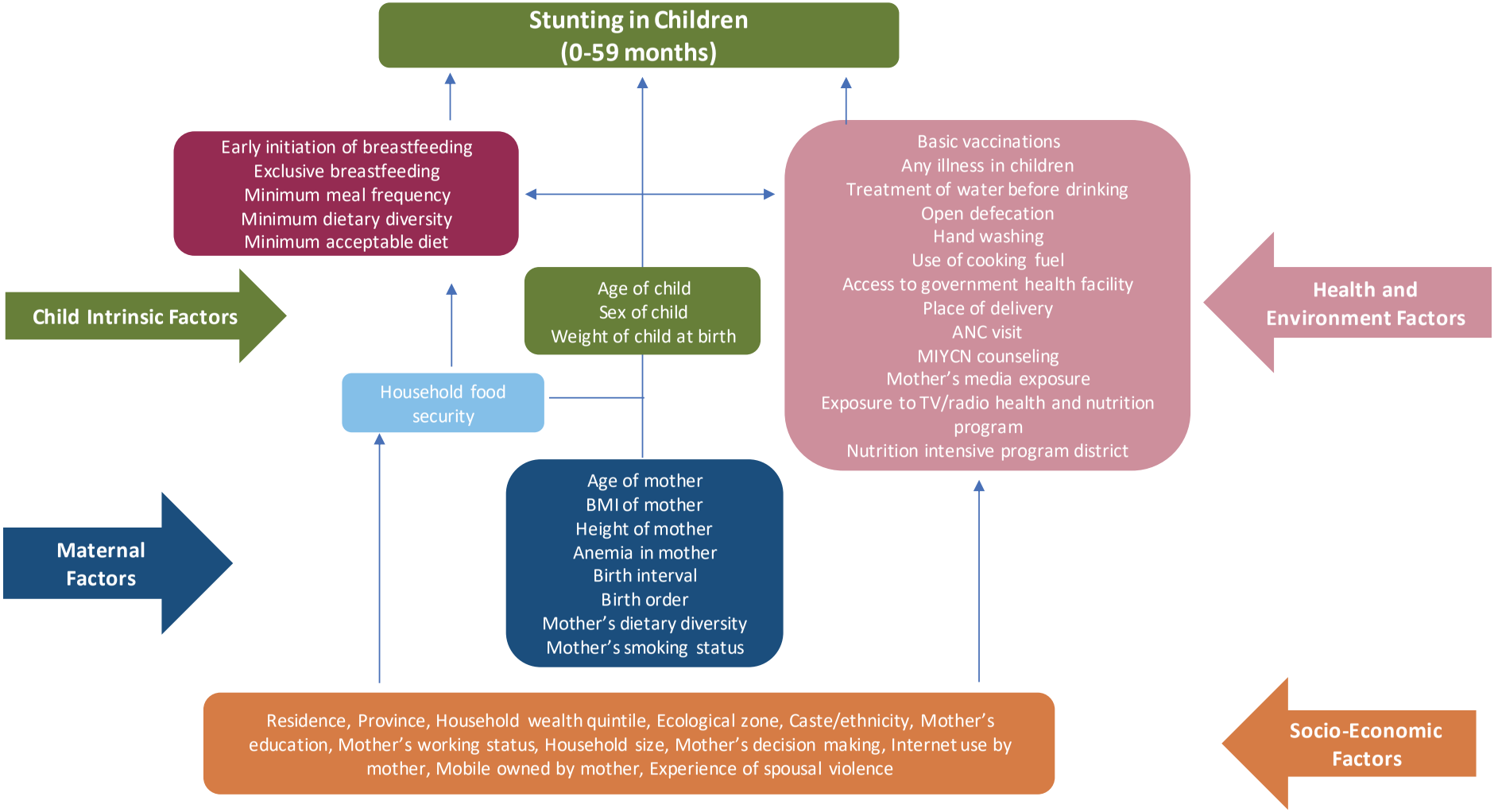
	2011	2016
Date of data collection	February–June 2011	June 2016–January 2017
Number of households interviewed	10,826	11,040
Household response rate	99.4	98.5
Number of women age 15-49 interviewed	12,674	12,862
Sample for stunting	2,376	2,349
Sample for minimum acceptable diet	1,439	1,497

2.2 Conceptual Framework

We used the UNICEF Conceptual Framework for Malnutrition in Children (UNICEF 1991) and the Lancet Framework (Black et al. 2013) to guide our variable grouping and our analysis plan. We identified potential risk factors based on the literature from South Asia, and consultations with the Government of Nepal and national nutrition experts. Figure 2 shows a simplified schema of this conceptual framework for child malnutrition in Nepal, which is determined by multiple factors in which each plays a unique role. In a country like Nepal, health and nutrition outcomes can be attributed to poverty from a lack of resources and poor access to services. Although these factors have an important role in the outcome, they do not directly cause malnutrition. However, there are factors that are directly associated with our study outcomes. After considering the multiple determinants of stunting in Nepalese children, we grouped the likely direct and indirect explanatory factors as socioeconomic, health and environment, maternal, child-instrinsic, and feeding and care practices, as shown in Figure 2.

The variables in the feeding and care practices include early initiation of breastfeeding, exclusive breastfeeding, minimum meal frequency, minimum dietary diversity, and MAD. Age, sex, and weight of the child at birth are considered child-intrinsic factors. Maternal characteristics include a woman's age, body mass index (BMI), height, birth interval, birth order, anemia, dietary diversity, and smoking. Health and environment factors include all basic vaccinations, any illnesses, the treatment of water before drinking, open defecation, handwashing, use of cooking fuel, access to a government health facility, place of delivery, antenatal care (ANC) visit, maternal, infant, and young child nutrition (MIYCN) counseling, exposure to media by women, and exposure to a health and nutrition program on television or radio. Socioeconomic factors include residence, province, wealth quintile, ecological zone, caste/ethnicity, women's education, women's working status, household size, household food security, women's decision making, Internet use by women, mobile phone ownership by women, and spousal violence.

Figure 2 Conceptual framework for stunting among children age 0-59 months



We coded stunting into a binary variable with 1 as stunted and 0 as not stunted. The standard DHS datasets include a variable for children's height-for-age standard deviation, which is the number of standard deviation units from the median height among children at that age, according to the new WHO Child Growth Standards (WHO 2015). The measures in the data file are presented with two decimal places. We divided the variable by 100 to obtain the actual measure of the z-score (HAZ). A z-score less than -2 was considered stunting.

Age of children in months was grouped into 0-11, 12-23, 24-35, 36-47, and 48-59-month categories. The weight of child at birth was re-coded into small (<2.5kg), normal (2.5-3.49 kg), and large (3.5 kg or more). Age of women in years was categorized as 15-24, 25-34, and 35-49. The BMI of women was divided into three categories: underweight (<18.5), normal (18.5-24.9), and overweight/obese (≥25). Height of women was divided into two categories: less than 145 cm (stunted) and 145 cm or more (normal). Anemia in women was categorized as either anemic or non-anemic. Birth interval was grouped into less than 3 years and 3 years or more or no preceding interval (for first order births). Birth order was re-coded into three categories: first born, second to fourth, and fifth or more. Women's dietary diversity score was calculated by grouping all food groups consumed by women into fewer than 5 food groups and 5 or more food groups, according to the FANTA/FAO guidelines (FAO and FHI360 2016). Women's smoking status was grouped as smoking and nonsmoking. Indicators for IYCF were represented by dichotomous variables that indicated whether or not the child was fed per recommended practice for each variable. The variables included early initiation of breastfeeding (proportion of infants age 0-23 months who were breastfed within 1 hour of birth); exclusive breastfeeding (the proportion of infants age 0-5 months fed only breast milk); minimum meal frequency (proportion of breastfed and non-breastfed children age 6-23 months who receive solid, semisolid, or soft foods, including milk feeds for non-breastfed children, the minimum number of times or more); minimum dietary diversity (proportion of children age 6-23 months who received four or more food groups); and MAD (proportion of children age 6-23 months who received four or more food groups and a minimum meal frequency).

Vaccinations (proportion of children age 12-23 months who received all doses of basic vaccines) and any illnesses (children with acute respiratory infection (ARI), diarrhea, or fever) were categorized as dichotomous variables. Households with no toilet facility or those that use the bush or field for defecation were categorized as open defecation.[2] Cooking fuel was categorized as solid and clean fuel.[3] Handwashing was grouped as household with and without soap, water, or cleansing agents. Access to a government health facility was grouped into <30 minutes, 30-60 minutes, and over 60 minutes. Place of delivery was grouped into home/other and health facility. We use a variable categorizing residence in each of Nepal's seven provinces and use the nomenclature Province 1 – Province 7, since these are the province names that were in effect at the time of the survey.[4] Caste/ethnicity was grouped as Brahmin/Chhetri, Terai/Madhesi other caste, Dalit, Newar, Janajati, and Muslim. Women's working status was categorized into three categories as not working, nonagricultural, and agricultural or self-

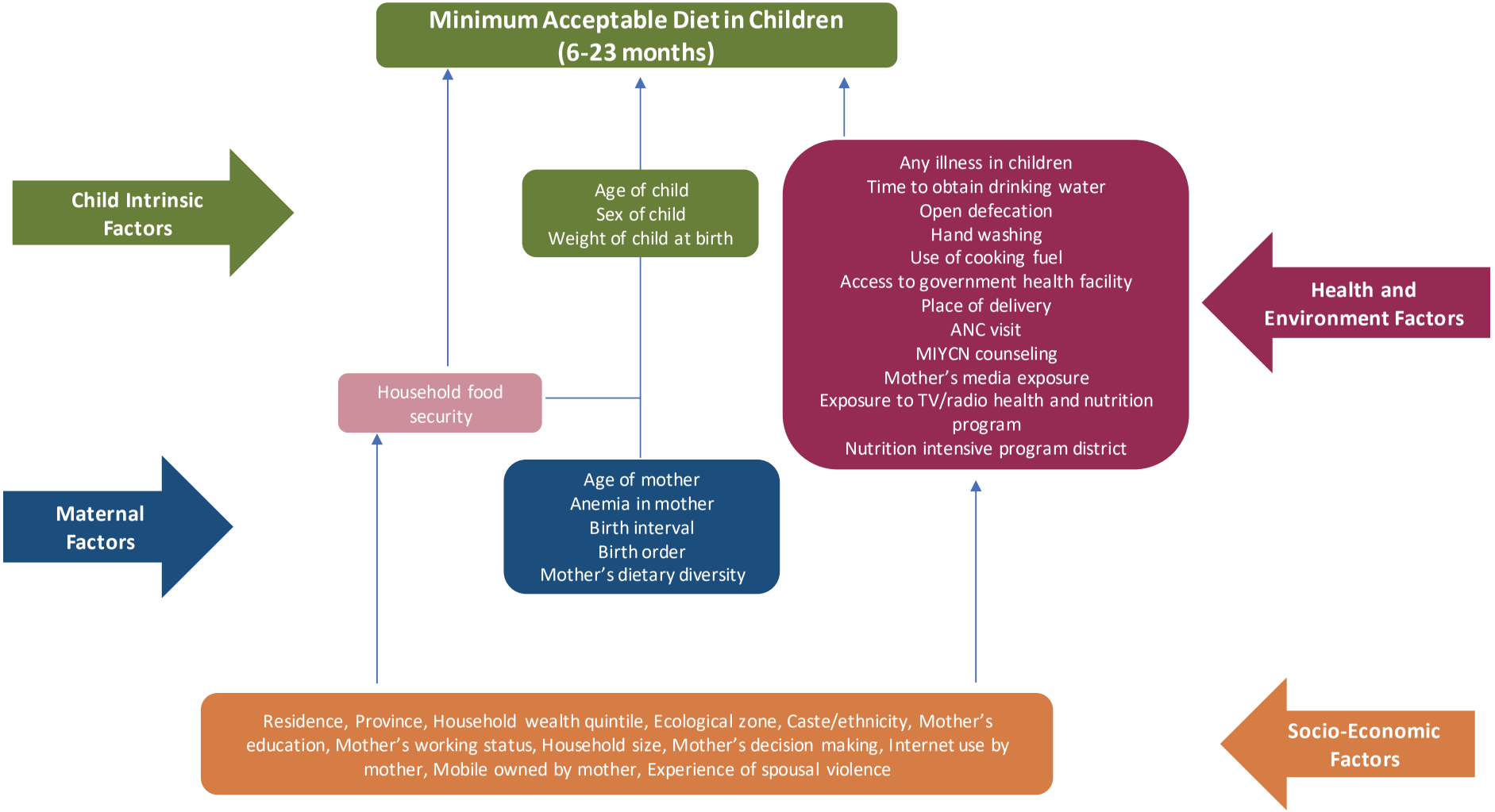
[2] In this study, *open defecation free (ODF)* is defined as those households that have a shared or non-shared toilet. The toilets could be flush/pour flush toilets to piped sewer systems, septic tanks, and pit latrines; ventilated improved pit (VIP) latrines; pit latrines with or without slabs; and composting toilets.
[3] Solid fuel includes charcoal, wood, straw/shrubs/grass, agricultural crops, and animal dung while clean fuel includes electricity and LPG/natural gas/biogas.
[4] Province 4 has since changed its name to Gandaki Province (July 2018), Province 6 to Karnali Province (February 2018), and Province 7 to Sudurpashchim Province (September 2018). The remaining four provinces have not adopted permanent names as of the time of this publication.

employed. The household size was re-coded as more or less than 4. Household food security was grouped into food secure, mild, moderate, and severe food insecurity.

We generated a composite variable for women's decision making by using three variables: women can refuse sex, can decide about their own health care, and can decide on the use of contraception. This variable is represented by two categories: a woman can or cannot make decisions about any of the three variables. Internet use by women was represented by use of Internet in previous 12 months or not. Similarly, experience of spousal violence is divided into two groups: women who were or were not experiencing either physical, sexual, or spousal violence.

For the MAD (Figure 3), the analysis is restricted to children age 6-23 months, with independent variables that include child-instrinsic, maternal, health and environment, and socioeconomic groups as previously defined. The analysis is based on the conceptual framework above. We removed some independent variables such as indicators related to IYCF, which were not relevant for the analysis. Age of the child was re-coded into either age 6-11 or 12-23 months. Household food security was grouped as food secure and food insecure due to the small sample size. Categorization for the other variables was the same as those used in the stunting analysis.

Figure 3 Conceptual framework for minimum acceptable diet among children age 6-23 months



2.3 District Categorization of Nutrition Programming

The Government of Nepal has been implementing regular nutrition-specific and -sensitive interventions through its health and non-health sector networks and community outreach with female community health volunteers, farmer groups, teachers, students, and consumer groups. The interventions include iron and folic acid supplementation to pregnant and lactating women, growth monitoring and promotion, control of parasitic infestation by deworming, and Vitamin A supplementation to women and children. Since 2007 and 2008, the Nutrition Section of the MoHP decided to implement IYCF programs with support from development partners across all 75 districts of the country. After the MSNP was endorsed in 2012, Nepal experienced increased investment in nutrition. Different development partners began implementing multi-sector integrated projects and programs in different parts of the country. In 2012, USAID began an integrated nutrition project "Suaahara – good nutrition" first in 20 districts and then in 40 districts across the country. Other projects such as USAID's KISAN, SABAL and PAHAL were also implemented. Likewise, UNICEF supported the Government of Nepal for implementation of programs, namely IMAM, IYCF linked with MNP, and Child Cash Grant. The World Bank supported the implementation of the Agriculture and Food Security Project and Sunaula Hazar Din.

For this analysis, we categorized nutrition programming for all 75 districts, under the direction of the Technical Working Group, which includes representatives from the Family Welfare Division, Policy, Planning and Monitoring Division of the MoHP, and all key development partners that work in the health sector. The districts were divided into four categories based on type and intensity of nutrition interventions: Groups A, B, C, and D, as shown in Table 2. We identified maternal, infant and young child nutrition (MIYCN), Essential Hygiene Actions (EHA), Homestead Food Production (HFP), functional district and subdistrict level food and nutrition security coordination committee (Nutrition Governance), and integrated MCH and FP services with nutrition, Integrated Management of Acute Malnutrition (IMAM), and the Child Cash Grant (CCG) as the key nutrition interventions in the country.

Table 2 District categorization by different nutrition program interventions

Program interventions	Group A Districts= 17	Group B Districts= 21	Group C Districts= 8	Group D Districts= 29
MIYCN	X	X	X	
HFP	X		X	
MCH/FP	X		X	
EHA	X		X	
Nutrition governance	X	X	X	
MSNP		X	X	
IMAM		X	X	
MNP		X	X	
Child Cash Grant (CCG)		X		
Government regular nutrition interventions	X	X	X	X

Group A received MIYCN, HFP, MCH/FP, EHA, and Nutrition Governance interventions. Group B received Nutrition Governance, MIYCN, MSNP, IMAM, MNP, and CCG.[5] Meanwhile, Group C received all of the interventions in both Group A and Group B, except CCG. Districts in Group D

[5] Only 5 districts in Karnali region have had CCG interventions available.

received regular nutrition programs[6] implemented by the government. Groups A, B, and C also received regular government nutrition interventions. According to the defined criteria, 17 districts were included in Group A, 21 districts in Group B, 8 districts in Group C, and 29 districts in Group D. See Appendix Table A1 for a list of districts in each group.

Before data collection, Group A had intervention exposure to a set of nutrition interventions (MIYCN, EHA, HFP, Nutrition Governance and MCH/FP) for 2.5 years. Group B received interventions (Nutrition Governance, MIYCN, IMAM and CCG) for approximately 2 years except for five districts in Karnali that received more than 5 years of CCG interventions. Districts in Group C had exposure to both set of interventions in Groups A and B. All groups were exposed to government-supported regular nutrition interventions, although only Group D did not receive additional interventions beyond the regular nutrition interventions.

2.4 Statistical Analysis

This study uses data from the household member recode data file (PR) for stunting and the children's recode data file (KR) for MAD, with additional variables merged from the women's recode file (IR) of the 2016 DHS for descriptive statistics, and the bivariate and multivariate regression analyses. For the assessment of changes in stunting by key socioeconomic variables, we used the modified PR dataset from 2011 with the province variable added and merged it with the KR and IR File. Likewise, the 2016 data file with the merged KR, PR, and IR files was created and appended with the 2011 merged file.

