INEQUALITY IN CHILD NUTRITION IN NEPAL: A DECOMPOSITION ANALYSIS

A Thesis

Submitted to the Central Department of Economics,
Faculty of Humanities and Social Sciences,
Tribhuvan University, Nepal,
in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF ARTS

in

ECONOMICS

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March, 2023

DECLARATION

I, Mohan Khanal, author of this proposed thesis, declare that this thesis entitled Inequality in child nutrition in Nepal: A Decomposition Analysis submitted to Central Department of Economics, Tribhuvan University is my own original work unless otherwise indicated or acknowledged in the thesis. The thesis does not contain materials which has been accepted or submitted for any other degree at the University or other institution. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

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LETTER OF RECOMMENDATION

This thesis entitled INEQUALITY IN CHILD NUTRITION IN NEPAL: A DECOMPOSITION ANALYSIS has been prepared by Mr. Mohan Khanal under my guidance and supervision. I, hereby, recommend it in partial fulfilment of the requirements for the Degree of MASTERS OF ARTS IN ECONOMICS for final. examination.

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APPROVAL SHEET

We certify that this thesis entitled CHANGES IN INEQUALITY IN CHILD NUTRITION IN NEPAL: A DECOMPOSITION ANALYSIS submitted by MOHAN KHANAL to the Central Department of Economics, Faculty of Humanities and Social Sciences, Tribhuvan University, in partial fulfilment of the requirements for the Degree of MASTER OF ARTS in ECONOMICS has been found satisfactory in scope and quality. Thus, we accept this thesis as a part of the said degree.

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ACKNOWLEDGEMENT

The past years in Central Department of Economics, Tribhuvan University has been quite an amazing journey for me since it has taught me how to find solutions from rich amount of textbooks for which I am always proud of. The master's program at Central Department of Economics, Tribhuvan University has not only been about teaching the textbooks and preparing students like us for the exams, but also about involving students in discussions, seminars and research studies which are beyond the syllabus. I take this opportunity to express my sincere gratitude towards the entire faculties and staffs at CEDECON, TU who have always worked hard in favour of students. I would like to express my deepest gratitude towards my mentor and supervisor Mr. Khagendra Katuwal, Central Department of Economics, Tribhuvan University. He has been a wonderful mentor and inspiration to me as well as majority of the students when it comes to applying whatever we learn in the real life. Working with him on surveys, research studies, paper presentation conference have always been a great experience and learning opportunity for me. I would like to thank him for all the scholarly guidance and inputs that he has given me while writing this thesis. I also like to thank my seniors Ajay Gautam and Manab Prakash for guidance and suggestions during my early days in the department, and I am also inspired from their works in this field. I am indebted to my dear colleague Shreezal G.C who helped me throughout this process. Special regards to all my teachers from my school, high schools and undergraduate whose influence led me to get achieve this prestigious degree. I am greatly indebted towards my family members who have continuously supported me in this pursuit. I couldn't have reached this height if it wasn't for my family members who have always motivated me in whatever I undertake.

ABSTRACT

The nutrition outcomes vary across different regions in the developing countries, socio-economic factors are drivers for inequality across urban and rural regions. Nepal is facing migration from from rural to urban by large and in recent times health facilities and nutrition intakes in two differently populated regions are varying. Nutrition intake and outcome leading to growth of human capital have different factors associated with them in these two regions. The nutrition outcomes measured in terms of height for age z scores and prevalence or stunting are often found to be concentrated among poor groups and household's access to health and sanitation facilities. The concentration indices were drawn to show whether the inequality across rural and urban group of children prevailed. The logistic regression showed the likelihood of stunting, wasting and underweight across the different categories of dependent variables. The gap across nutritional outcomes were decomposed using linear decomposition technique and Oaxaca Blinder approach with Height for Age(HAZ), Weight for Age and Weight for Height(WHZ) as outcome variable. For outcome variables as Stunting, wasting and underweight we decomposed results with non-linear based Fairlie decomposition technique. The results showed that stunting and underweight have higher inequality in rural group and lower inequality for urban group. Logistic regression showed children belonging to Lumbini province were likely to suffer wasting and children from Karnali province had higher chances of stunting to children from other provinces. Similarly, the likelihood of stunting and underweight also remained significant among the poorer household group children. The likelihood of stunting and underweight is also significant for children belonging to household with no toilet facility. From linear based Oaxaca Blinder decomposition mother's education contributes 38% and 36% to the endowment induced urban rural gap in HAZ and WAZ outcome. Wealth index also contributes to urban rural gap in HAZ and WAZ by 50%. Maternal autonomy contributes to endowment induced gap in urban rural HAZ by 24%, anemia only shows significant result at 1 %