We expressed the dependent variables (stunting and MAD) as dichotomous variables with stunting as either stunted or not stunted, and MAD as children fed or not fed with MAD. We initially ran the descriptive analysis to assess the change in distribution of all variables from 2011 to 2016. Next, using the 2016 dataset, we conducted the bivariate analysis to examine the association between the outcomes with selected explanatory variables. We used the chi-square test to detect associations between each of the explanatory variables with the outcomes.

We used logistic regression analysis to assess the association between stunting and MAD with each independent variable separately. We then regressed stunting and MAD on the child-instrinsic, maternal, health and environment, and socioeconomic variables separately. We also regressed stunting on the IYCF variables as well.

All data were analyzed using Stata version 15.1. Standard Stata analytic commands were used for all analyses. All estimates are weighted. The "svy" command was used to account for the complex survey design (stratification, clustering, and sample weights) and for estimation of summary estimates across all variables. A p-value of less than 0.05 was considered significant.

[6] Regular nutrition programs include Growth Monitoring and Promotion, Biannual Vitamin A Supplementation, and IFA supplementation to pregnant and lactating women.

3 TRENDS IN OUTCOME AND EXPLANATORY VARIABLES, 2011-2016

We selected a total of 42 independent variables for assessing the determinants of stunting among children age 0-59 months. For MAD, there were 33 variables. A detailed distribution of these variables for 2011 and 2016 of the households with children measured for anthropometry (stunting) is shown in Appendix Table A2. Table 3 shows the distribution of those explanatory variables that showed a significant change in previous 5 years. Nepal continues to be a high-burden country with a stunting prevalence of 36% in 2016, despite the decline from 40% in 2011, which was a reduction of 5 percentage points. The prevalence of overweight/obesity (BMI ≥25) among women has increased by 6 percentage points from 2011 to 2016. A similar trend was shown for anemia in women with an increase of 8 percentage points.

Progress in IYCF practices has been uneven in Nepal. Early initiation of breastfeeding has improved over the years from 44% in 2011 to 54% in 2016, which was an increase of 10 percentage points in the last 5 years. However, within the same period, exclusive breastfeeding (EBF) practices have decreased, with an almost 3 percentage point reduction in the EBF rate (see Appendix Table A2). In 2011, four in five children (78%) were fed according to the recommended times of minimum meal frequency. The practice decreased by 10 percentage points in 2016. Trends in the rate of minimum dietary diversity in children during the study period showed improvement with a percentage point increase of 15 in 2016. Overall, IYCF practices have improved between 2011 and 2016, as reflected in the composite indicator MAD, which increased by 12%.

A total of 19% of households treated their water for drinking in 2016 as compared to 13% in 2011. In 2016, there was a decrease in open defection of more than 25 percentage points with 23% of households practicing open defecation. In 2016, almost 23 percentage points more women went to a health facility for delivery as compared to 2011. There has been an almost 20 percentage point increase in the rate of four or more ANC visits between 2011 and 2016. Households with severe food insecurity dropped by almost 11 points, although households with mild food insecurity increased by almost 11 points from 2011 to 2016.

Table 3 Distribution and patterns of covariates in study population, Nepal DHS 2011-2016

Characteristics	2011		2016		Percentage point change 2016-2011	p-value[1]
	%	*N*	%	*N*		
Stunting						
No	59.7	*1,419*	64.4	*1,512*	4.6	*
Yes	40.3	*957*	35.7	*838*	-4.6	
Minimum acceptable diet						
No	76.0	*1,094*	64.3	*962*	-11.8	***
Yes	24.0	*345*	35.8	*535*	11.8	
Mother's BMI						
Underweight (<18.5)	19.6	*464*	19.2	*450*	0.4	***
Normal (18.5-24.9)	71.1	*1,683*	65.2	*1,530*	5.9	
Overweight/obese (≥25)	9.3	*221*	15.6	*366*	-6.3	
Mother's anemia status						
Anemic	38.1	*892*	45.7	*1,067*	7.6	**
Non-anemic	61.9	*1,450*	54.3	*1,267*	-7.6	
Early initiation of breastfeeding						
Child was breastfed within 1 hr. of birth	43.7	*423*	55.4	*544*	11.7	**
Child was not breastfed within 1 hr. of birth	56.3	*545*	44.6	*438*	-11.7	
Minimum meal frequency						
Child was not fed meal with recommended minimum number of times	21.7	*153*	31.5	*236*	9.7	**
Child was fed meal with recommended minimum number of times	78.3	*553*	68.6	*513*	-9.7	
Minimum dietary diversity						
Child was not fed with minimum dietary diversity	71.0	*502*	55.7	*417*	-15.3	***
Child was fed with minimum dietary diversity	29.0	*205*	44.3	*332*	15.3	
Treatment of water before drinking						
No treatment done	87.4	*2,076*	81.3	*1,907*	-6.1	**
Treatment done	12.6	*300*	18.7	*439*	6.1	
Open defecation						
Open defecation free	51.3	*1,219*	77.4	*1,819*	26.1	***
Open defecation	48.7	*1,157*	22.6	*530*	-26.1	
Place of delivery						
Home/other	65.7	*1,549*	42.8	*1,001*	-22.9	***
Health facility	34.4	*810*	57.2	*1,340*	22.9	
ANC visit						
None	16.8	*317*	5.5	*106*	11.3	***
1-3	34.4	*647*	25.5	*489*	8.7	
4 or more	48.8	*919*	68.9	*1,320*	-19.9	
Household food security						
Food secure	43.1	*1,024*	40.9	*961*	2.2	***
Mild food insecurity	12.3	*292*	22.7	*534*	-10.4	
Moderate food insecurity	23.3	*553*	25.8	*606*	-2.5	
Severe food insecurity	21.3	*507*	10.6	*248*	10.8	

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

[1] p-value is the result of a chi-square test of independence between covariate and survey year.

4 STUNTING IN CHILDREN AGE 0-59 MONTHS

4.1 Pattern and Distribution of Stunting in 2011 and 2016

Figure 4 shows changes in the distribution of height-for-age z-score (HAZ) from 2011 to 2016 that reflect a parallel rightward shift. The distribution pattern may indicate that the change was observed across the entire distribution, and the rightward shift may indicate that the severity of stunting has also decreased during this period. The significance test to determine any difference in HAZ scores between the two surveys was significant, which indicated possible change between 2011 and 2016 (z=2.602 with the two-tailed p-value 0.009).

Figure 4 Distribution of child height-for-age z-score (HAZ), Nepal DHS 2011-2016

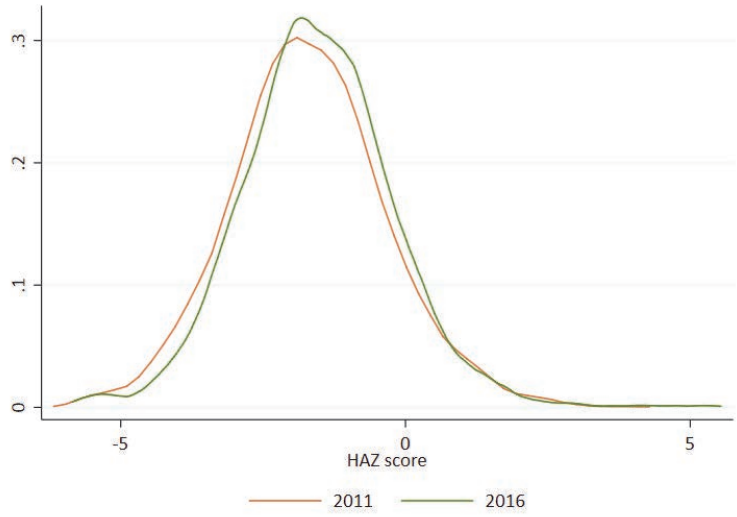
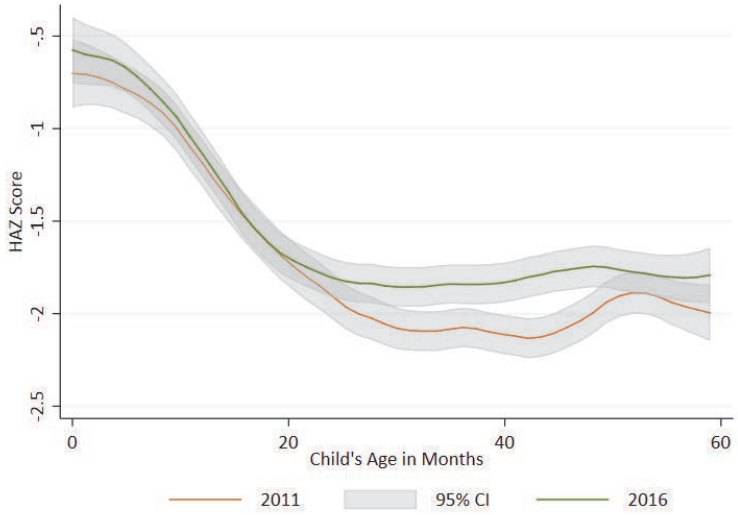


Figure 5 shows patterns of the HAZ score by age of children in 2011 and 2016. The figure indicates how growth of a child falters as their age progresses. The green line shows the 2016 distribution of the HAZ score, while the orange line for 2011 with the shaded area around the lines represents the 95% confidence interval (CI). From the age when child is born (zero month) until the child reaches age 23 months, there is a consistent decline in growth with both the 2011 and 2016 data. Both years' data show similar patterns for growth faltering until age 23 months, although the growth shows further decline in 2011 and a flattening pattern for 2016 for children close to age 60 months. The graph also shows overlapping confidence intervals of the 2011 and 2016 data for much of the age distribution.

Figure 5 Distribution of child height-for-age z-score (HAZ) by age of children, Nepal DHS 2011-2016



Note: "lpoly" command is used to smooth the line for HAZ score by age of children for 2011 and then another line is added using "lpolyci and addplot."

4.2 Socioeconomic Inequalities in Stunting in 2011 and 2016

The WHO has emphasized that governments should have an explicit, robust commitment to equity, which is crucial to the inclusive growth of a country (WHO 2019). As part of the SDG II, the SUN Movement, the International Conference on Nutrition II (ICN2) Framework for Action, and the WHO MIYCN Plan, Nepal is committed to addressing the factors that influence inequity in malnutrition and ensuring equality for interventions that assure no child will be left behind. Our analysis of the trends of stunting by selected key socioeconomic and sociodemographic variables between 2011 and 2016 is presented in Table 4.

Table 4 Trends in stunting across key explanatory variables, Nepal DHS 2011-2016

Characteristics	2011		2016		Percentage point change 2016-2011	p-value
	%	N	%	N		
Age of child (in months)						
0-11	17.8	*82*	16.1	*75*	-1.8	
12-17	28.6	*76*	31.9	*74*	3.3	
18-23	41.9	*90*	42.3	*118*	0.4	***
24-35	52.2	*250*	45.0	*200*	-7.3	
36-47	53.5	*270*	39.6	*188*	-13.9	
48-59	42.0	*188*	40.3	*183*	-1.6	
Sex of child						
Male	41.2	*497*	35.5	*436*	-5.7	*
Female	39.3	*459*	35.8	*402*	-3.5	
Province						
Province 1	37.0	*187*	33.1	*123*	-3.9	
Province 2	39.9	*200*	36.6	*235*	-3.3	
Province 3	33.4	*104*	29.7	*105*	-3.7	
Province 4	35.8	*93*	28.7	*52*	-7.1	*
Province 5	42.4	*157*	37.8	*168*	-4.6	
Province 6	58.4	*92*	54.7	*82*	-3.7	
Province 7	46.0	*124*	35.4	*73*	-10.6	
Household wealth quintile						
Poorest	56.2	*341*	49.1	*237*	-7.0	
Poorer	45.1	*218*	38.0	*194*	-7.1	
Middle	35.1	*194*	35.5	*189*	0.5	*
Richer	30.0	*122*	32.5	*166*	2.6	
Richest	25.1	*82*	16.4	*51*	-8.7	
Ecological zone						
Mountain	53.1	*100*	46.5	*76*	-6.7	
Hill	41.8	*392*	32.3	*278*	-9.5	***
Terai	37.2	*465*	36.5	*484*	-0.6	
Caste/ethnicity						
Brahmin/Chhetri	36.9	*268*	33.8	*218*	-3.1	
Terai/Madhesi other	45.8	*105*	41.9	*199*	-3.9	
Dalit	46.9	*203*	39.2	*133*	-7.7	*
Newar	30.8	*19*	21.4	*15*	-9.4	
Janajati	40.6	*316*	32.3	*213*	-8.3	
Muslim	30.9	*45*	37.5	*61*	6.6	
Mother's education						
No education	47.4	*534*	45.7	*372*	-1.7	
Primary	41.4	*193*	36.7	*173*	-4.7	
Some secondary	32.0	*148*	31.7	*179*	-0.4	
SLC or higher	25.3	*81*	22.8	*114*	-2.5	
Household size						
4 or less	39.2	*261*	29.0	*205*	-10.2	***
More than 4	40.7	*695*	38.5	*633*	-2.2	
Household food security						
Food secure	33.1	*339*	29.2	*280*	-3.9	
Mild food insecurity	39.5	*115*	35.7	*191*	-3.8	
Moderate food insecurity	45.2	*250*	41.5	*252*	-3.7	
Severe food insecurity	49.8	*252*	46.3	*115*	-3.5	
Nutrition intervention program district[1]						
Group A	42.0	*116*	34.6	*82*	-7.4	
Group B	40.2	*365*	36.6	*304*	-3.7	
Group C	47.9	*110*	38.3	*82*	-9.6	
Group D	38.0	*366*	34.6	*366*	-3.4	

[1] This variable is created to categorize all districts of Nepal according to nutrition interventions/programs/projects. Districts in Group A received MIYCN, HFP, MCH/FP, EHA, and Nutrition Governance; those in Group B received MIYCN, MSNP, IMAM, MNP, and CCG; while those in Group C had overlapping district with Group A and Group B interventions. Districts under Group D received regular nutrition programs by the government.

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

The p-value is the result of a chi-square test of independence between covariate and survey year.

Stunting has declined between the two surveys among boys (6 percentage points) and among children age 24-47 months (7-14 percentage points), but not among girls or children of other age groups. There was a statistically significant reduction in stunting between 2011 and 2016 of 11 percentage points in

Province 7 (Sudurpashchim Province). Stunting has significantly decreased among poorest households. The Hill ecological zone experienced a significant decline in stunting from 42% to 32%. Stunting decreased among the Janajati (8 percentage points) caste/ethnicity group.

For mother's education, the declines were significant, falling by 5 percentage points among women with primary education. A significant reduction of 10 percentage points was seen among households with four or fewer members. Stunting has declined by 4 percentage points among households with moderate food insecurity. Stunting also declined in districts with Group A and C nutrition interventions, with the largest reduction (10 percentage points) observed in Group C.

4.3 Understanding the Factors behind Stunting in Children (age 0-59 months) in Nepal using DHS 2016 Data

As described in the methodology section, we adopted a modification of the widely used UNICEF Conceptual Framework, which identifies immediate, basic, and underlying causes of undernutrition in children. In this section, we focus on exploring the association of 42 different explanatory variables (categorized as child-instrinsic, maternal, IYCF practices, health and environment, and socioeconomic situation-related characteristics) with stunting as the outcome.

4.3.1 Association of child-intrinsic factors with stunting

Table 5 shows that current age and weight at birth are strongly associated with stunting among children in Nepal ($p<0.001$). The likelihood of stunting increases with the rise in a child's age. Sixteen percent of children age 0-11 months are stunted, with the proportion of stunted children increasing to 32% among children age 12-17 months. The proportion of stunting continues to increase until age 35 months, when the proportion of stunting gradually decreases among older children. The proportion of stunting is higher among small birthweight children (47%) than normal and large birthweight children (25%-28%). There is no significant difference in stunting between male and female children.

Table 5 Distribution of stunting across child-intrinsic factors, Nepal DHS 2016

Characteristics	%	N	p-value
Age of child (in months)			
0-11	16.1	*75*	***
12-17	31.9	*74*	
18-23	42.3	*118*	
24-35	45.0	*200*	
36-47	39.6	*188*	
48-59	40.3	*183*	
Sex of child			
Male	35.5	*436*	
Female	35.8	*402*	
Weight of child at birth			
Small (<2.5 kg)	46.9	*83*	***
Normal (2.5-3.49 kg)	28.4	*236*	
Large (≥3.5 kg)	25.2	*109*	

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

4.3.2 Association of maternal factors with stunting

Six of eight maternal factors are associated with stunting as shown in Table 6. No significant association with stunting is detected for woman's age and anemia in women. Child stunting is more common among children born to underweight women (BMI less than 18.5) than those born to normal and overweight women. Almost 45% of children are stunted among underweight women as compared to 24% of children born to overweight/obese women with a BMI greater than 25. The height of women is strongly

associated with stunting, with the prevalence of stunting higher among children of women with a height less than 145 cm (59%) than among children of women with a height greater than 145 cm.

Table 6 Distribution of stunting across maternal factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Mother's age			
15-24 years	32.6	*325*	
25-34 years	37.2	*423*	
35-49 years	41.5	*90*	
Mother's BMI			
Underweight (<18.5)	44.9	*192*	***
Normal (18.5-24.9)	36.3	*489*	
Overweight/obese (≥25)	24.1	*79*	
Mother's height			
Less than 145 cm	58.8	*154*	***
145 cm or more	32.7	*682*	
Mother's anemia			
Anemic	35.8	*382*	
Non-anemic	35.3	*448*	
Birth interval			
Less than 3 years	46.0	*311*	***
3 years or more or no preceding interval	32.9	*255*	
Birth order			
First born	30.4	*272*	***
2-4	37.4	*473*	
5 or more	48.3	*93*	
Mother's dietary diversity			
Less than 5 food groups	38.4	*624*	***
5 or more food groups	29.5	*213*	
Mother's smoking status			
Smoking	47.8	*62*	**
Non-smoking	34.9	*776*	

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

4.3.3 Association of infant and young child feeding factors with stunting

Analysis of NDHS data shows significant associations of stunting with factors related to breastfeeding but not with those related to complementary feeding. A higher proportion of stunting (30%) is found among the group of children who were not exclusively breastfed.

Table 7 Distribution of stunting across infant and young child feeding factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Early initiation of breastfeeding			
Child was breastfed within 1 hr. of birth	25.4	*110*	
Child was not breastfed within 1 hr. of birth	29.1	*157*	
Exclusive breastfeeding			
Child was exclusively breastfed	--	--	**
Child was not exclusively breastfed	29.9	*240*	
Minimum meal frequency			
Child was fed meal with recommended minimum number of times	27.8	*65*	
Child was not fed meal with recommended minimum number of times	33.5	*171*	
Minimum dietary diversity			
Child was fed with minimum dietary diversity	30.3	*100*	
Child was not fed with minimum dietary diversity	32.8	*136*	
Minimum acceptable diet			
Child was fed with recommended minimum acceptable diet	31.2	*76*	
Child was not fed with recommended minimum acceptable diet	32.0	*160*	

*** p<0.001, **p<0.01, *p<0.05
-- indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
Note: For early initiation of breastfeeding, the analysis is done among last-born children who were born in the 2 years preceding the survey. For exclusive breastfeeding, analysis is restricted to youngest children under age 2 who are living with their mother. For complementary feeding-related indicators, the analysis is restricted to the youngest children age 6-23 months living with their mother.

4.3.4 Association of health and environment factors with stunting

Table 8 shows the association of stunting with health and environment factors. Households that treated water before drinking have significantly lower proportion of stunted children (25%). Similarly, households not practicing open defecation have fewer stunted children (32%). Children in households with facilities for washing hands with soap or water are significantly less likely to experience stunting (25%), compared to those without soap and water (42%). Use of cooking fuel is also significantly associated with stunting, with less stunting in households that used clean fuel (22%) versus solid fuel (40%). The proportion of stunted children is significantly less among women who delivered at health facilities (29%) than among women who delivered at home or elsewhere (44%). Households with more than a 60-minute trip to reach the government health facility also have more stunted children.

Table 8 Distribution of stunting across health and environment factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Vaccinations			
Child (12-23 months) received all basic vaccines	37.4	147	
Child (12-23 months) not received all basic vaccines	38.6	45	
Any illnesses			
Child had no illness	35.9	628	
Child had any illness	34.9	209	
Treatment of water before drinking			
No treatment done	38.1	726	
Treatment done	25.5	112	***
Open defecation			
Open defecation free	31.8	578	
Open defecation	48.9	259	***
Handwashing			
Household with no soap and water	42.1	613	
Household with soap and water	25.0	221	***
Use of cooking fuel			
Clean fuel	22.6	125	
Solid fuel	39.7	709	***
Access to government health facility			
<30 minutes	31.8	384	
30-60 minutes	37.4	321	
60+ minutes	45.8	122	***
Place of delivery			
Home/other	43.5	436	
Health facility	29.7	398	***
ANC visit			
None	49.2	52	
1-3	40.3	197	
4 or more	28.6	376	***
MIYCN counselling			
No	36.7	720	
Yes	29.9	114	*
Mother's media exposure			
Access none of the 3 media at all	50.5	274	
Access any of 3 media (radio, television or newspaper) less than once a week	37.6	210	
Access any of 3 media (radio, television or newspaper) at least once a week	28.2	350	***
Exposure to TV/radio health and nutrition program			
Heard/seen none of the TV/radio H&N programs	40.2	584	
Heard/seen any one of the TV/radio H&N programs	28.1	250	***
Nutrition intervention program district[1]			
Group A	34.6	82	
Group B	36.6	304	
Group C	38.3	82	
Group D	34.6	366	

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

[1] This variable is created to categorize all districts of Nepal according to nutrition interventions/ programs/projects. Districts in Group A received MIYCN, HFP, MCH/FP, EHA, and Nutrition Governance; those in Group B received MIYCN, MSNP, IMAM, MNP, and CCG; while those in Group C had overlapping district with Group A and Group B interventions. Districts under Group D received regular nutrition programs by the government.

Children of women who had more than four ANC visits are significantly less likely to be stunted (29%) than those who had either fewer than four visits (40%) or no ANC visit (49%). There is a significant association between MIYCN counseling and stunting. Only 30% of children are stunted among households with women who received counseling versus those in households who did not (37%). Exposure to media and exposure to any TV/radio health and nutrition programs are strongly associated with stunting. More than half of children (51%) are stunted among women who had no access to any type of media (radio, television, or newspaper), while the proportion of stunted children is significantly lower (28%) if the woman had access to any media at least once a week. A marked difference is observed

for stunting between women who had heard or seen any one health or nutrition program on TV or radio as compared to those who had not seen a program.

4.3.5 Association of socioeconomic status factors with stunting

There is a significant association between stunting and the covariates of residence, province, wealth quintile, ecological zone, women's education, women's occupation, household size, household food security, Internet use by women, and women owning a mobile phone. There is no statistically significant association with caste/ethnicity, women's ability for decision making, and experience of spousal violence. A significant higher proportion of stunted children is found in rural areas. Substantially high stunting prevalence is found in Province 6 (Karnali Province) compared to the other provinces. Province 4 (Gandaki Province) has the lowest prevalence. A negative relationship is observed between stunting and household wealth quintile, with a gradual decline across quintiles. There is markedly less stunting among the richest quintile compared to other wealth quintiles. Fewer stunted children are from the Hill region, compared to the Terai and Mountain regions.

Table 9 Distribution of stunting across socioeconomic factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Residence			
Urban	31.6	393	***
Rural	40.2	444	
Province			
Province 1	33.1	123	
Province 2	36.6	235	
Province 3	29.7	105	
Province 4	28.7	52	***
Province 5	37.8	168	
Province 6	54.7	82	
Province 7	35.4	73	
Household wealth quintile			
Poorest	49.1	237	
Poorer	38.0	194	
Middle	35.5	189	***
Richer	32.5	166	
Richest	16.4	51	
Ecological zone			
Mountain	46.5	76	
Hill	32.3	278	**
Terai	36.5	484	
Caste/ethnicity			
Brahmin/Chhetri	33.8	218	
Terai/Madhesi other	41.9	199	
Dalit	39.2	133	*
Newar	--	--	
Janajati	32.3	213	
Muslim	37.5	61	
Mother's education			
No education	45.7	372	
Primary	36.7	173	***
Some secondary	31.7	179	
SLC or higher	22.8	114	
Mother's occupation			
Not working	30.0	280	
Non-agricultural	35.7	117	***
Agricultural (self-employed)	40.5	436	
Household size			
4 or less	29.0	205	***
More than 4	38.5	633	
Household food security			
Food secure	29.2	280	
Mild food insecurity	35.7	191	***
Moderate food insecurity	41.5	252	
Severe food insecurity	46.3	115	
Mother's decision making			
Cannot make decision	36.5	434	
Can make decision	33.7	327	
Mother's internet use			
Not used in past 12 months	38.3	741	***
Used in past 12 months	22.8	93	
Mother owns a mobile phone			
No	45.2	249	***
Yes	32.7	585	
Mother's experience of spousal violence			
Did not experience	35.3	523	
Experienced	38.1	118	

*** p<0.001, **p<0.01, *p<0.05
-- indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

Mother's education shows a negative relationship with stunting. The working status of mother and household size are significantly associated with stunting. Access to food at household level, as shown by the Household Food Insecurity Access Scale (HFIAS), also shows a significant association, with

severe food insecure households having the highest, and food secure households having the lowest prevalence of stunting. Use of a mobile phone or the Internet have a positive association with stunting, with a higher proportion of stunting among mothers who did not use Internet in the previous 12 months.

4.4 Determinants of Child Stunting

In this section, we examine the potential determinants of stunting. In Table 10, Model I shows the unadjusted odds ratios (uOR) from separate bivariate logistic regressions. Model II reports the adjusted odds ratios (aOR) for stunting from a separate multiple logistic regression for each group of the conceptual framework: child-intrinsic factors, maternal factors, infant and young child feeding factors, health and environment factors, and socioeconomic factors. For example, in the child-intrinsic factors model, we include independent variables such as age, sex, and weight of the child. Table 10 shows only the subset of independent variables that show significant associations with stunting in Model II. No variables in the full model for infant and young child feeding factors were significantly associated with stunting and so these data are not shown in Table 10. Appendix Table A3 presents results of the five full models with significant and nonsignificant variables.

Model I shows a significant association with a range of factors. Among maternal factors, mother's age and birth order appear to be positively associated while mother's height, dietary diversity, and non-smoker status appear to be negatively associated with stunting, but none of these factors remain significant in Model II. The case is similar for several health and environment factors (lack of water treatment, open defecation, solid cooking fuel, lack of facility delivery or ANC, and no exposure to health and nutrition programming on TV/radio) and socioeconomic factors (rural residence, caste/ethnicity, household food insecurity, and lack of internet use and mobile phone). The child-intrinsic factor, sex of child; the maternal factor, mother's anemia; all infant and young child feeding factors; the health and environment factors, vaccinations, any illnesses, nutrition intervention program district, and MYCN counseling; and the socioeconomic factors, women's decision making and experience of spousal violence are not presented as they do not show any significant association in either Model I or Model II (see Appendix Table A3).

In Model II for child-instrinsic factors, age of the child is positively associated with stunting while weight of the child at birth is negatively associated with stunting. Mother's BMI (aOR 0.75 and 0.42 for normal and overweight, respectively) and long birth interval (aOR 0.63) are negatively associated with stunting after controlling for other maternal factors. Among health and environment factors, receiving all basic vaccines and poor access to government health facility are positively associated with stunting while handwashing with soap and water, and mother's media exposure are negatively associated with stunting. In the model with socioeconomic factors, the strongest association with stunting is seen for Province 6, Karnali Province (aOR 1.73), mother's work in a non-agricultural occupation (aOR 1.94), and household sized of more than four (aOR 1.41). Household wealth quintile and mother's education are negatively associated with stunting, after controlling for other factors in this model.

Table 10 Association of stunting and child-instrinsic, maternal, infant and young child feeding, health and environment and socioeconomic factors. Results from separate multiple logistic regressions, Nepal DHS 2016

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Child-instrinsic factors model				
Age of child (in months)				
0-11	Ref			
12-17	2.44***	1.62-3.67	2.01**	1.17-3.45
18-23	3.82***	2.55-5.73	3.52***	2.17-5.69
24-35	4.26***	3.04-5.98	3.97***	2.56-6.19
36-47	3.42***	2.41-4.85	2.62***	1.67-4.11
48-59	3.53***	2.38-5.22	2.68***	1.62-4.45
Weight of child at birth				
Small (<2.5 kg)	Ref			
Normal (2.5-3.49 kg)	0.45***	0.31-0.65	0.46***	0.32-0.67
Large (≥3.5 kg)	0.38***	0.25-0.58	0.37***	0.24-0.57
Only covariates with a significant association are shown. The full model in Model II controls for the following additional child-instrinsic variable: sex of child.				
Maternal factors model				
Mother's BMI				
Underweight (<18.5)	Ref			
Normal (18.5-24.9)	1.27*	1-1.6	0.75*	0.58-0.96
Overweight/obese (≥25)	1.45	0.99-2.12	0.42***	0.28-0.62
Birth interval				
Less than 3 years	Ref			
3 years or more or no preceding birth interval	0.54***	0.46-0.72	0.63***	0.49-0.81
Only covariates with a significant association are shown. The full model in Model II controls for the following additional maternal variables: mother's age, anemia status, height, dietary diversity, and smoking status; birth interval; and birth order.				
Health and environment factors model				
Vaccinations				
Child (12-23) not received all basic vaccines	Ref			
Child (12-23) received all basic vaccines	0.95	0.57-1.59	2.28***	1.74-2.99
Handwashing				
Household with no soap and water	Ref			
Household with soap and water	0.45***	0.37-0.56	0.64***	0.5-0.82
Access to government health facility				
<30 minutes	Ref			
30-60 minutes	1.24*	0.99-1.53	1.24	0.98-1.57
60+ minutes	1.75***	1.28-2.4	1.60*	1.11-2.31
Mother's media exposure				
Access none of the 3 media at all	Ref			
Access any of 3 media (radio, television or newspaper) less than once a week	0.59***	0.45-0.77	0.68*	0.49-0.93
Access any of 3 media (radio, television or newspaper) at least once a week	0.39***	0.3-0.48	0.55***	0.39-0.72
Only covariates with a significant association are shown. The full model in Model II controls for the following additional health and environment variables: child's experience of any illness; household's water treatment, open defecation, and cooking fuel; nutrition intervention district; mother's place of delivery, ANC, MIYCN counseling, and exposure to TV/radio health and nutrition programming.				

Continued…)

Table 10—Continued

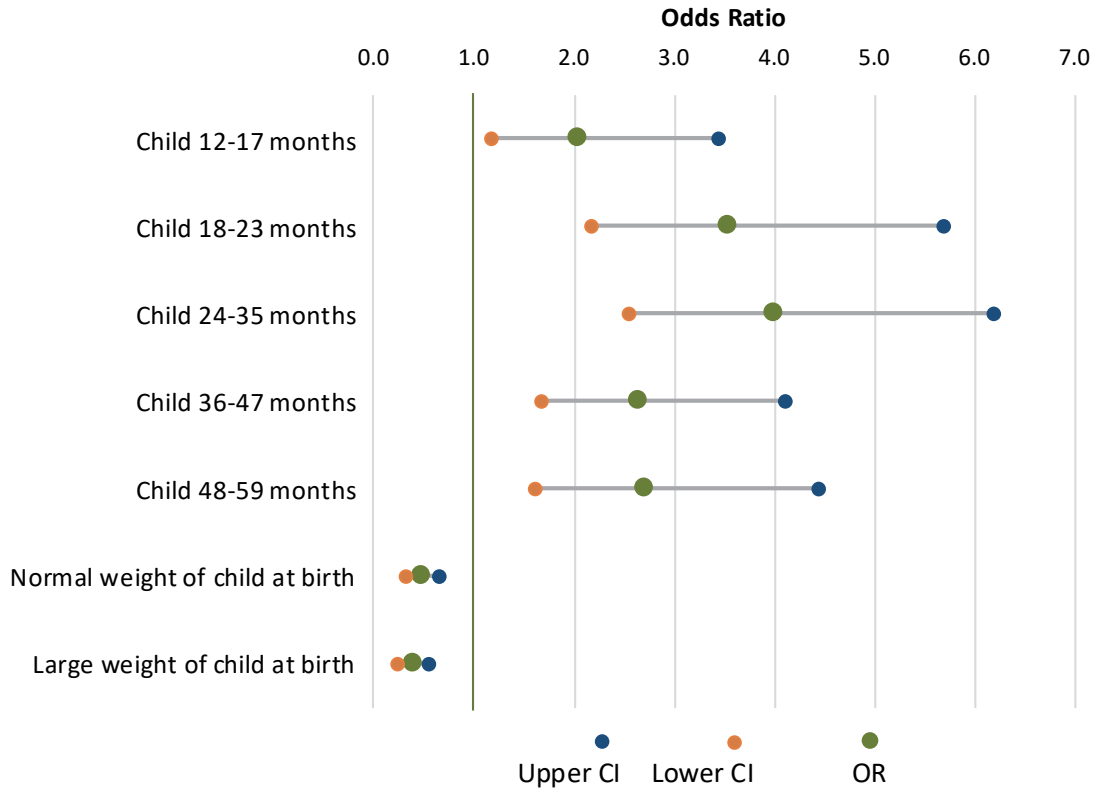
Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Socioeconomic factors model				
Province				
Province 1	Ref			
Province 2	1.17	0.85-1.6	0.65	0.4-1.07
Province 3	0.85	0.55-1.33	1.03	0.69-1.53
Province 4	0.82	0.52-1.29	1.10	0.67-1.81
Province 5	1.23	0.82-1.85	0.96	0.62-1.48
Province 6	2.44***	1.69-3.54	1.73*	1.12-2.65
Province 7	1.11	0.75-1.63	0.84	0.56-1.27
Household wealth quintile				
Poorest	Ref			
Poorer	0.63**	0.47-0.85	0.77	0.54-1.1
Middle	0.57***	0.42-0.77	0.55**	0.37-0.82
Richer	0.50***	0.37-0.67	0.51**	0.33-0.79
Richest	0.20***	0.14-0.3	0.34***	0.19-0.61
Mother's education				
No education	Ref			
Primary	0.69**	0.54-0.88	0.76	0.55-1.04
Some secondary	0.55***	0.42-0.71	0.82	0.59-1.14
SLC or higher	0.35***	0.26-0.47	0.56*	0.34-0.91
Mother's Occupation				
Not working	Ref			
Non-agricultural	1.31	0.96-1.79	1.94***	1.31-2.85
Agricultural (self-employed)	1.61***	1.3-1.98	1.32	0.99-1.75
Household size				
4 or less	Ref			
More than 4	1.55***	1.22-1.93	1.41*	1.06-1.87

Only covariates with a significant association are shown. The full model in Model II controls for the following additional socioeconomic variables: residence; ecological zone; caste/ethnicity; household food security; and mother's internet use, mobile phone ownership, decision making, and experience of spousal violence.