however, in contribution to urban rural gap WAZ score. The non linear decomposition results showed anemia as major contributor to wasting outcomes and toilet facility to all nutritional undernutrition outcomes.

LIST OF ABBREVIATIONS

BR	Biomarker Recode
BO	Blinder-Oaxaca
CI	Confidence Interval
DHS	Demographic and Health Survey
HAZ	Height for Age
LMIC	Low and Middle Income Country
MNSP	Multi-Sectoral Nutrition Plan
NL	Non-Linear
OR	Odd Ratio
QRCD	Quantile Regression Counterfactual Decomposition
SDG	Sustainable Development Goals
UNICEF	United Nations Children's Emergency Fund
WAZ	Weight for Age
WHO	World Health Organization
WHZ	Weight for Height

Table of Contents

List of Tables

List of Figures

CHAPTER I

INTRODUCTION

This chapter provides background of the study, problem statement, research objectives, significance and limitations of the study. The outline of the thesis is presented at the end of this chapter.

1.1 Background

Poor nutrition is a global pandemic with social, economic, and environmental causes and consequences. Of the 17 Sustainable Development Goals (SDGs), only SDG2 explicitly mentions nutrition. Amid the global pandemic in Corona Virus and halfway through to the Sustainable Goals target, the goal will definitely face hindrances since 17 sustainable goals are closely linked to nutrition. The nutrition outcome results are are key to assess the human capital overall however for developing countries like Nepal the study becomes even more important with the landscape of migration as seen in recent times (Karn et al., 2019). The child undernutrition is among important variable whose weight in developing multidimensional poverty index for Nepal is ranked higher. Among consequences of undernutrition. Pravana et al. (2017) child survival, cognitive development damages with physical development of individuals and ultimately economic productivity of individuals and societies are few. Nutrition has a direct impact on future health outcomes, but it also has a significant impact on economic output. Stunting is linked to lower earnings, according to quasi-experimental research studies from the international literature; a 1 cm drop in adult height is linked to a 4% drop in male wages and a 6% drop in female income (McGovern et al., 2017).

Nepal in 1990s was predominantly a country whose large part of the population worked

in self-subsistence agriculture or the informal sector. In recent decade, some socio-political changes, the migration from hills to terai and rural to urban, has seen unprecedented changes in lifestyle and economic opportunities. Besides these changes there are significant efforts in the nutrition program in the country. Nepal joined Multi-Sectoral Nutrition Plan (MNSP) II in 2012,covering 2013-2017 second phase of the programs started in 2018 covering 2018-2022. Nepal was one of early entrant for the Scaling Up Nutrition Movement and it was signed in 2012 (Ruducha et al., 2022). Low-income and middle-income countries (LMICs) are said to suffer the so-called double burden of malnutrition, with continuing stunting of growth and deficiencies of essential nutrients along with obesity in national populations and within families (Black et al., 2013). Stunting remains a key outcome because Government of Nepal has underlined this as key outcome indicator for the Multi-sector Nutrition Plan II (Karn et al., 2019).

According to Conway et al. (2020), Nepal has shown a consistent decline in stunting among children under the age of five. This is especially true when compared to several other nations in the area. Despite a decade of Maoist insurgency and instability, socioeconomic outcomes have been improving. A steady progress across different developing and underdeveloped countries in terms of human development is an encouraging sign however. Even more impressive progress is in the case of Nepal over past decades in terms of child mortality and stunting prevalence.