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

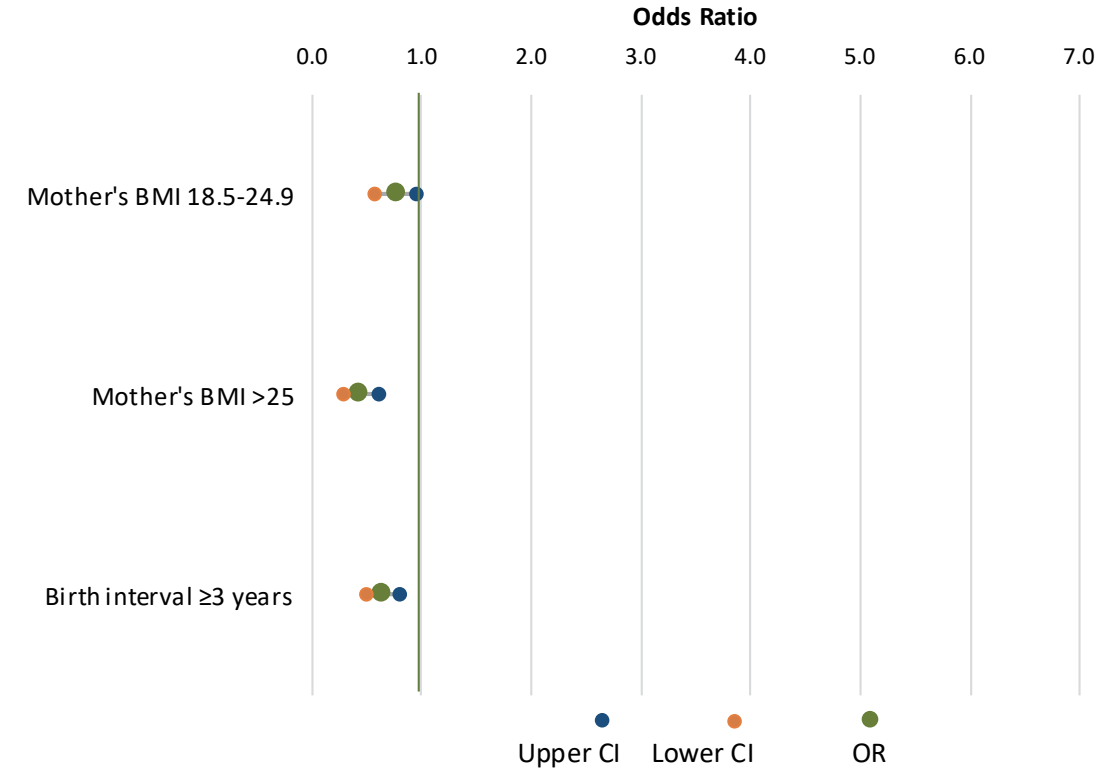
Figures 6-9 present graphics of the key determinants of stunting from Model II that shows that the odds of stunting is highest among children age 24-35 months (child-intrinsic factors model), while the odds of stunting is lowest among children from the richest wealth quintile (socioeconomic factors model).

Figure 6 **Key child-intrinsic determinants of stunting in children age 0-59 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016**



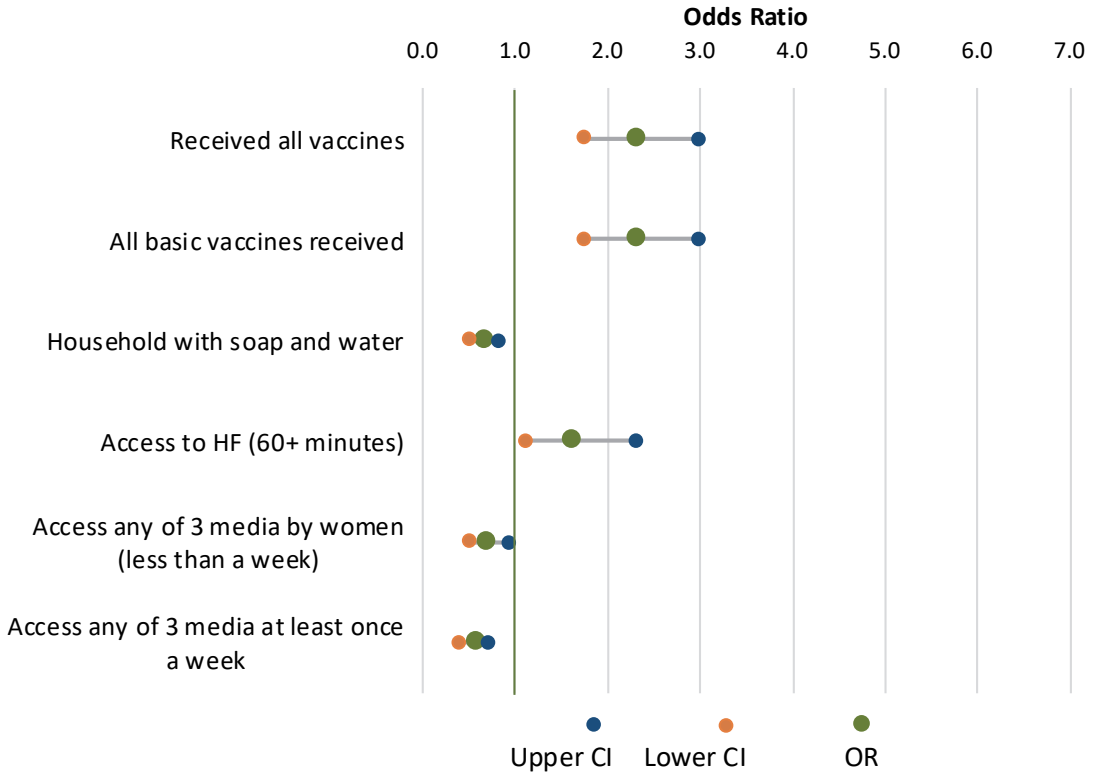
Note: Only covariates with a significant association are shown. The full model controls for the following additional child-instrinsic variable: sex of child.

Figure 7 **Key maternal determinants of stunting in children age 0-59 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016**



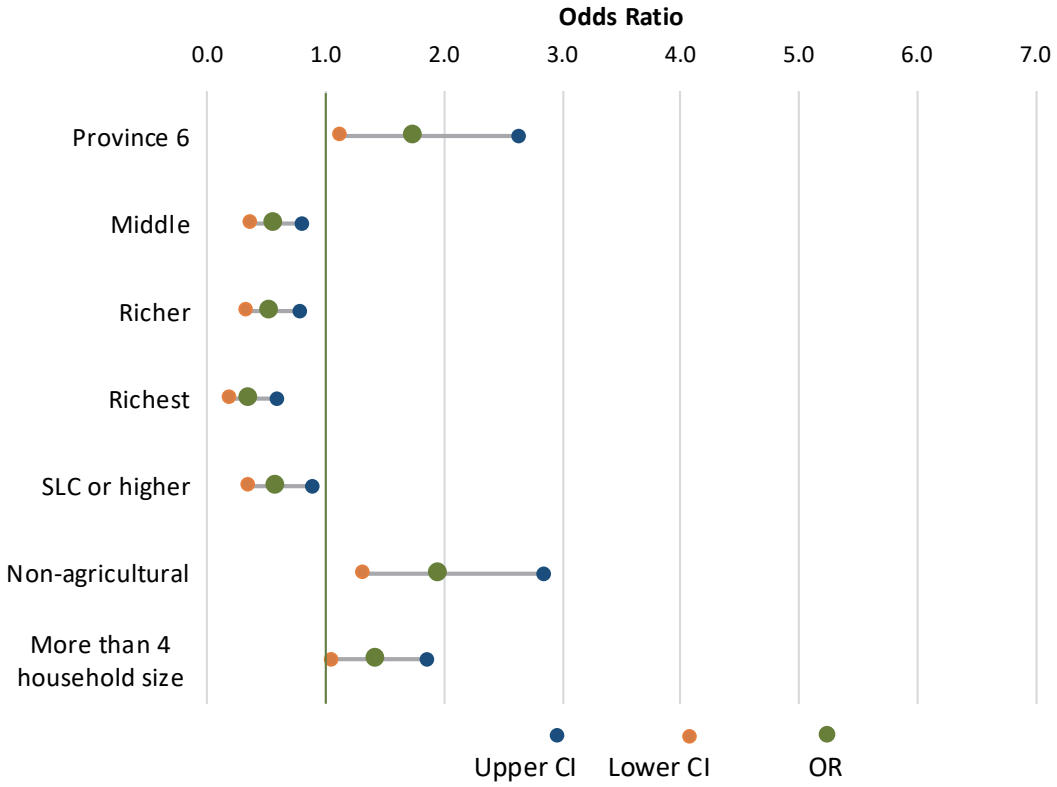
Note: Only covariates with a significant association are shown. The full model controls for the following additional maternal variables: mother's age, anemia status, height, dietary diversity, and smoking status; birth interval; and birth order.

Figure 8 **Key health and environment determinants of stunting in children age 0-59 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016**



Note: Only covariates with a significant association are shown. The full model controls for the following additional health and environment variables: child's experience of any illness; household's water treatment, open defecation, and cooking fuel; nutrition intervention district; mother's place of delivery, ANC, MIYCN counseling, and exposure to TV/radio health and nutrition programming.

Figure 9 **Key socioeconomic determinants of stunting in children age 0-59 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016**



Note: Only covariates with a significant association are shown. The full model controls for the following additional socioeconomic variables: residence; ecological zone; caste/ethnicity; household food security; and mother's internet use, mobile phone ownership, decision making, and experience of spousal violence.

5 MINIMUM ACCEPTABLE DIET IN CHILDREN AGE 6-23 MONTHS

In 2008, WHO, UNICEF, and USAID published a set of indicators that assess IYCF practices at the household level. The MAD, a composite indicator, is one of the core indicators identified to assess IYCF practices at the population level. This indicator includes minimum dietary diversity (quality aspect of complementary food), as well as minimum meal frequency (quality aspect of complementary food). The indicator is calculated for both breastfed and non-breastfed children. Studies have shown a strong association between inappropriate IYCF practices and stunting in children. This indicator includes both the quantitative and qualitative aspects of complementary feeding for breastfed and non-breastfed children.

5.1 Socioeconomic Inequalities in Minimum Acceptable Diet in 2011 and 2016

The trends for MAD disaggregated by different socioeconomic variables are presented in Table 11. The trend analysis indicates improvement in MAD for children age 6-23 months across all covariates. MAD has significantly improved in both the 6-11 ($p<0.01$) and 12-23-month ($p<0.001$) age groups. Improvement in MAD is greater in female children (13 percentage points) than male children (11 percentage points). Provinces 5 and 6 show the largest improvement among all provinces (22 to 25 percentage points).

Significant improvement in MAD is restricted to children in the poorest (17 percentage points) and poorer (14 percentage points) wealth quintiles. All ecological zones show improvement in MAD among children. The Mountain Zone shows the largest improvement of 20 percentage points as compared to the Hill (14 percentage points) and Terai (10 percentage points) zones.

MAD has significantly improved among all ethnic groups except the Newar and Muslim groups. The improvement in MAD is significant among women with no education and with higher education. Households with food security show greater improvement in MAD compared to the food insecure households. MAD increased in all nutrition intervention districts except those in Group D.

Table 11 Trends in minimum acceptable diet among children age 6-23 months by key explanatory variables, Nepal DHS 2011-2016

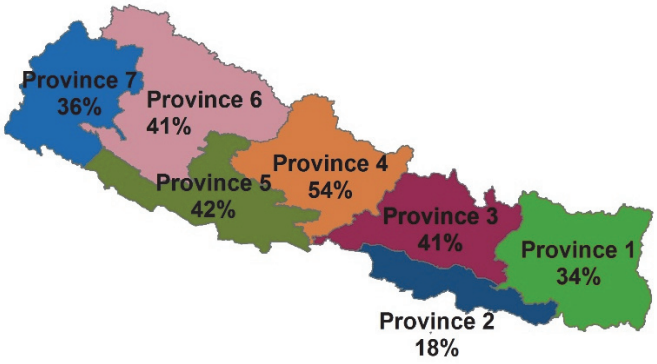
Characteristics	2011		2016		Percentage point change 2016-2011	p-value
	%	*N*	%	*N*		
Age of child (in months)						
6-11	14.0	68	22.4	112	8.4	**
12-23	29.1	277	42.4	423	13.3	***
Sex of child						
Male	23.9	170	34.4	279	10.6	**
Female	24.1	175	37.3	256	13.2	***
Province						
Province 1	31.0	94	34.3	91	3.3	
Province 2	5.3	--	20.0	76	14.7	***
Province 3	35.1	70	44.0	106	8.9	
Province 4	43.3	66	53.2	67	9.9	
Province 5	21.2	49	42.8	118	21.7	***
Province 6	14.6	--	39.8	34	25.2	***
Province 7	24.8	34	35.6	43	10.9	
Household wealth quintile						
Poorest	13.7	48	30.7	93	17.1	***
Poorer	19.3	57	33.7	110	14.4	***
Middle	21.1	68	28.1	96	7.1	
Richer	33.9	85	41.6	132	7.6	
Richest	40.4	86	50.5	105	10.1	
Ecological zone						
Mountain	22.3	27	42.7	42	20.4	**
Hill	32.1	189	46.3	266	14.3	***
Terai	17.7	129	27.7	227	10.0	**
Caste/ethnicity						
Brahmin/Chhetri	36.9	158	52.4	200	15.5	***
Terai/Madhesi other	--	--	23.6	72	16.6	***
Dalit	16.1	37	32.6	68	16.5	***
Newar	--	--	--	--	6.8	
Janajati	24.6	117	34.9	151	10.3	*
Muslim	9.9	10	21.4	23	11.6	
Mother's education						
No education	11.0	66	23.7	107	12.7	***
Primary	21.3	57	29.7	88	8.5	
Some secondary	38.4	178	41.2	218	2.9	
SLC or higher	42.1	44	56.6	121	14.5	*
Household size						
4 or less	28.7	112	42.7	169	14.0	***
More than 4	22.3	233	33.3	366	11.0	***
Household food security						
Food secure	30.5	182	43.5	286	13.0	***
Food insecure	19.4	163	29.8	249	10.4	***
Nutrition intervention program district[1]						
Group A	35.1	64	54.7	85	19.6	**
Group B	11.5	61	29.7	153	18.2	***
Group C	22.3	29	38.6	59	16.4	*
Group D	32.1	192	35.5	237	3.4	

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

[1] This variable is created to categorize all districts of Nepal according to nutrition interventions/programs/projects. Districts in Group A received MIYCN, HFP, MCH/FP, EHA, and Nutrition Governance; those in Group B received MIYCN, MSNP, IMAM, MNP, and CCG; while those in Group C had overlapping district with Group A and Group B interventions. Districts under Group D received regular nutrition programs by the government.

-- indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

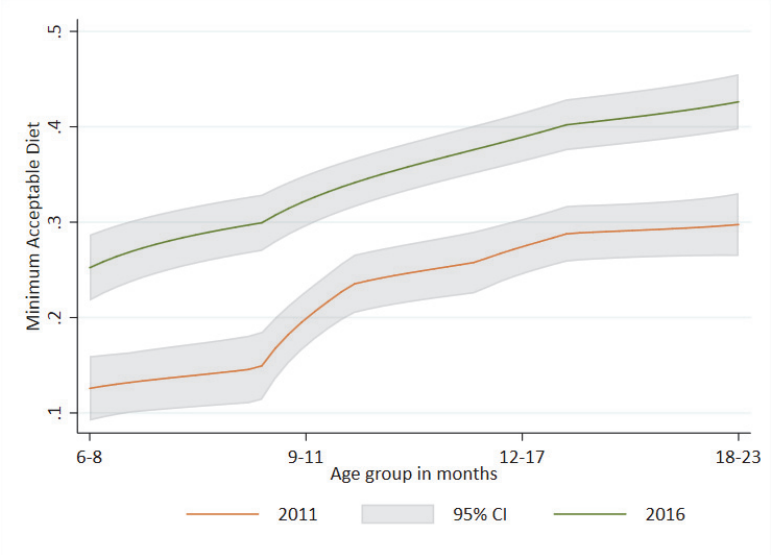
Figure 10 Minimum acceptable diet by province, Nepal DHS 2016



Overall, improvement in MAD is observed across in all provinces. There is, however, a wide variation observed in levels of MAD among provinces in 2016, as highlighted in Figure 10. More than 50% of children received MAD in Province 5, while this figure is only 18% children in Province 2.

The 2011 and 2016 data show gradual improvement in MAD as a child grows older, as seen in Figure 11. The figure shows that in both years, more children above age 1 were fed according to recommended practices than children less than 1 year. Across the age distribution, MAD is significantly higher in 2016 than in 2011.

Figure 11 Distribution of minimum acceptable diet in children across age, Nepal DHS 2016



5.2 Understanding the Factors behind Minimum Acceptable Diet in Children Age 6-23 in Nepal

5.2.1 Association of child-instrinsic factors with MAD

MAD is significantly associated with children's age. A notably higher proportion of children age 12-23 months were fed according to recommended practices when compared to children age 6-11 months. The other two child-instrinsic variables (sex and weight at birth) do not show a significant association.

Table 12 Distribution of minimum acceptable diet across child-instrinsic factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Age of child (in months)			
6-11	22.4	112	***
12-23	42.4	423	
Sex of child			
Male	34.4	279	
Female	37.3	256	
Weight of child at birth			
Small (<2.5 kg)	37.7	46	
Normal (2.5-3.49 kg)	39.6	237	
Large (≥3.5 kg)	40.6	118	

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

5.2.2 Association of maternal factors with MAD

All maternal characteristics except mother's anemia status show significant association with MAD as shown in Table 13. Children of mothers age 25-34 are more likely to have received MAD compared to other age groups. More children received MAD if their mothers had a birth interval of 3 years or more as compared to those with a birth interval of fewer than 3 years. Birth order is also significantly associated, with more children who are the first-born receiving MAD compared to children of a higher birth order. A significantly higher proportion of children of mothers who consumed more diverse food (five or more) were fed per the recommendations than children of mothers who did not.

Table 13 Distribution of minimum acceptable diet across maternal factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Mother's age			
15-24 years	32.1	248	**
25-34 years	40.7	260	
35-49 years	31.7	27	
Mother's anemia			
Anemic	30.8	109	
Non-anemic	35.4	138	
Birth interval			
Less than 3 years	24.3	95	***
3 years or more	39.1	191	
Birth order			
First born	40.5	248	***
2-4	35.4	232	
5 or more	19.5	23	
Mother's dietary diversity			
Less than 5 food groups	17.9	134	***
5 or more food groups	53.7	401	

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

5.2.3 Association of health and environment factors with MAD

The results related to the association of MAD with health and environment factors are presented in Table 14. Twenty-one percent of children in households with open defecation fed their children according to the recommended feeding practice, significantly less than the 40% among children in households without open defecation. Use of cooking fuel also shows an association, with children in households with clean fuels more likely to be fed MAD than children in household using solid fuels.