UNICEF outlines increasing triple burden of malnutrition- undernutrition, micronutrient deficiencies and overweight and highlights the role of diets and care as immediate determinants of maternal and child nutrition. The nutrition outcomes are therefore based on enabling, underlying and immediate determinants of adequate nutrition. Based on this framework, we aimed at assessing a comprehensive study of socioeconomic factors, child factors and environmental factors on determining child undernutrition.

1.2 Statement of Problem

The nutritional status of children in country has improved since 1996 based on the annual reports of Department of Health Services (2021) and Ministry of Health- Nepal, New ERA and ICF (2017). Government of Nepal has launched National Nutrition Programme aimed at achieving nutrition well being of all people. The study aims at finding contributing factors of gap in nutritional outcomes across rural and urban children. The article explores the decomposition method to find inequality value among rural and urban population.

(i) What are the nutritional status across rural and urban children using z scores of height for age ratio and quantify factors leading to increased or decreased stunting ?

(ii) What are major contributing factors to inequality in child nutrition outcomes across urban and rural?

1.3 Research Objectives

The research objectives of this study are as follows:

(i) To evaluate the nutritional status across rural and urban children using z scores of height for age ratio and calculate increased or decreased likelihood of stunting due to independent factors.

(ii) To conduct a decomposition analysis of demographic and socio economic characteristics causing inequality across nutritional status of rural and urban children.

1.4 Significance of the Study

This study, specifically focusing on health inequalities and population health in Nepal, can provide valuable insights and contribute to efforts to improve these areas in the country.

Since the government of Nepal, partner organization and health sector government and non-government agencies have emphasized the need for a multi-sector approach to implement nutrition plan and Nepal has placed a high priority on improving child nutrition in its Multi-Sector Nutrition Plan 2013-2017 (Karn et al., 2019). The study draws contributing factors of stunting, wasting and underweight across urban and rural group of children in Nepal. The study is significant in the sense that it goes beyond mean height for age(HAZ), weight for height(WAZ) and weight for height(WHZ) decomposition results to decompose contributing factors on presence of stunting, wasting and underweight. Thus, the study is prominent in terms of policy implications. Yet, to the best of our knowledge, no study in Nepal has examined the role of socio-economic inequality in child malnutrition and its determinants.

1.5 Limitations of the Study

The study is based on fifth round of Nepal Demographic Health Survey data because most recent survey data was not available for the study analysis. The results are thus based on data from 2016 survey. Moreover, the study assumes that rural and urban characteristics of the study in the survey to be homogeneous across variables.

1.6 Chapter Outline

This thesis is organized into five chapters including the introduction in chapter one. The second chapter explains review of literature with overview of related methods, international and national paper on child nutrition inequality. The third chapter includes methodology with presentation of conceptual framework, discussion of statistical and empirical strategy. The forth chapter includes data analysis as discussed in chapter three. The fifth chapter summarizes and concludes the study.

CHAPTER II

LITERATURE REVIEW

This chapter presents the review of studies done in the past to examine factors leading to inequality in child nutrition outcomes. Starting with overview of methods related to the present study and followed by review of literature in child undernutrition. The papers reviewed consist the work from global, dominantly developing and national contexts. The chapter concludes identifying the research gap in the field.

2.1 Overview of methods

Studies have outlined the child nutrition inequality among poor and non poor from urbanization contexts in developing countries (Firestone et al., 2011; Singh et al., 2020). There are numerous work on inequality determination in child nutrition outcomes, predominantly based on height for age(HAZ), weight for age(WAZ) and weight for height(WHZ) indices. The health inequality determination for assessing the causes behind the inequalities decomposition technique are employed in various studies.. The works of Sharaf & Rashad (2016) explain the urban-rural disparities in chronic malnutrition among children using Blinder-Oaxaca decomposition. The Blinder Oaxaca decomposition is a technique that decomposes inequities between any two groups and has been used extensively in explaining wage differentials between males and females, immigrants and natives, blacks and whites workers.

The study Wagstaff et al. (2007) outlines that group differences in the mean of an outcome variable administered in Blinder Oaxaca technique follows mean HAZ score in case of child malnutrition, these variables are less interesting. Thus the paper attempts to find stunting, wasting and underweight gap, i.e dichotomous outcome variable in relationship of interest

expressed in non-linear logit model. Further the study follows the extended version of BO Decomposition for non linear outcome based on the original works of Fairlie (1999) and Fairlie (2005). Nie et al. (2019) have also followed non-linear decomposition approach for binary dependent variable in-case of India, identifying and quantifying the changes in nutrition outcomes using data from India Demographic and Health Survey from 2004-05 and 2011-12.

2.2 Review of Empirical Studies

A study conducted by Pravana et al. (2017) has found that the mother's age at birth, birth interval, socioeconomic status, father's educational level and initiation of complementary feeding at the age of 6 months were important determinants of Severe Acute Malnutrition among children. In addition, a study by Headey & Hoddinott (2015) outlines healthy women with the time and resources to care for themselves and their children are essential for healthy fetal growth and early child development. Gender inequality contributes to the under-nutrition of women and girls, which then affects the subsequent generation.

Meanwhile one study (Fotso, 2006) has outlined evidence of short and long-term consequences of nutritional deficiencies include increased risk of both morbidity from infectious diseases and mortality, impaired cognitive or delayed mental development and, subsequently, reduced learning abilities in school, and poor work capacity in adulthood. Thus it is imperative to understand child nutrition causes to assess human capital for country. The rapid pace of urbanisation in developing countries has led to an increase in the number of people living in cities and towns and cities, according to Fotso (2006).

Another study by Sharaf & Rashad (2016) have discussed on the wealth index as affordability of purchasing nutrition rich food. Children's sex, age, age squared, mother's age and education level, father's education, family economic situation as determined by the wealth index, access to piped water, having a private toilet, giving birth in a medical facility, and parental medical visits were all specifically analyzed.The paper discusses based

on previous studies that educated mothers would feed better, benefit themselves from health care providers and information on health care since mothers are more aware on sanitation and hygienic living environment. Otherwise risk of diseases and infections are more common in deficient sanitation and water supply.

A comprehensive assessment of stunting in South Asia reveals substantial differences in the performance of countries in reducing the prevalence of under-nutrition, with Nepal achieving the greatest declines and Pakistan the least (Krishna et al., 2018). The authors have diagnosed child stunting across three dimensions of disadvantages (a) children's access to food, represented by dietary diversity, (b) social, represented by maternal educational attainment; and (c) economic, represented by household and these are represented on the nested levels of child nutrition- child level, mother-level, and house-hold-level complying the UNICEF's conceptual model of nutrition (Unicef et al., 2013).

A similar study done by Nie et al. (2019) conducts a comprehensive analysis of the demographic and socio-economic factors contributing to changes in the nutritional status (HAZ, WAZ and CIAF) of children aged 0–5 years in India using the IHDS data for 2004–2005 and 2011–2012. The study focused on three key questions : i. has there been any changes in nutritional status of children across period 2004/2005-2011/2012 across region ii. what are factors relating to change in nutritional outcomes of children with special attention to maternal autonomy.

The persistence of rural-urban disparities in child nutrition, along with increasing urbanisation and inequality in child nutrition in urban areas, highlights the need for a better understanding of the main drivers of urban-rural differences in nutrition outcomes (Srinivasan et al., 2013). The authors have employed Quantile Regression-based Counterfactual Decomposition (QR-CD) from the DHS data, 45% of children under the age of five are stunted in rural Bangladesh, compared to 36% in urban areas, with a population average of 43%. In Nepal, 51% of under-fives in rural areas are stunted, compared to 36% in urban areas, with the population average being 49%. The employment of decomposition among

rural-urban group showed that the covariate effect is dominant between covariate and co-efficient effects in nutrition outcome. The results in the same study indicate a unit increase in the wealth index is strongly associated with child HAZ scores in urban households than in rural households. However, in Bangladesh, the disadvantage of rural areas is largely countered by the favorable effect of extended families on child nutrition in specific quantiles. The co-efficient effect of the wealth index tends to expand rural-urban differences.