Table 14 Distribution of minimum acceptable diet across health and environment factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Any illnesses			
Child had any illness	36.6	371	
Child had no illness	34.0	164	
Time to obtain drinking water			
Water on premises	35.5	334	
Less than 30 minutes	36.8	120	
30 minutes or longer	28.4	27	
Open defecation			
Open defecation free	39.8	469	***
Open defecation	20.8	66	
Handwashing			
Household with no soap and water	32.4	297	**
Household with soap and water	41.3	238	
Use of cooking fuel			
Clean fuel	46.1	155	***
Solid fuel	31.8	327	
Access to government health facility			
<30 minutes	40.1	101	
30-60 minutes	41.1	167	
60+ minutes	39.2	93	
Place of delivery			
Home/other	29.7	153	**
Health facility	39.1	382	
ANC visit			
No	--	--	
Yes	36.0	515	
Nutrition intervention program district[1]			
Group A	54.7	85	
Group B	29.7	153	***
Group C	38.6	59	
Group D	35.5	237	
MIYCN counseling			
No	32.7	392	***
Yes	48.5	143	
Mother's media exposure			
Access none of the 3 media at all	23.4	80	
Access any of 3 media (radio, television or newspaper) less than once a week	31.3	107	***
Access any of 3 media (radio, television or newspaper) at least once a week	43.0	348	
Exposure to TV/radio health and nutrition program			
Heard/seen none of the TV/radio H&N programs	47.3	247	***
Heard/seen any one of the TV/radio H&N programs	46.9	288	

[1] This variable is created to categorize all districts of Nepal according to nutrition interventions/programs/projects. Districts in Group A received MIYCN, HFP, MCH/FP, EHA, and Nutrition Governance; those in Group B received MIYCN, MSNP, IMAM, MNP, and CCG; while those in Group C had overlapping district with Group A and Group B interventions. Districts under Group D received regular nutrition programs by the government.

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

-- indicates that a figure is based on fewer than 25 unweighted cases. Results for such groups are not reported.

A significantly higher proportion of children who reside in Group A nutrition intervention districts (55%) were fed MAD compared to children in other districts (30%-39%). Likewise, a higher proportion of MAD is observed among children whose mothers had received the MIYCN counselling compared to those who did not. Mother's exposure to media is strongly associated, with more children whose mothers had access to any of three media (radio/television/ newspaper) at least once a week receiving

MAD than children of mothers who did not. Similar results are found for children of mothers who had exposure to any one of the TV/radio health and nutrition programs.

There is no observed association between MAD and any illness in children in previous 2 weeks, time to obtain drinking water, access to government health facility, or mother's ANC visitation.

5.2.4 Association of socioeconomic status factors with MAD

Table 15 shows that province, household wealth quintile, ecological zone, caste/ethnicity, household food security, and mother's education, working status, decision making, internet use, and mothers owning a mobile phone are significantly associated with MAD.

Table 15 Distribution of minimum acceptable diet across socioeconomic status factors, Nepal DHS 2016

Characteristics	%	*N*	p-value
Residence			
Urban	36.6	293	
Rural	35.0	242	
Province			
Province 1	34.3	91	***
Province 2	20.0	76	
Province 3	44.0	106	
Province 4	53.2	67	
Province 5	43.2	118	
Province 6	39.8	34	
Province 7	35.6	43	
Household wealth quintile			
Poorest	30.7	93	***
Poorer	33.7	110	
Middle	28.1	96	
Richer	41.6	132	
Richest	50.5	105	
Ecological zone			
Mountain	42.7	42	***
Hill	46.3	266	
Terai	27.7	227	
Caste/ethnicity			
Brahmin/Chhetri	52.4	200	***
Terai/Madhesi other	23.6	72	
Dalit	32.6	68	
Newar	--	--	
Janajati	34.9	151	
Muslim	21.4	23	
Mother's education			
No education	23.7	107	***
Primary	29.7	88	
Some secondary	41.2	218	
SLC or higher	56.6	121	
Mother's occupation			
Not working	30.2	204	***
Non-agricultural	57.2	101	
Agricultural (self-employed)	35.9	229	
Household size			
4 or less	42.7	169	**
More than 4	33.3	366	
Household food security[1]			
Food secure	43.5	286	***
Food insecure	29.8	249	
Mother's decision-making			
Cannot make decision	31.8	261	**
Can make decision	41.8	240	
Mother's internet use			
Used in past 12 months	49.3	136	***
Not used in past 12 months	32.8	399	

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

[1] The categorization of household food security is recoded as food secure and food insecure due to small sample size. Food Insecure includes mild, moderate and severe food insecurity.

-- indicates that a figure is based on fewer than 25 unweighted cases. Results for such groups are not reported.

5.3 Determinants of MAD

Table 16 below shows the results of the unadjusted (Model I) and four separate adjusted (Model II) multiple logistic regressions for MAD in children age 6-23 months. The four adjusted models correspond to the components of the conceptual framework: child-intrinsic factors, maternal factors, health and environment factors, and socioeconomic factors. Only significant findings are presented

here, with the complete findings shown in Appendix Table A4. Figures 12-15 show the adjusted odds ratios from Model II for significant determinants.

Controlling for other child-instrinsic factors, the odds of MAD are higher among children age 12-23 months than among children age 6-11 months (aOR 3.67). In the model for maternal factors, children of mothers age 35-49 have higher odds of MAD than children of mothers age 15-25 (aOR3.29). Similarly, children of mothers who consumed five or more food groups have higher odds of being fed with MAD compared with children of mothers who consumed fewer than five food groups (aOR 5.55).

Controlling for other health and environment factors, children from households with open defecation have lower odds of MAD compared to children from open defecation free households (aOR 0.62). Children from Group B, C, and D districts have lower odds of MAD compared to children from district Group A (aORs 0.45, 0.56, and 0.50, respectively).

Table 16 Association of minimum acceptable diet and child-instrinsic, maternal, health and environment, and socioeconomic factors. Results from multiple logistic regression, Nepal DHS 2016

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Child-instrinsic factors model				
Age of child (in months)				
6-11	Ref			
12-23	2.55***	1.95-3.34	3.67***	2.29-5.87
Only covariates with a significant association are shown. The full model in Model II controls for the following additional child-instrinsic variables: sex of child, weight of child at birth.				
Maternal factors model				
Mother's age				
15-24 years	Ref			
25-34 years	1.45**	1.13-1.87	1.30	0.80-2.11
35-49 years	0.98	0.57-1.69	3.29*	1.25-8.64
Mother's dietary diversity				
Less than 5 food groups	Ref			
5 or more food groups	5.31***	4.17-6.77	5.55***	3.74-8.25
Only covariates with a significant association are shown. The full model in Model II controls for the following additional maternal variables: birth interval; birth order, and mother's anemia.				
Health and environment factors model				
Open defecation				
Open defecation free	Ref			
Open defecation	0.40***	0.28-0.56	0.62**	0.43-0.89
Nutrition intervention program district[1]				
Group A	Ref			
Group B	0.35***	0.24-0.52	0.45***	0.29-0.70
Group C	0.52**	0.32-0.85	0.56*	0.32-0.97
Group D	0.46***	0.31-0.67	0.50***	0.34-0.75
MIYCN counseling				
No	Ref			
Yes	1.94***	1.45-2.59	1.51**	1.11-2.06
Exposure to TV/radio health and nutrition program				
Heard/seen none of the TV/radio health and nutrition programs	Ref			
Heard/seen any one of the TV/radio health and nutrition programs	2.31***	1.80-2.95	1.59**	1.15-2.21
Only covariates with a significant association are shown. The full model in Model II controls for the following additional health and environment variables: household's time to drinking water, handwashing, cooking fuel and access to government health facility; child's illness, ANC visits, place of delivery, and mother's media exposure.				

(Continued…)

Table 16—Continued

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Socioeconomic factors model				
Province				
Province 1	Ref			
Province 2	0.48***	0.31-0.74	0.91	0.33-2.53
Province 3	1.50	0.93-2.44	2.31	0.93-5.73
Province 4	2.18***	1.47-3.23	3.17**	1.35-7.44
Province 5	1.46	0.97-2.20	1.48	0.72-3.08
Province 6	1.26	0.81-1.97	1.01	0.45-2.27
Province 7	1.06	0.62-1.83	0.61	0.23-1.63
Household wealth quintile				
Poorest	Ref			
Poorer	1.15	0.76-1.73	2.03	0.99-4.17
Middle	0.88	0.59-1.32	2.76**	1.31-5.83
Richer	1.61*	1.04-2.48	2.76*	1.21-6.27
Richest	2.30***	1.48-3.58	1.99	0.68-5.78
Ecological zone				
Mountain	Ref			
Hill	1.16	0.69-1.96	0.44	0.19-1.04
Terai	0.51*	0.31-0.87	0.26**	0.10-0.71
Caste/ethnicity				
Brahmin/Chhetri	Ref			
Terai/Madhesi other	0.28***	0.18-0.44	0.40	0.14-1.13
Dalit	0.44***	0.29-0.66	0.68	0.31-1.51
Newar	0.52*	0.30-0.90	0.11***	0.03-0.40
Janajati	0.49***	0.34-0.70	0.45*	0.24-0.85
Muslim	0.25***	0.12-0.49	0.59	0.14-2.46
Mother's education				
No education	Ref			
Primary	1.05	0.60-1.84	0.89	0.42-1.89
Some secondary	2.16**	1.33-3.48	1.94	0.99-3.81
SLC or higher	3.83***	2.23-6.57	3.96**	1.57-10.01

Only covariates with a significant association are shown. The full model in Model II controls for the following additional socioeconomic variables: residence, household size and food security; and mother's internet use, mobile phone ownership, decision making, and experience of spousal violence.

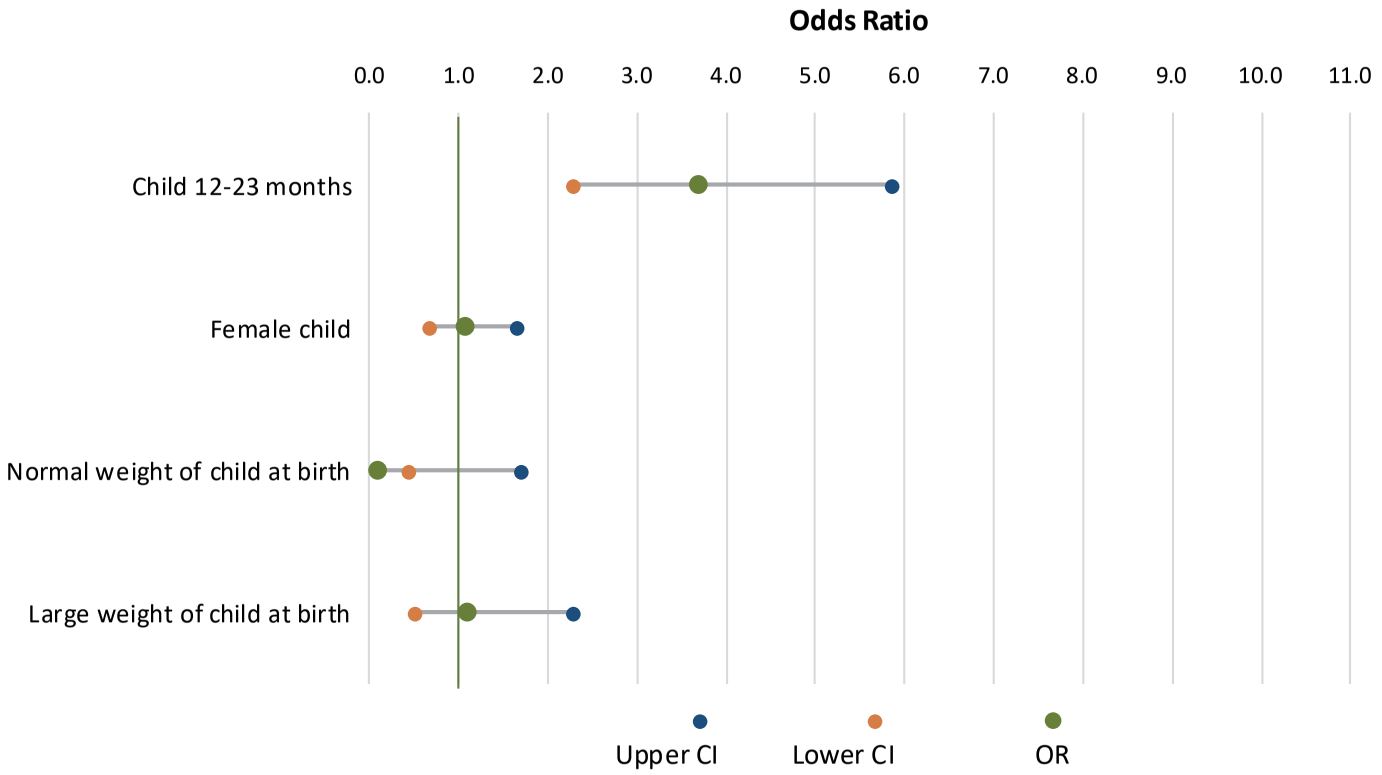
[1] This variable is created to categorize all districts of Nepal according to nutrition interventions/programs/projects. Districts in Group A received MIYCN, HFP, MCH/FP, EHA, and Nutrition Governance; those in Group B received MIYCN, MSNP, IMAM, MNP, and CCG; while those in Group C had overlapping district with Group A and Group B interventions. Districts under Group D received regular nutrition programs by the government.

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

Children of mothers who were counseled on MIYCN have higher odds of MAD than children whose mothers were not counseled on MIYCN (aOR 1.51). Moreover, if the mother had heard/seen any TV or radio health and nutrition programs, their children have higher odds of being fed MAD than children whose mother had no exposure to such programs (aOR1.59).

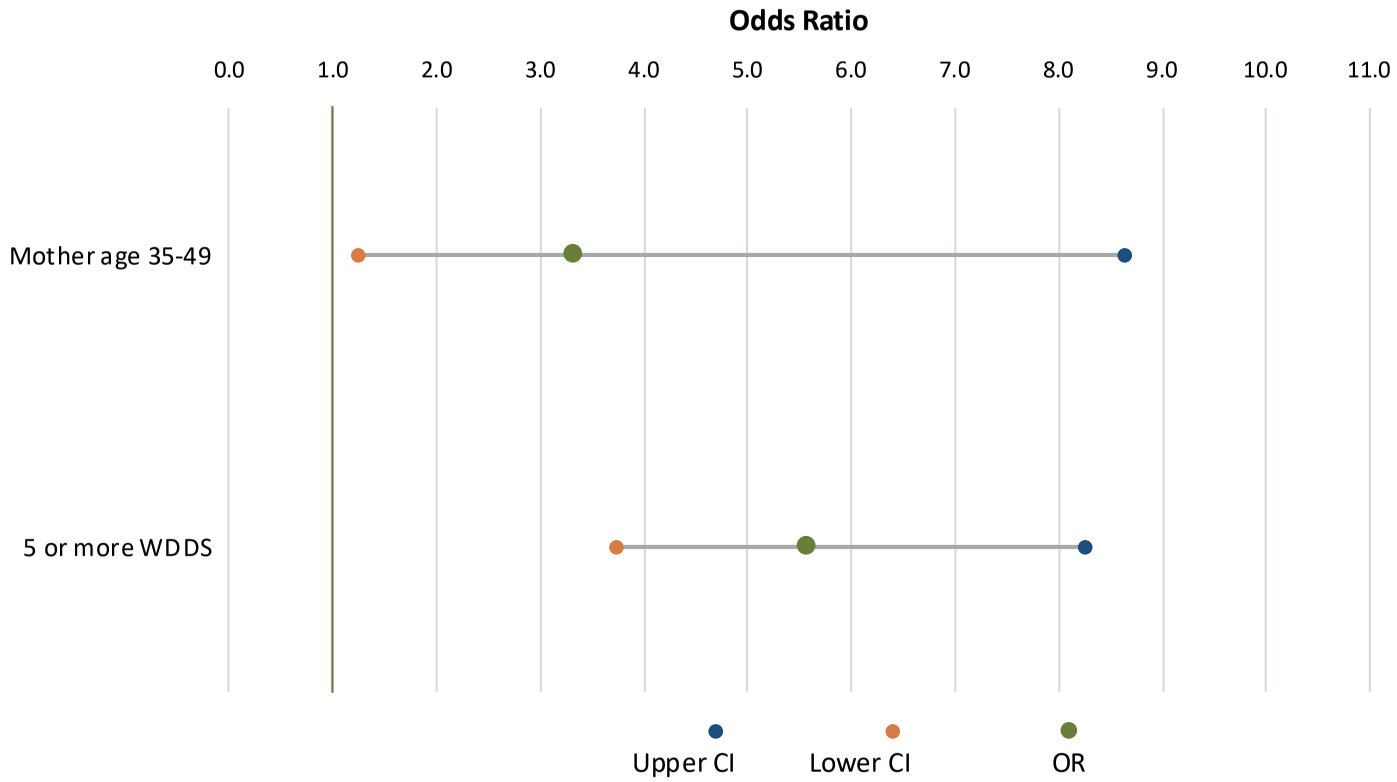
Among socioeconomic factors, children from Province 4 (Gandaki Province) have higher odds of MAD than children from Province 1 (aOR 3.17). Children from households in the middle and richer wealth quintiles have higher odds of MAD than children from the poorest households (aOR 2.76), as do children of mothers who have higher education (aOR 3.96). Children from the Terai have lower odds of being fed MAD than children from the Mountain zone (aOR 0.26). Similarly, children from the Newar and Janajati groups have lower odds of being fed MAD than children from the Brahmin/Chhetri groups (aOR 0.11 and aOR 0.45 respectively).

Figure 12 **Key child-instrinsic determinants of minimum acceptable diet in children age 6-23 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016**



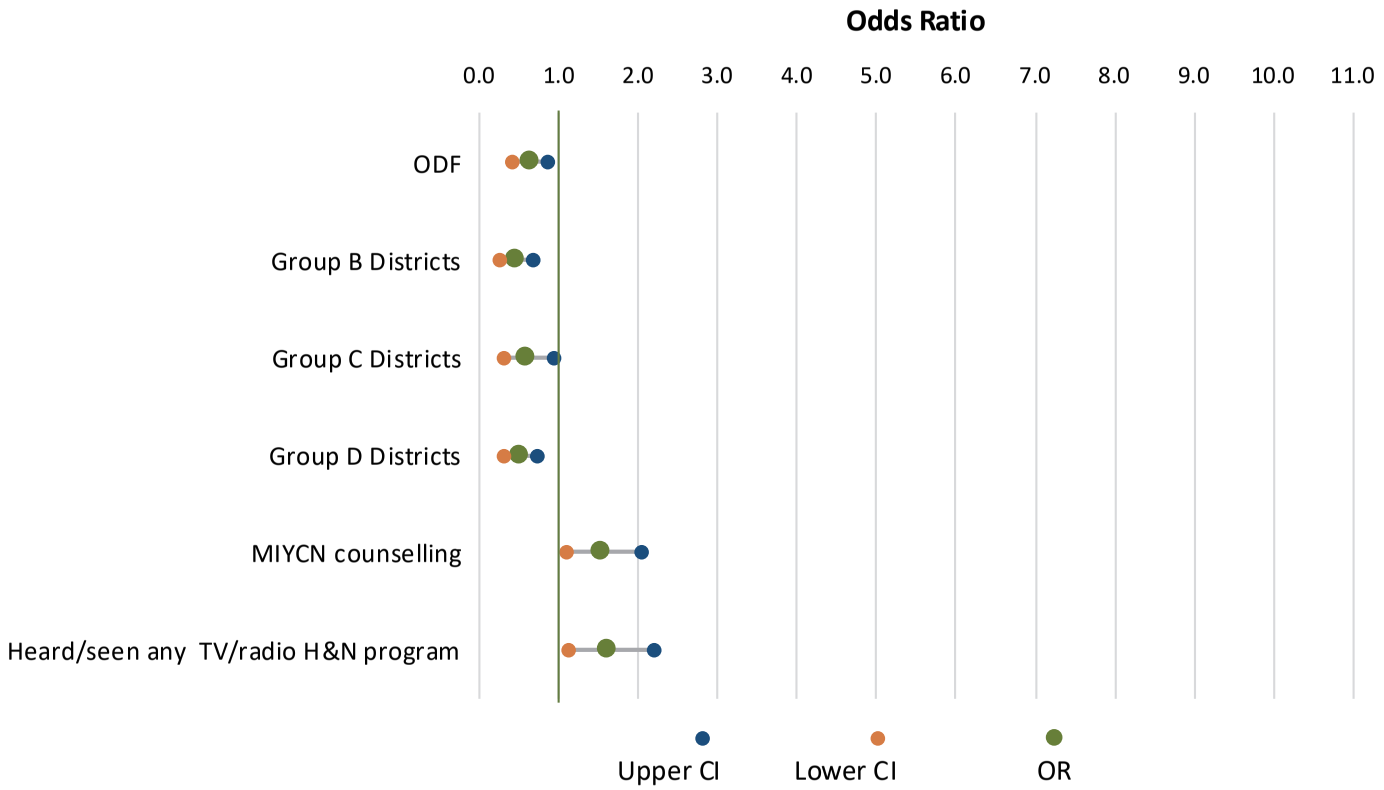
NOTE: Only covariates with a significant association are shown. The full model in Model II controls for the following additional variables: mother's age; birth interval; birth order; child's illness; household's cooking fuel and access to government health facility; mother's media exposure; household size and food security; mother's internet use, mobile phone ownership, decision making, and experience of spousal violence.

Figure 13 Key maternal determinants of minimum acceptable diet in children age 6-23 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016



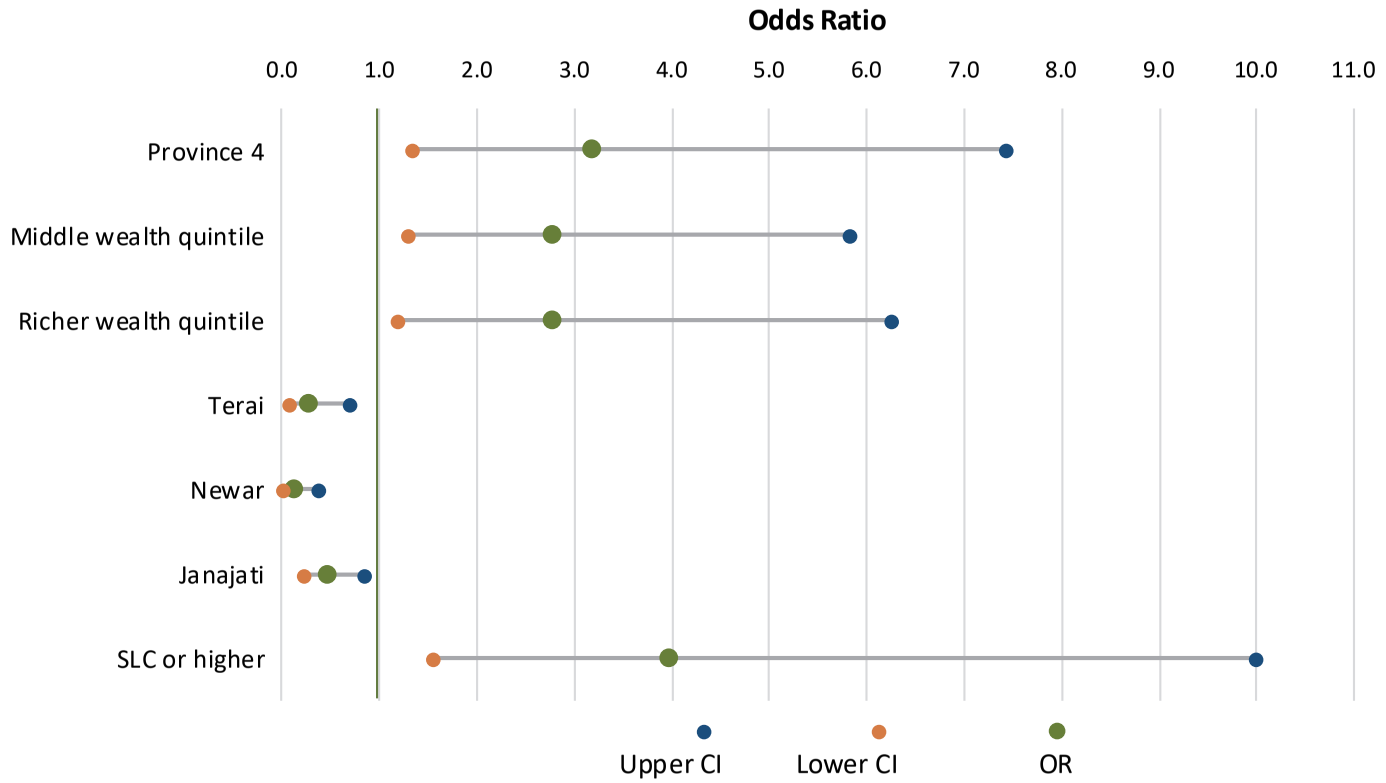
Note: Only covariates with a significant association are shown. The full model controls for the following additional maternal variables: birth interval; birth order, and mother's anemia.

Figure 14 **Key health and environment determinants of minimum acceptable diet in children age 6-23 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016**



Note: Only covariates with a significant association are shown. The full model controls for the following additional health and environment variables: household's time to drinking water, handwashing, cooking fuel and access to government health facility; child's illness, ANC visits, place of delivery, and mother's media exposure.

Figure 15 **Key socioeconomic determinants of minimum acceptable diet in children age 6-23 months; adjusted odds ratios (ORs) with 95% confidence intervals (CIs), Nepal DHS 2016**



Note: Only covariates with a significant association are shown. The full model controls for the following additional socioeconomic variables: residence, household size and food security; and mother's internet use, mobile phone ownership, decision making, and experience of spousal violence.

6 DISCUSSION

6.1 Stunting

The study shows that, on average, children's anthropometric status has improved over the past 5 years, with notable differences across socioeconomic groups in trends and present nutritional status. In recent years, there have been impressive improvements in the nutritional status of children in South Asian countries (Black et al. 2013; Stevens et al. 2012; UNICEF, WHO, and World Bank 2018). Despite these positive trends, children in Nepal remain alarmingly undernourished, although the prevalence of stunting is less than that of other neighboring countries such as India and Bangladesh (UNICEF 2018a). The parallel rightward shift of the HAZ curve implies that the progress was uniform across the entire age distribution. Age was found to be one of the predictors for stunting in children. Although the increase of stunting among children age 12-17 months shows the importance of continuing the intensity of integrated nutrition interventions, the gradual increment in stunting as the child ages also indicates the critical importance of interventions beyond 1,000 days. It is also interesting to note that the rate of stunting has significantly decreased among the 24-35- and 36-47-months age groups. It might suggest that the interventions aimed at 1,000 days show an impact at a later age of the children.

For the first time, this study has evaluated the trends of stunting by provinces, which will be useful for context-specific decision making in the new federal structure. In all provinces, the prevalence of stunting has decreased in the last 5 years, but the reduction was significant in province 7 (Sudurpashchim Province) only. In addition, there is a large variation in stunting prevalence across provinces. The recent focus on emphasizing the variability in stunting across the country is key to addressing this inequity (Menon et al. 2018; WHO 2018). This highlights the importance of identifying and addressing key determinants by geography to reduce inequalities and the overall stunting burden in Nepal. Since 2011, integrated nutrition programs and projects with high-impact nutrition interventions (such as Community MIYCN counseling, nutrition-sensitive agriculture interventions, nutrition governance, WASH (water, sanitation, and hygiene) interventions coupled with intensive community mobilization) have been implemented in Province 7 (Sudurpashchim Province). In addition, other development activities are also concentrated in the region. This entails the fact that if evidence-based programs or projects are implemented in an area with a focus on convergence of interventions at the household level, it can have a desirable synergistic impact. Nevertheless, this requires greater understanding of the province-specific determinants of stunting. This also calls for further discussion about the possibility that the larger decline in Province 7 (Sudurpashchim Province) could be related to higher rates of stunting at an earlier time as compared to Province 1 or Province 4 (Gandaki Province) where the stunting rate was much lower.

A significant reduction in the rate of stunting among the poor population and the Dalit and Janajati groups is consistent with recent government efforts of policy coherence across the sectors (National Planning Commission 2012), intensive nutrition interventions that targeted disadvantaged communities, and the scaling-up of community nutrition programs with the aim of reducing the gaps and reaching the unreached. Also consistent with this policy aim, this study found the Group A and B nutrition intervention districts witnessed the largest reduction in stunting. In 2013, the Government of Nepal enforced the Multi-Sector Nutrition Plan, which provided the framework for implementation of large-scaled integrated projects. As a result, there was increased engagement, interest, and investment of donors and partners in nutrition. Many nutrition interventions were scaled-up in the country with the involvement of many concerned sectors (Department of Health Services 2017). Recent supportive

policies and scaling-up of effective nutrition interventions and programs that strengthen community outreach for quality nutrition services and improve the health and nutrition behaviors may be influential in narrowing the gaps. Coordination mechanisms between different sectors for multi-sector coherent action enhanced programs at the national and subnational levels (Cunningham et al. 2017).

There is emerging evidence (Ahmed et al. 2012; Department of Health Services 2017; Harding et al. 2017; National Planning Commission 2017) and interest (SAARC 2014; UNICEF 2018b) in the role of adolescent and maternal nutrition for stunting reduction in the region. This reinforces the lifecycle approach to nutrition programming. Our study shows that stunting is associated with birth interval and the weight of child at birth. Since the weight of child at birth is influenced by maternal factors such as maternal BMI, number of pregnancies, birth interval, and anemia (Headey, Hoddinott, and Park 2016), Nepal's effort to strengthen accessibility to maternal, neonatal, and child health and nutrition services should be reflected in the country's nutrition policies and programming.

In South Asia, women's empowerment is associated with a child's nutritional status (Cunningham et al. 2015). Our study shows that greater women's participation in the workforce, integrated nutrition services that target the most vulnerable population and disadvantaged communities, improved accessibility to information and communication technology (ICT), and exposure to media for women are associated with reduced odds of stunting in Nepal. These findings, which are consistent with other studies (Kjeldsberg et al. 2018; Shroff et al. 2009; Smith et al. 2003) in the region, support the policies of global nutrition organizations such as USAID (USAID 2014), the World Bank (Shekar et al. 2017), and UN organizations (FAO and WHO 2014). In addition, the focus on improving women's health with strategies that improve health-care-seeking behavior of women through behavior change communication programs seems to be effective at the community level. In these interventions, the role of ICT is critical, given women's increasing access to mobile phones. Ongoing and new innovative approaches to nutrition service delivery aimed at the most vulnerable and poor populations should be documented, explored, and scaled-up by the government. Such projects have yielded encouraging results in many parts of the world (Graziose et al. 2018; Huda et al. 2018; Patel et al. 2018).

The Government of Nepal has prioritized women empowerment programs that are designed to improve women's physical and financial autonomy. A study done in Nepal shows that control over income by women is positively associated with lower rates of stunting (Malapit et al. 2015). Women's empowerment also reduces family size. Nepal has made remarkable progress in reducing its fertility rate over the past decade. Our findings show that household size is one of the determinants of stunting in Nepal with a high rate of stunting among households with more than five members. These results support the importance of addressing the underlying determinants of stunting through a multi-pronged, cross-sector approach. Other determinants of stunting from our findings include access to health facility, and residence in Province 6 (Karnali Province), while handwashing and household wealth are determinants of less stunting. Implementation of a multi-sector approach to integrated, nutrition-specific interventions may contribute to addressing the factors associated with the high rate of stunting in Nepal. The policy environment in Nepal is conducive to multi-sector action, and these findings highlight the need for integrated interventions that address malnutrition at the community and household level. With Province 6 (Karnali Province) emerging as one of the key determinants of stunting, nutritional planning and interventions should be tailored to the specific geography with socioeconomic and cultural realities taken into account.

6.2 Minimum Acceptable Diet

This study analyzed DHS 2011 and 2016 data from Nepal to assess the change in MAD over the past 5 years, and to further explore the determinants of MAD. While the analysis reveals interesting patterns for WHO-recommended practices over the years, it also uncovers important gaps that exist in meeting the recommended MAD criteria. Between 2011 and 2016, there have been notable improvements in MAD. However, our findings show better improvement in children age 12-23 months compared to children age 6-11 months. This finding, which is consistent with studies in Nepal (Na et al. 2017) and Ethiopia (Adhena et al. 2018), highlights the importance of timely initiation of complementary feeding and improving both the minimum meal frequency and minimum dietary diversity among children age 6-11 months.

Between 2011 and 2016, our findings show that the recommended practice of MAD improved in the following groups: Provinces 2, 5, and 6; the poorest and poorer wealth quintiles; disadvantaged caste/ethnic groups (Dalit, Terai/Madhesi other caste, and Janajati); children of women with no education; and households with moderate and severe food insecurity. These positive findings may be attributed to the government's current focus on high-impact, nutrition-specific programs that are integrated and coordinated across sectors. Examples of such programs include Suaahara, the EU-UNICEF Partnership for MSNP, and the AFSP. The programs include maternal, infant, and young child nutrition counseling in their intervention package, which is integrated with health system strengthening, agriculture, and WASH interventions and is supported by mobilized frontline workers who work in the community to target the 1,000-days mothers and their families with consistent, coherent messages that influence the MIYCN practices, especially among the disadvantaged groups (Cunningham et al. 2017; Dahal, Sharma, and Chitekwe 2017; Ministry of Agricultural Development 2016). During implementation, these programs have enhanced the institutional capacity across different sectors and, more importantly, they have strengthened multi-sector coordination for joint planning, implementation, and monitoring of the integrated nutrition interventions (National Planning Commission 2017; Pomeroy-Stevens et al. 2016; Webb et al. 2016). Although the outcome is very positive in reducing inequities among the vulnerable and disadvantaged groups, a detailed understanding and documentation of program and project processes would be a helpful reference and allow replication by other programs and projects.

The fact that the highest rate of improvement is observed in Group A followed by Groups B and C may indicate that the results and impact may be better if the nutrition programs or interventions are scaled-up with a strong emphasis on behavior change communication through different channels to reach the 1,000-days mothers and their families. In all these districts, a strong component of the programs is the scaling-up of MIYCN counseling through frontline workers, which was then integrated with other nutrition-specific interventions across sectors. This helped in reaching the households in marginalized, disadvantaged communities with the appropriate MIYCN messages through personal communication, mobilization of frontline workers and women groups, and context- and culture-specific radio programs (USAID 2018). The association of covariates, namely MIYCN counseling, exposure to health and nutrition programming on TV/Radio, and residence in districts with Group B, C and D nutrition programming with the improved MAD practices also reinforce the importance of scaling-up behavior change communication interventions that use diverse communication channels to promote change at the household level. Similar approaches have been effective in other countries in improving the appropriate MIYCN knowledge and practices (Hoddinott et al. 2018; Osendarp and Roche 2016; Singh et al. 2018).

The key predictors for the recommended MAD from the final model were child 12-23 months age and female child, normal and large weight of child at birth, five or more women's dietary diversity, 30 minutes to obtain drinking water, open defecation free, household with soap and water, Group B, C and D nutrition intervention program districts, MIYCN counseling-Yes, Exposure to TV/Radio health and nutrition program, Rural residence, Middle or Richer household wealth quintile, residence in Terai ecological zone or in Province 4 (Gandaki Province), and women's education (SLC or higher), while Newar or Janjati caste/ethnic groups are associated with not practicing MAD.

Over the years, a consistent finding (Joshi et al. 2012; Khanal, Sauer, and Zhao 2013) has shown that younger children are less likely to meet the recommended MAD practices, which leaves these children at greater risk of micronutrient deficiencies. Our study reinforces this finding. This indicates a need to provide a nutritious diet to children in terms of quantity and quality, and also highlights the importance of timely initiation of complementary feeding. Our results support the understanding that if women consume a minimum of diverse foods, their children will have greater odds of meeting MAD than children whose mothers do not consume a minimum of diverse foods. Similar results were found in a study by Nguyen et al. (2013).