The stunting regression results showed that safe drinking water and satisfactory sanitation's reduced malnutrition in both years and the effects were stronger in 1998. Household consumption was found to have negative relationship with malnutrition. The inequality decomposition results were found to disfavor the poor in terms of inequality in drinking water, satisfactory sanitation and schooling in both years.

Bhutta et al. (2013) argue that prevalence of overweight and obesity is increasing in children younger than 5 years globally and is an important contributor to diabetes and other chronic diseases in adulthood. The authors also have highlighted the previous findings undernutrition during pregnancy affecting fetal growth, and the first 2 years of life is a major determinant of both stunting of linear growth and subsequent obesity and non-communicable diseases in adulthood. Deficiencies of vitamin A and zinc result in deaths; deficiencies of iodine and iron, together with stunting, can contribute to children not reaching their developmental potential. In settings with insufficient material and social resources, children are not able to achieve their full growth and developmental potential.

A research on measuring health inequality among children in developing countries by Houweling et al. (2003) assess relevance of the choice of economic status. The researcher have discussed World Bank index developed for possession of several durable consumer goods, housing quality, water and sanitary facilities and other amenities. The index has been employed in wealth quintile measure in the Demographic and Health Surveys program(DHS) program too.

In a study by Rijal et al. (2011) done in 512 children it was found that 28.9% were

undernourished. Similarly, weight for height assessment showed 10.3 % as wasted and 3.9 % as severely wasted. For height for age variable 10 % children were stunted and 2.5% were severely wasted. The results were further decomposed for causes of malnutrition. For children with extent of malnutrition (weight for age) it was evident that significant results existed for 53.9 % mother's being illiterate and 40.6 % illiterate fathers. Likewise, children with no exclusive breast feeding and delayed weaning subsequently had 37.4 % and 44.0 % of malnutrition, 71.6 % children suffered malnutrition when family had more than four children. Lastly, for wealth group variables, children suffered malnutrition with 33.3 % from lower income and 27.3 % from upper lower, 18.6 % from lower middle and 13.6 % from upper middle group families.

Meanwhile a study in Dhanusha district with height-for-age and weight-for-age anthropomertric measurement among children of 0-23 month age (Sah, 2004). The study found more proportion of children of older age suffering underweight and stunted than 6 months and below children. The family attributes has been further diagnosed the ethnicity for the study shows slight effect on anthropometric measure. The case for dalit caste dominated with untouchability and deprivation experiences historically, has mild effect on their nutritional status. Despite prevalence of higher economic disparity in the areas, no direct effect existed among those who were self sufficient, mother's education had effect on underweight of the children, colostrum feeding had little effect on stunting and noticeable effect on underweight. Sah (2004) found that children who were fed rice with rice scum were well nourished compared to who were without rice scum.

A study by Headey & Hoddinott (2015) demonstrate the drivers of success story during the period of their study 2001-2011 on reducing undernutrition. The paper is an attempt to assess in dynamic approach of nutritional status. The authors have focused largely on nutritional specific interventions whose works complement to experimental evaluation i.e control trials method in the related study. The study employs Nepal's Demographic Health Surveys of round 2001, 2006 and 2011. The study follows Kolenikov, Angeles, et al. (2004)

method in using DHS asset index to proxy for household wealth. The index is developed with providing some weights called loading for ownership of appliance, equipment and facilities of houses. The proxies thus were used to re scale the index which range between 0 to 10 with 10 being the maximum score. The author outlines the limitation induced in the index, those are the resources outside the household wealth that effect the nutrition of child. The study by Headey & Hoddinott (2015) considers community-level indicators of open defecation unlike previous studies whose focus were based on open defecation engaged by respective households. Women empowerment variable has been introduced with decision making index for women based on questions from large household purchases, her own healthcare, the spending of money she has earned and visits to relatives.