Having a nutrition intervention program in the district was another predictor for MAD with all district groups (B, C, and D) having lower odds of meeting recommended practices than Group A. This shows that an area benefits with nutritional improvement from integrated nutrition interventions with an enhanced multi-sector coordination structure in place, and through community- and household-focused behavior-change communication strategies. These include districts where IYCF practices are well integrated and targeted to reach all 1,000-days beneficiaries, including mothers-in-law and husbands as part of the household approach, and additional attention to disadvantaged communities. Our findings related to improved MAD practices among the higher wealth quintiles and among children of women with higher education are consistent with studies from neighboring countries (Campbell et al. 2018; Na et al. 2018).

There are spatial variations in terms of MAD practices in Nepal. Although rural areas and Province 4 (Gandaki Province) had greater odds of meeting recommended practices in comparison to urban and other provinces, the Terai Region was 64% less likely to meet the practice compared to other ecological zones. Moreover, the Newar and Janajati groups had lower odds of meeting the recommended practices. These findings suggest that determinants of IYCF practices are complex, with variations in MAD practices by province, residence, and ecological zone serving as reminders that the sociocultural diversity of Nepal may play a complex role in determining MAD practices. It is important to support quantitative results with qualitative insights gleaned from focus groups and other methods in order to better understand the origin of cultural practices and to tailor innovative strategies to the specific locale, and all socio-ethnic and socioeconomic groups. The findings support the positive role played by the media and MIYCN counseling because some study locales had greater exposure to the media and access to counseling services.

6.3 Limitations of the Study

This study assessed the determinants for stunting and the MAD based on the DHS data sets, which are cross-sectional surveys. The findings can only show association between any two variables, and not the causality. For most of the explanatory variables, DHS collects information retrospectively from respondents on practices, behaviors, and events. Such information may be subject to recall and social desirability bias. Some practices such as exclusive breastfeeding, dietary diversity, and women's dietary

practices are based on the practices of the previous 24 hours and, as such, may not be an accurate measure of common practice.

For the analysis purpose in this study, all the districts are grouped based on the type of programs or interventions being implemented. One of the limitations of this study is that while we would have liked to do a detailed analysis based on the comprehensive information on the scale and coverage of the programs and interventions of districts in this report, we did not look for all the specificities as it was beyond the scope of this work. In addition, we couldn't find an exhaustive documentation about all the programs and interventions in all the districts of the country. Government or partners might look at these aspects through a separate study.

6.4 Policy and Programmatic Implications

A multi-sector approach is key for improved nutrition outcome. In Nepal, there is a range of determinants for stunting and MAD in children. The key determinants of stunting are increasing age of child, low birthweight of child, not receiving all basic vaccines, soap and water not available in the household, access to a government health facility, lack of access to media, province, lack of wealth, mothers' lack of education, mothers' non-agricultural occupation, and household size. Similarly, the age and weight of the child, women's dietary diversity score, time to obtain drinking water, open defecation free, handwashing with soap and water, MIYCN counseling, province, residence, wealth quintile, caste/ethnicity, women's education, and nutrition-intensive program in the district are determinants of MAD. Our findings reveal the multi-sector nature of nutrition, and the need for any solution to stunting must also be multi-sector. It is important for the government to view nutrition policy through a multi-sector lens with multi-sector planning, implementation, and evaluation of nutrition programs at all the levels. Given the country's recent transition to a federal structure, this approach needs to be enhanced at the local level.

Multi-sectoral actions composed of both nutrition-specific as well as nutrition-sensitive interventions with convergence of integrated interventions at the targeted households for targeted beneficiaries should be taken into consideration by the local level while they plan and implement such programs. While it is important to scale-up these programs, it is essential to devise appropriate strategies for improving the coverage of interventions, especially with a focus on reaching the beneficiaries who are in real need.

A blanket approach is not the answer. While the integrated package of interventions yields the highest impact, the universal approach is not necessarily the appropriate answer to addressing the context-specific determinants of stunting and feeding practices throughout Nepal. It is crucial for federal, state, and local governments to adapt the approach of service delivery to their own realities and context. For instance: Province 2's context is entirely different from Province 6 (Karnali Province), despite the fact that both have high stunting rates. Therefore, it is important to understand each context and the local determinants in order to package the interventions and determine the best delivery to beneficiaries.

The need for a lifecycle approach to nutrition programming. The results show that there are different determinants of stunting and feeding practices that target women, children, and caretakers. In concurrence with the UNICEF conceptual framework, nutritional programming should address the various levels of determinants with a focus on women, children, and adolescent girls so that the intergenerational cycle of chronic malnutrition can be broken.

The importance of tailoring intensive approaches for sustainable reduction in the gap. The findings show that when integrated interventions are tailored to the needs of the various targeted groups, places,

and context, overall achievement may be higher and, more importantly, inequity gaps may be reduced. Given the diversity of Nepal, the approaches for service delivery must be tailored to reach the most disadvantaged and vulnerable groups. Based on the evidence, local, state, and federal authorities need to plan nutrition actions so that equity is enhanced across all socioeconomic and geographic domains.

6.5 Conclusion

Nepal has reduced the prevalence of stunting and improved the recommended complementary feeding practices, especially among the disadvantaged groups in the past 5 years. Yet, disparities exist across different socioeconomic and socio-geographic areas. Current determinants of stunting and feeding practices show that there is a need to strengthen the multi-sector approach to nutrition across sectors: health, WASH, agriculture, and education. Recent efforts that incorporated policy coherence across sectors and implementation of large-scale integrated nutrition interventions that focused on the life-cycle approach and reaching disadvantaged groups have begun reducing the gaps. As a socioeconomically and geographically diverse country, Nepal needs a tailored approach with intensive nutrition interventions that reach the underserved with an integrated package of nutrition-specific and nutrition-sensitive interventions. This will help the country achieve its 2030 target of reducing stunting in children and realizing the goal of all Nepalese children reaching their full potential.

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APPENDICES

Appendix Table A1 District categorization

Group A	Group B	Group C	Group D
District	District	District	District
Taplejung	Bardiya	Sankhuwasabha	Bara
Bhojpur	Dang	Rasuwa	Rautahat
Solukhumbu	Dhanusha	Gorkha	Siraha
Dolakha	Dolpa	Nawalparasi	Udaypur
Sindhupalchowk	Humla	Rupandehi	Sindhuli
Lamjung	Jajarkot	Bajura	Khotang
Myagdi	Jumla	Achham	Terhathum
Baglung	Kalikot	Dadeldhura	Jhapa
Parbat	Kanchanpur		Illam
Syangja	Kapilvastu		Panchthar
Darchula	Mahottari		Kaski
Bajhang	Makwanpur		Tanahu
Nuwakot	Morang		Dhading
Baitadi	Mugu		Kavre
Doti	Okhaldhunga		Chitwan
	Palpa		Banke
	Parsa		Rolpa
	Rukum		Salyan
	Saptari		Dailekh
	Sarlahi		Surkhet
	Sunsari		Pyuthan
			Arghakhanchi
			Ramechhap
			Kailali
			Gulmi
			Kathmandu
			Lalitpur
			Bhaktapur
			Dhankuta

Appendix Table A2 Trends in the distribution in study population of covariates for stunting, Nepal DHS 2011-2016

Characteristics	2011			2016			Percentage point change 2016-2011	p-value
	%	*N*	95% CI	%	*N*	95% CI		
Stunting								
No	59.7	*1,419*	56.9-62.6	64.4	*1,512*	61.9-66.8	-4.6	*
Yes	40.3	*957*	37.4-43.2	35.7	*838*	33.3-38.1	4.6	
Age of child (in months)								
0-11	19.5	*463*	17.5-21.6	19.8	*465*	18.0-21.2	-0.3	
12-17	11.2	*266*	9.6-13.0	9.8	*231*	8.6-11.2	1.4	
18-23	9.1	*216*	7.8-10.6	11.9	*279*	10.5-13.4	-2.8	
24-35	20.2	*479*	18.3-22.2	18.9	*445*	17.3-20.7	1.2	
36-47	21.2	*504*	19.2-23.5	20.3	*476*	18.5-22.2	1.0	
48-59	18.9	*448*	17.3-20.5	19.3	*454*	17.8-20.9	-0.5	
Sex of child								
Male	50.8	*1,207*	48.4-53.2	52.2	*1,227*	50.1-54.3	-1.4	
Female	49.2	*1,169*	46.8-51.6	47.8	*1,122*	45.7-49.9	1.4	
Weight of child at birth								
Small (<2.5 kg)	11.5	*98*	9.1-14.5	12.3	*178*	10.5-14.4	-0.8	
Normal (2.5-3.49 kg)	52.1	*444*	47.7-56.4	57.7	*833*	54.6-60.7	-5.6	*
Large (≥3.5 kg)	36.4	*311*	31.9-41.2	30.0	*433*	27.0-33.2	6.4	
Mother's age								
15-24 years	41.9	*995*	39.3-44.5	42.4	*997*	39.5-45.4	-0.5	
25-34 years	46.3	*1,100*	43.3-49.3	48.4	*1,136*	45.7-51.0	-2.1	
35-49 years	11.8	*281*	10.0-13.9	9.2	*216*	7.7-11.0	2.6	
Mother's BMI								
Underweight (<18.5)	19.6	*464*	17.0-22.5	19.2	*450*	16.8-21.9	0.4	
Normal (18.5-24.9)	71.1	*1,683*	67.8-74.1	65.2	*1,530*	62.3-68.0	5.9	***
Overweight/obese (≥25)	9.3	*221*	7.6-11.4	15.6	*366*	13.6-17.8	-6.3	
Mother's height								
Less than 145 cm	11.8	*280*	9.8-14.2	11.2	*262*	9.5-13.1	0.7	
145 cm or more	88.2	*2,087*	85.8-90.2	88.8	*2,083*	86.9-90.5	-0.7	
Mother's anemia status								
Anemic	38.1	*892*	34.4-42.0	45.7	*1,067*	42.5-48.9	-7.6	**
Non-anemic	61.9	*1,450*	58.1-65.6	54.3	*1,267*	51.1-57.5	7.6	
Birth interval								
Less than 3 years	49.5	*762*	45.2-53.8	46.5	*676*	43.0-50.1	3.0	
3 years or more	50.5	*778*	46.2-54.8	53.5	*777*	50.0-57.0	-3.0	
Birth order								
First born	35.1	*833*	32.5-37.8	38.0	*893*	35.7-40.4	-3.0	
2-4	51.9	*1,232*	49.3-54.4	53.7	*1,262*	51.4-56.1	-1.9	***
5 or more	13.1	*310*	10.9-15.6	8.2	*194*	6.7-10.1	4.8	
Mother's dietary diversity								
Less than 5 food groups	na	na	na	69.2	*1,625*	66.2-72.1	na	
5 or more food groups	na	na	na	30.8	*724*	28.0-33.8	na	
Mother smoking status								
Smoking	12.0	*284*	9.8-14.5	5.5	*129*	4.3-7.1	6.5	***
Non-smoking	88.0	*2,092*	85.5-90.2	94.5	*2,220*	92.9-95.7	-6.5	
Early initiation of breastfeeding								
Child was breastfed within 1 hr. of birth	43.7	*423*	38.9-48.7	55.4	*544*	51.6-59.2	-11.7	***
Child was not breastfed within 1 hr. of birth	56.3	*545*	51.3-61.1	44.6	*438*	40.8-48.4	11.7	
Exclusive breastfeeding								
Child was exclusively breastfed	18.6	*171*	15.2-22.6	15.7	*151*	13.4-18.4	2.9	
Child was not exclusively breastfed	81.4	*749*	77.4-84.8	84.3	*810*	81.6-86.7	-2.9	
Minimum meal frequency								
Child was not fed meal with recommended minimum number of times	21.7	*153*	17.6-26.5	31.5	*236*	27.8-35.4	-9.7	**
Child was fed meal with recommended minimum number of times	78.3	*553*	73.5-82.4	68.6	*513*	64.6-72.	9.7	

(Continued…)

Appendix Table A2—Continued

Characteristics	2011			2016			Percentage point change 2016-2011	p-value
	%	*N*	95% CI	%	*N*	95% CI		
Minimum dietary diversity								
Child was not fed with minimum dietary diversity	71.0	*502*	65.8-75.8	55.7	*417*	51.6-59.7	15.3	***
Child was fed with minimum dietary diversity	29.0	*205*	24.3-34.2	44.3	*332*	40.3-48.4	-15.3	
Minimum acceptable diet								
Child was not fed with minimum acceptable diet	74.1	*523*	69.1-78.5	67.5	*506*	63.4-71.4	6.6	*
Child was fed with minimum acceptable diet	25.9	*183*	21.5-30.9	32.5	*243*	28.6-36.6	-6.6	
Vaccinations								
Child (12-23 months) received all basic vaccines	26.4	*628*	23.8-29.2	24.9	*584*	22.9-26.9	1.6	
Child (12-23 months) not received all basic vaccines	73.6	*1,748*	70.8-76.2	75.2	*1,765*	73.1-77.1	-1.6	
Any illnesses								
Child had no illness	70.6	*1,678*	68.2-73.0	74.4	*1,749*	72.2-76.5	-3.8	*
Child had any illness	29.4	*698*	27.0-31.8	25.6	*601*	23.5-27.8	3.8	
Treatment of water before drinking								
No treatment done	87.4	*2,076*	84.4-89.8	81.3	*1,907*	78.3-84.0	6.1	**
Treatment done	12.6	*300*	10.2-15.6	18.7	*439*	16.0-21.7	-6.1	
Open defecation								
Open Defecation Free	51.3	*1,219*	45.2-57.4	77.4	*1,819*	73.0-81.3	-26.1	***
Open Defecation	48.7	*1,157*	42.6-54.9	22.6	*530*	18.7-27.0	26.1	
Handwashing								
Household with no soap and water	63.6	*1,499*	58.8-68.1	62.2	*1,456*	58.4-65.9	1.4	
Household with soap and water	36.5	*860*	31.9-41.2	37.8	*885*	34.1-41.7	-1.4	
Use of cooking fuel								
Clean fuel	14.0	*330*	11.5-16.9	23.61	*553*	20.5-27.1	-9.6	***
Solid fuel	86.0	*2,028*	83.1-88.5	76.39	*1,788*	72.9-79.6	9.6	
Access to government health facility								
<30 minutes	na	na	na	51.8	*1,208*	46.9-56.6	na	
30-60 minutes	na	na	na	36.8	*859*	32.3-41.5	na	
60+ minutes	na	na	na	11.4	*267*	9.1-14.3	na	
Place of delivery								
Home/other	65.7	*1,549*	62.0-69.2	42.8	*1,001*	39.2-46.4	22.9	***
Health facility	34.4	*810*	30.8-38.1	57.2	*1,340*	53.6-60.8	-22.9	
ANC visit								
None	16.8	*317*	13.7-20.4	5.5	*106*	4.4-6.9	11.3	
1-3	34.4	*647*	30.8-38.1	25.5	*489*	22.8-28.5	8.8	***
4 or more	48.8	*919*	44.4-53.3	68.9	*1,320*	65.7-72.0	-20.1	
MIYCN counseling								
No	na	na	na	83.8	*1,960*	81.2-86.0	na	
Yes	na	na	na	16.3	*380*	14.0-18.8	na	
Mother's media exposure								
Access none of the 3 media at all	14.8	*351*	11.8-18.4	23.1	*544*	20.2-26.4	-8.4	
Access any of three media (radio, television or newspaper) less than once a week	30.7	*729*	27.2-34.4	23.8	*560*	21.4-26.5	6.9	***
Access any of three media (radio, television or newspaper) at least once a week	54.5	*1,296*	49.5-59.5	53.0	*1,246*	49.5-56.5	1.5	
Exposure to TV/radio health and nutrition program								
Heard/seen none of the TV/radio health and nutrition programs	65.3	*1,551*	70.2-70.1	61.6	*1,446*	58.0-65.0	3.7	
Heard/seen any one of the TV/radio health and nutrtion programs	34.7	*825*	29.9-39.9	38.4	*903*	35.0-42.0	-3.7	

(Continued…)