In a study by Pravana et al. (2017), conducted in Nepal, authors have found that infant mortality rate was 33.46 per 1000 live births in 2011 which has declined to 28.51 per 1000 live births in 2016 and 25.62 per 1000 live births in 2019. The under five deaths have also been decreasing over the past years in Nepal based on statistics by Aguayo et al. (2015). Children's height, weight, and age data were used to calculate three indices: height-for-age, weight for-height, and weight-for-age. Each one provides different information about growth and body composition and is helpful for assessing nutritional status.

The Oaxaca decomposition is a technique that decomposes inequalities between any two groups and has been used extensively in explaining wage differentials between males and females, immigrants and natives, blacks and whites workers (Jann, 2008). Wagstaff et al. (2003) decomposed the inequality of child malnutrition in Vietnam using pooled data of height-for-weight z-score for the years 1993 and 1998 and compared the changes between those two years. The stunting regression results showed that safe drinking water and satisfactory sanitation's reduced malnutrition in both years and the effects were stronger in 1998. Household consumption was found to have negative relationship with malnutrition.The inequality decomposition results were found to disfavor the poor in terms of inequality in drinking water, satisfactory sanitation and schooling in both years. The Rural and urban

Severe Acute Malnutrition percentage is 2% and 1.8% based on DHS 2016 data. The works of Nie et al. (2019) have also decomposed changes in nutritional measures from DHS data in terms of linear and nonlinear decomposition forms. The author has decomposed HAZ, WAZ and WHZ using linear form of Blinder-Oaxaca decomposition, meanwhile further decomposition using stunting, underweight and composite index of anthropometric failure using Fairlie's(1999) non-linear decomposition. Sharaf & Rashad (2016) have decomposed result of urban and rural child stunting rates in Egypt, Jordan and Yemen. The difference occurred across rural and urban regions is mere 2.3 % with better results among rural children. Results from analysis of Yemen data were disastrous with high malnutrition rates too. Data showed 17 % differences in stunting rates among urban and rural in Yemen. Jordan's result show better child stunting rates, staying at less than 8 percent and difference only around 1.5 % with better urban stunting rate data. Similarly, results from background characteristics of households in the rural-urban differences for three countries examined the results for place of delivery -health facility, women with secondary or higher education, households using an improved water source, households with improved non-shared toilet facilities, households with electricity. Results indicate higher differences for Yemen across characteristics and almost few difference in characteristics of Rural-Urban Jordan data (Sharaf & Rashad, 2016). Similarly, results from Egypt showed mixed result with households with improved non-shared toilet facilities showing larger results.

2.3. Research Gap

While the studies in Nepal have been able to decompose the child health inequality across socio-economic determinants and have pointed out the concentration of poor health among families with low living standard, such child health gap can also exist between urban and rural strata provided that better opportunities and facilities are more urban centric in the case of Nepal. However, the literature is scant on estimating the drivers of urban-rural child health differences which could identify possible levers for better policy implications.

(i) Identify the underlying factors, behind the rural- urban gap in child malnutrition in Nepal.

(ii) In Nepal, weather the regional gap in child malnutrition is mostly due to differences in the level of the determinants of child nutritional status, rather than by differences in their effect.

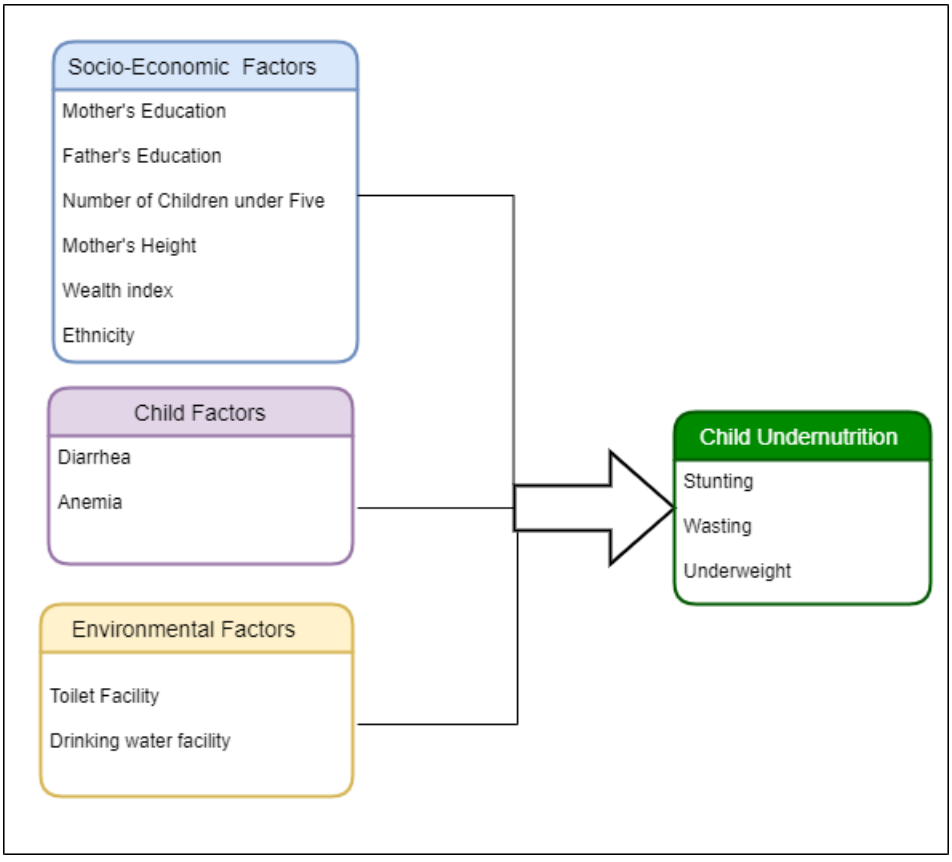
CHAPTER III

METHODOLOGY

This chapter discusses presents conceptual framework, data and variables statistical analysis and econometric analysis. This chapter also explains outcome and dependent variables considered in the study.

3.1 Conceptual Framework

Figure 3.1: Conceptual Framework



The framework of the study is based on measuring the endowment and coefficient effects on child malnutrition outcome variable due to socioeconomic factor, child factor

Table 3.1: Dependent Variables and Definition

Dependent Variable	Definition on the WHO Child Growth Standard
Stunting	Severely - Number of children whose height-for-age z-score is below minus 3 (-3.0) standard deviations (SD) below the mean. Moderately- below minus 2 standard deviations(SD) below the mean.
Wasting and Overweight	Severely -Number of children whose weight-for-height z-score is below minus 3 (-3.0) standard deviations (SD) below the mean. Moderately- below minus 2 standard deviations(SD) below the mean.
Underweight and Overweight for age	Severely - Number of children whose weight-for-age z-score is below minus 3 (-3.0) standard deviations (SD) below the mean. Moderately - below minus 2 standard deviations (SD) below the mean

Source: DHS Manual 2016 and DHS guide

and environmental factor. Among the socio-economic factors parental education, number of children under Five, Mother's Height.

Wealth Index and ethnicity are considered from the data. Diarrhea and Anemia are two child factor variables in the study. The environmental factors include toilet facility and drinking water facility. The conceptual framework uses underlying and enabling determinants of outcome variables of malnutrition set by UNICEF Conceptual framework on Maternal and Child Nutrition. The environmental factors are aligned with underlying determinants. The enabling determinants as resources are socioeconomic and child factors categorised in the present study.