Appendix Table A2—Continued

Characteristics	2011			2016			Percentage point change 2016-2011	p-value
	%	*N*	95% CI	%	*N*	95% CI		
Nutrition intervention program district								
Group A	11.7	*277*	8.3-16.1	10.1	*237*	7.7-13.1	1.6	
Group B	38.2	*908*	30.4-46.6	35.4	*832*	29.7-41.6	2.8	
Group C	9.6	*229*	7.3-12.6	9.2	*216*	6.3-13.2	0.4	
Group D	40.5	*963*	33.0-48.5	45.3	*1,064*	39.0-51.8	-4.8	
Province								
Province 1	21.2	*499*	17.4-25.4	15.7	*368*	13.9-17.8	5.4	
Province 2	21.0	*494*	15.3-28.1	27.5	*643*	24.5-30.6	-6.5	
Province 3	13.1	*309*	10.2-16.7	15.2	*355*	12.4-18.3	-2.0	
Province 4	11.0	*259*	8.0-15.0	7.7	*180*	6.4-9.2	3.3	*
Province 5	14.7	*346*	11.3-18.9	18.9	*442*	16.6-21.4	-4.2	
Province 6	7.7	*182*	5.54-10.6	6.3	*148*	5.5-7.3	1.4	
Province 7	11.4	*269*	9.8-13.3	8.8	*205*	7.4-10.4	2.6	
Household wealth quintile								
Poorest	25.6	*608*	21.7-29.9	20.6	*483*	17.6-23.9	5.0	
Poorer	20.3	*482*	17.6-23.3	21.7	*510*	19.3-24.4	-1.4	
Middle	23.3	*554*	19.5-27.7	22.7	*532*	20.2-25.3	0.7	
Richer	17.1	*406*	14.5-20.1	21.7	*510*	18.6-25.2	-4.6	
Richest	13.7	*326*	10.9-17.1	13.4	*314*	10.9-16.2	0.4	
Ecological zone								
Mountain	7.9	*188*	6.9-9.1	7.0	*163*	4.8-10.0	1.0	
Hill	39.5	*938*	35.9-43.1	36.6	*860*	31.9-41.6	2.9	
Terai	52.6	*1,250*	48.7-56.5	56.4	*1,325*	51.5-61.2	-3.8	
Caste/ethnicity								
Brahmin/Chhetri	30.7	*727*	26.4-35.2	27.4	*644*	24.1-30.9	3.3	
Terai/Madhesi other	9.4	*230*	6.5-13.5	20.3	*474*	16.3-24.9	-10.9	
Dalit	18.2	*433*	14.1-23.1	14.4	*338*	11.9-17.4	3.8	*
Newar	2.7	*63*	1.8-4.1	3.1	*72*	2.1-4.5	-0.4	
Janajati	33.0	*779*	27.6-38.8	27.9	*658*	24.4-31.8	5.0	
Muslim	6.2	*146*	2.8-13.3	7.0	*163*	4.3-11.1	-0.8	
Mother's education								
No education	47.4	*1,119*	42.2-52.8	34.6	*812*	31.5-37.9	12.8	
Primary	19.7	*461*	17.1-22.6	20.1	*471*	17.8-22.6	-0.4	***
Some secondary	19.4	*459*	16.6-22.5	24.0	*560*	21.6-26.6	-4.6	
SLC or higher	13.5	*319*	11.1-16.3	21.3	*498*	18.8-24.0	-7.8	
Mother's occupation								
Not working	28.1	*667*	23.8-32.7	39.9	*937*	36.0-43.9	-11.8	
Non-agricultural	12.0	*285*	10.0-14.3	14.1	*332*	12.3-16.2	-2.1	***
Agricultural (Self-employed)	59.9	*1,424*	55.2-64.5	46.0	*1,080*	42.0-50.0	14.0	
Household size								
4 or less	28.1	*667*	25.4-31.0	30.1	*708*	27.3-33.1	-2.1	
More than 4	71.9	*1,709*	69.0-74.6	69.9	*1,641*	66.9-72.7	2.1	
Household food security								
Food secure	43.1	*1,024*	39.0-47.3	40.9	*961*	37.7-44.2	2.2	
Mild food insecurity	12.3	*292*	10.3-14.6	22.7	*534*	20.3-25.3	-10.4	***
Moderate food insecurity	23.3	*553*	20.2-26.7	25.8	*606*	23.2-28.6	-2.5	
Severe food insecurity	21.3	*507*	18.0-25.1	10.6	*248*	8.7-12.7	10.8	
Mother's decision making								
Cannot make decision	47.3	*437*	42.6-52.0	55.1	*1,196*	51.9-58.3	-7.8	**
Can make decision	52.7	*487*	48.0-57.4	44.9	*974*	41.8-48.1	7.8	
Mother's internet use								
Not used in past 12 months	na	na	na	17.3	*406*	15.0-19.9	na	
Used in past 12 months	na	na	na	82.7	*1,943*	80.2-85.0	na	
Mother owns a mobile phone								
No	na	na	na	23.5	*551*	79.5-85.6	na	
Yes	na	na	na	76.5	*1,798*	14.4-20.5	na	
Mother's experience of spousal violence								
Did not experience	78.3	*1,458*	74.8-81.5	82.8	*1,490*	79.5-85.6	-4.5	
Experienced	21.7	*404*	18.6-25.2	17.2	*310*	14.4-20.5	4.5	

na = not available
*** p<0.001, **p<0.01, *p<0.05
[1] p-value is the result of a chi-square test of independence between covariate and survey year.

Appendix Table A3 Association of stunting and child-instrinsic; maternal, infant, and young child feeding; health and environment; and socioeconomic factors. Results from separate multiple logistic regressions, Nepal DHS 2016

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Child-instrinsic factors model				
Age of child (in months)				
0-11	Ref			
12-17	2.44***	1.62-3.67	2.01**	1.17-3.45
18-23	3.82***	2.55-5.73	3.52***	2.17-5.69
24-35	4.26***	3.04-5.98	3.97***	2.56-6.19
36-47	3.42***	2.41-4.85	2.62***	1.67-4.11
48-59	3.53***	2.38-5.22	2.68***	1.62-4.45
Sex of child				
Male	Ref			
Female	1.01	0.84-1.24	0.84	0.65-1.08
Weight of child at birth				
Small (<2.5 kg)	Ref			
Normal (2.5-3.49 kg)	0.45***	0.31-0.65	0.46***	0.32-0.67
Large (≥3.5 kg)	0.38***	0.25-0.58	0.37***	0.24-0.57
Maternal factors model				
Mother's age				
15-24 years	Ref			
25-34 years	1.22	0.97-1.55	1.18	0.92-1.50
35-49 years	1.46*	1.01-2.12	1.14	0.72-1.81
Mother's BMI				
Underweight (<18.5)	Ref			
Normal (18.5-24.9)	1.27*	1-1.6	0.75*	0.58-0.96
Overweight/obese (≥25)	1.45	0.99-2.12	0.42***	0.28-0.62
Mother's anemia				
Anemic	Ref			
Non-anemic	0.98	0.8-1.19	1.08	0.88-1.33
Mother's height				
Less than 145 cm	Ref			
145 cm or more	0.34***	0.25-0.48	0.35	0.25-0.49
Birth interval				
Less than 3 years	Ref			
3 years or more or no preceding birth interval	0.54***	0.46-0.72	0.63***	0.49-0.81
Birth order				
First born	Ref			
2-4	1.37**	1.1-1.71	1.01	0.78-1.30
5 or more	2.14***	1.48-3.06	1.30	0.78-2.15
Mother's dietary diversity				
Less than 5 food groups	Ref			
5 or more food groups	0.67***	0.53-0.85	0.79	0.61-1.02
Mother smoking status				
Smoking	Ref			
Non-smoking	0.58**	0.39-0.87	0.68	0.44-1.05
Infant and young child feeding factors model				
Early initiation of breastfeeding				
Child was breastfed within 1 hr. of birth	Ref			
Child was not breastfed within 1 hr. of birth	1.30	0.92-1.84	1.34	0.93-1.94
Exclusive breastfeeding				
Child was exclusively breastfed	Ref			
Child was not exclusively breastfed	0.75	1.31-3.67	0.43	0.08-2.2
Minimum Meal Frequency				
Child was not fed with minimum meal frequency	Ref			
Child was fed with minimum meal frequency	1.39	0.96-2.03	1.60	0.99-2.57
Minimum Dietary Diversity				
Child was not fed with minimum dietary diversity	Ref			
Child was fed with minimum dietary diversity	0.93	0.64-1.35	1.04	0.55-1.97
Minimum Acceptable Diet				
Child was not fed with minimum acceptable diet	Ref			
Child was fed with minimum acceptable diet	1.00	0.67-1.49	0.78	0.36-1.7

(Continued…)

Appendix Table A3—Continued

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Health and environment factors model				
Vaccinations				
Child (12-23 months) received all basic vaccines	Ref			
Child (12-23 months) had not received all basic vaccines	0.95	0.57-1.59	2.28***	1.74-2.99
Any illnesses				
Child had no illness	Ref			
Child had any illness	0.95	0.76-1.18	1.02	0.79-1.31
Treatment of water before drinking				
No treatment done	Ref			
Treatment done	0.56***	0.39-0.78	0.92	0.64-1.32
Open defecation				
Open defecation free	Ref			
Open defecation	2.06***	1.58-2.67	1.29	0.94-1.76
Handwashing				
Household with no soap and water	Ref			
Household with soap and water	0.45***	0.37-0.56	0.64***	0.5-0.82
Use of cooking fuel				
Clean fuel	Ref			
Solid fuel	2.25***	1.66-3.05	1.21	0.89-1.64
Nutrition Intervention Program District				
Group A	Ref			
Group B	1.08	0.75-1.57	0.94	0.66-1.33
Group C	1.17	0.77-1.76	1.19	0.78-1.81
Group D	0.99	0.7-1.42	1.03	0.74-1.44
Access to government health facility				
<30 minutes	Ref			
30-60 minutes	1.24*	0.99-1.53	1.24	0.98-1.57
60+ minutes	1.75***	1.28-2.4	1.60*	1.11-2.31
Place of delivery				
Home/other	Ref			
Health facility	0.55***	0.44-0.67	0.95	0.74-1.24
ANC visit				
None	Ref			
1-3	0.69	0.41-1.18	0.97	0.59-1.58
4 or more	0.41***	0.26-0.65	0.72	0.45-1.15
MIYCN counseling				
No	Ref			
Yes	0.74	0.55-1.01	0.96	0.72-1.31
Mother's media exposure				
Access none of the 3 media at all	Ref			
Access any of 3 media (radio, television or newspaper) less than once a week	0.59***	0.45-0.77	0.68*	0.49-0.93
Access any of 3 media (radio, television or newspaper) at least once a week	0.39***	0.3-0.48	0.55***	0.39-0.72
Exposure to TV/radio health and nutrition program				
Heard/seen none of the TV/radio health and nutrition programs	Ref			
Heard/seen any one of the TV/radio health and nutrition programs	0.58***	0.47-0.73	0.92	0.69-1.23

(Continued…)

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Socioeconomic factors model				
Residence				
Urban	Ref			
Rural	1.46***	1.17-1.81	1.08	0.85-1.38
Province				
Province 1	Ref			
Province 2	1.17	0.85-1.6	0.65	0.4-1.07
Province 3	0.85	0.55-1.33	1.03	0.69-1.53
Province 4	0.82	0.52-1.29	1.10	0.67-1.81
Province 5	1.23	0.82-1.85	0.96	0.62-1.48
Province 6	2.44***	1.69-3.54	1.73*	1.12-2.65
Province 7	1.11	0.75-1.63	0.84	0.56-1.27
Household wealth quintile				
Poorest	Ref			
Poorer	0.63**	0.47-0.85	0.77	0.54-1.1
Middle	0.57***	0.42-0.77	0.55**	0.37-0.82
Richer	0.50***	0.37-0.67	0.51**	0.33-0.79
Richest	0.20***	0.14-0.3	0.34***	0.19-0.61
Ecological zone				
Mountain	Ref			
Hill	0.55***	0.38-0.8	0.91	0.63-1.33
Terai	0.66*	0.47-0.95	1.43	0.93-2.2
Caste/ethnicity				
Brahmin/Chhetri	Ref			
Terai/Madhesi other	1.41*	1.06-1.88	1.52	0.89-2.59
Dalit	1.26	0.9-1.77	1.10	0.7-1.73
Newar	0.53	0.25-1.14	0.62	0.25-1.56
Janajati	0.94	0.7-1.25	0.80	0.56-1.15
Muslim	1.18	0.79-1.75	1.10	0.62-1.98
Mother's education				
No education	Ref			
Primary	0.69**	0.54-0.88	0.76	0.55-1.04
Some secondary	0.55***	0.42-0.71	0.82	0.59-1.14
SLC or higher	0.35***	0.26-0.47	0.56*	0.34-0.91
Mother's occupation				
Not working	Ref			
Non-agricultural	1.31	0.96-1.79	1.94***	1.31-2.85
Agricultural (self-employed)	1.61***	1.3-1.98	1.32	0.99-1.75
Household size				
4 or less	Ref			
More than 4	1.55***	1.22-1.93	1.41*	1.06-1.87
Household food security				
Food secure	Ref			
Mild food insecurity	1.35*	1.06-1.71	0.87	0.62-1.23
Moderate food insecurity	1.73***	1.33-2.23	1.08	0.75-1.56
Severe food insecurity	2.10***	1.4-3.13	1.30	0.81-2.08
Mother's internet use				
Used in past 12 months	Ref			
Not used in past 12 months	2.11***	1.56-2.84	1.06	0.71-1.6
Mother owns a mobile phone				
No	Ref			
Yes	0.59***	0.47-0.73	0.84	0.62-1.13
Mother's decision making				
Cannot make decision	Ref			
Can make decision	0.88	0.72-1.09	1.12	0.87-1.44
Mother's experience of spousal violence				
Did not experience	Ref			
Experienced	1.13	0.84-1.51	0.92	0.66-1.28

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

Appendix Table A4 Association of minimum acceptable diet and child-instrinsic; maternal; health and environment; and socioeconomic factors. Results from separate multiple logistic regressions, Nepal DHS 2016

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Child-instrinsic factors model				
Age of child (in months)				
6-11	Ref			
12-23	2.55***	1.95-3.34	3.67***	2.29-5.87
Sex of child				
Male	Ref			
Female	0.97	0.66-1.43	1.07	0.68-1.67
Weight of child at birth				
Small (<2.5 kg)	Ref			
Normal (2.5-3.49 kg)	1.08	0.68-1.73	0.89	0.46-1.71
Large (≥3.5 kg)	1.13	0.69-1.85	1.09	0.51-2.30
Maternal factors model				
Mother's age				
15-24 years	Ref			
25-34 years	1.45**	1.13-1.87	1.30	0.80-2.11
35-49 years	0.98	0.57-1.69	3.29*	1.25-8.64
Birth interval				
Less than 3 years	Ref			
3 years or more or no preceding birth interval	2.06***	1.53-2.79	0.98	0.572-1.67
Birth order				
First born	Ref			
2-4	0.77	0.58-1.00	0.73	0.44-1.21
5 or more	0.35***	0.21-0.60	0.38	0.13-1.14
Mother's anemia				
Anemic	Ref			
Non-anemic	1.23	0.85-1.78	1.15	0.77-1.73
Mother's dietary diversity				
Less than 5 food groups	Ref			
5 or more food groups	5.31***	4.17-6.77	5.55***	3.74-8.25
Health and environment factors model				
Time to obtain drinking water				
Water on premises	Ref			
Less than 30 minutes	1.06	0.77-1.45	1.14	0.81-1.62
30 minutes or longer	0.72	0.40-1.30	0.85	0.47-1.51
Open defecation				
Open defecation free	Ref			
Open defecation	0.40***	0.28-0.56	0.62**	0.43-0.89
Handwashing				
Household with no soap and water	Ref			
Household with soap and water	1.47**	1.15-1.89	0.94	0.69-1.29
Use of cooking fuel				
Clean fuel	Ref			
Solid fuel	0.55***	0.41-0.73	0.74	0.54-1.04
Access to government health facility				
<30 minutes	Ref			
30-60 minutes	1.02	0.79-1.32	1.01	0.74-1.36
60+ minutes	0.82	0.53-1.25	0.69	0.43-1.12
Any illnesses				
Child had any illness	Ref			
Child had no illness	0.89	0.69-1.16	0.95	0.71-1.27
ANC				
No ANC	Ref			
1-3 ANC visits	0.68	0.26-1.73	0.50	0.19-1.30
4+ ANC visits	1.35	0.60-3.02	0.77	0.32-1.88
Place of delivery				
Home/other	Ref			
Health facility	1.48**	1.09-2.03	0.88	0.62-1.24

(Continued…)

Appendix Table A4—Continued

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Nutrition Intervention Program District				
Group A	Ref			
Group B	0.35***	0.24-0.52	0.45***	0.29-0.70
Group C	0.52**	0.32-0.85	0.56*	0.32-0.97
Group D	0.46***	0.31-0.67	0.50***	0.34-0.75
MIYCN counseling				
No	Ref			
Yes	1.94***	1.45-2.59	1.51**	1.11-2.06
Mother's media exposure				
Access none of the 3 media at all	Ref			
Access any of 3 media (radio, television, or newspaper) less than once a week	1.50*	1.00-2.24	1.10	0.70-1.74
Access any of 3 media (radio, television, or newspaper) at least once a week	2.48***	1.75-3.51	1.46	0.93-2.29
Mother's exposure to TV/radio health and nutrition program				
Heard/seen none of the TV/radio health and nutrition programs	Ref			
Heard/seen any one of the TV/radio health and nutrition programs	2.31***	1.80-2.95	1.59**	1.15-2.21
Socioeconomic factors model				
Residence				
Urban	Ref			
Rural	0.94	0.71-1.22	1.58	0.93-2.68
Province				
Province 1	Ref			
Province 2	0.48***	0.31-0.74	0.91	0.33-2.53
Province 3	1.50	0.93-2.44	2.31	0.93-5.73
Province 4	2.18***	1.47-3.23	3.17**	1.35-7.44
Province 5	1.46	0.97-2.20	1.48	0.72-3.08
Province 6	1.26	0.81-1.97	1.01	0.45-2.27
Province 7	1.06	0.62-1.83	0.61	0.23-1.63
Household wealth quintile				
Poorest	Ref			
Poorer	1.15	0.76-1.73	2.03	0.99-4.17
Middle	0.88	0.59-1.32	2.76**	1.31-5.83
Richer	1.61*	1.04-2.48	2.76*	1.21-6.27
Richest	2.30***	1.48-3.58	1.99	0.68-5.78
Ecological zone				
Mountain	Ref			
Hill	1.16	0.69-1.96	0.44	0.19-1.04
Terai	0.51*	0.31-0.87	0.26**	0.10-0.71
Caste/ethnicity				
Brahmin/Chhetri	Ref			
Terai/Madhesi other	0.28***	0.18-0.44	0.40	0.14-1.13
Dalit	0.44***	0.29-0.66	0.68	0.31-1.51
Newar	0.52*	0.30-0.90	0.11***	0.03-0.40
Janajati	0.49***	0.34-0.70	0.45*	0.24-0.85
Muslim	0.25***	0.12-0.49	0.59	0.14-2.46
Mother's education				
No education	Ref			
Primary	1.05	0.60-1.84	0.89	0.42-1.89
Some secondary	2.16**	1.33-3.48	1.94	0.99-3.81
SLC or higher	3.83***	2.23-6.57	3.96**	1.57-10.01
Household size				
4 or less	Ref			
More than 4	0.66***	0.51-0.85	1.10	0.69-1.74
Household food security				
Food secure	Ref			
Food insecure	0.55***	0.43-0.71	0.76	0.45-1.30

(Continued…)

Appendix Table A4—Continued

Characteristics	Model I		Model II	
	uOR	95% CI	aOR	95% CI
Mother's decision making				
Cannot make decision	Ref			
Can make decision	1.54**	1.12-2.11	1.05	0.67-1.66
Mother's internet use				
Used in past 12 months	Ref			
Not used in past 12 months	0.50***	0.38-0.67	1.29	0.68-2.45
Mother owns a mobile phone				
No	Ref			
Yes	1.79***	1.35-2.38	0.82	0.43-1.55
Mother's experience of spousal violence				
Did not experience	Ref			
Experienced	0.53	0.27-1.02	0.67	0.32-1.41

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