3.2 Variables and Definitions

3.2.1 Dependent variables

From the data height for age, weight for age and weight for height are divided by 100 since the data set represents values in 100,200 and 300. The WHO standard values are expressed as 1,-1, 2,-2 and 3,-3 for different nutritional standards. The dependent variable defined in DHS manual and listed in DHS Guide in WHO Child Growth Standard is tabulated as follows:

Table 3.2: Independent Variables and Definition

Variables	Description
Place of residence	Rural or Urban
Number of Children under five	
Parental-Mother's and Father's Education	No Education, Primary, Secondary and Higher
Mother's height	Measure in cm units
Wealth index	Poorest, Poorer, Middle, Richer and Richest
Ethnicity	Hill Bhrahmin, Hill chhetri, Terai Brahmin, Other Terai Caste, Hill Dalit, Terai Dalit, Newar, Hill Janajati, Terai Janajati, Muslim, Other
Diarrhea	No and Yes in last two Weeks
Anemia	Not Anemic, Severe, Moderate and Mild
Toilet Facility	Flush, Pit/Ventilated, Bucket Hanging and No facility
Drinking Water Facility	Pipe water, Well water and Surface/unprotected source
Province	Koshi, Madhesh, Bagmati, Gandaki, Lumbini, Karnali and Sudur Pashchim
Ecological Zone	Terai, Mountain and Hill
Currently Breastfeeding	Yes and No
Mother's Autonomy	Dummy variable of women's involvement in 6 households decision
Vaccination	Dummy variable including 36 vaccination

Source: Author's Estimation

3.2.2 Independent variables

Explanatory variable are mother's age at birth, birth interval, socio economic characteristics,maternal autonomy, place of residence, ecological zone, province, mother's height, number of children under five, currently breastfeeding, ethnicity, diarrhea, anemia, mother's autonomy and vaccination . Variables belonging to nature factor variable and subcategory are treated the mentioned in dataset. Socio-economic characteristics (Sharaf & Rashad, 2016) variable includes maternal education, paternal/father's education and wealth index . Meanwhile, mother and father's education for given categories(0 = No Education, 1 = Incomplete primary, 2= Complete Primary, 3 = Incomplete Secondary. 4 = Complete Secondary, 5= Higher and 8= Don't Know) has been re-categorized(No Education, Primary, Secondary and Higher). Wealth index variable in DHS are provided and thus the study administered using this available index for financial stability variable. The index on the survey dataset includes response from assets and access to electricity, radio, television, mobile phone, landline phone, refrigerator, table, chair, bed, sofa, cupboard, computer, fan, clock, wall, floor, roof material, cooking fuel, toilet facility, modern toilet, number of rooms, availability of land, separate kitchen and ownership of domestic animals, vehicles

and land (Pravana et al., 2017).

This study followed Headey & Hoddinott (2015) in using a maternal autonomy or women's empowerment variables as defined in the work which has been developed based on four decision asked to women regarding decision making. These decisions are role of mother in in large household purchases, her own healthcare, the spending of money she has earned, and visits to relatives. The empowerment variable is developed in other works (Nie et al., 2019) based on decision autonomy and mobility autonomy. However present study focus solely on autonomy variable as a whole since decision maker on visits to family or relative is the only mobility autonomy question available in NDHS. The autonomy is measured by dummy variable indicating weather a women/mother has a say in any of aforementioned decisions solely or jointly.

3.3 Data and Sources

The study used secondary data Demographic and Health Surveys (DHS). The data are nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition. The DHS survey are conducted in every 5 years, to allow comparisons over time. The total observation are from DHS 2016 data. The sample of the study considers children aged below 5 years(0-59 months). A total of 1947 children under age five were involved for the study.

3.4 Analysis of Data

3.4.1 Statistical Analysis

This study uses data from biomarker recode data file(BR) for stunting, wasting and underweight of children under five years. Height for age(HAZ), Weight for age(WAZ) and weight for height(WHZ) were taken from the available data and dichotomous variables for stunting as either stunted or not, wasting as wasted or not and underweight as underweight

or not were created for logistic regression and non-linear decomposition analysis. Logistic regression using dichotomous variables as outcome variable were administered with independent variables. We analysed the data using software Stata version 17 for generation of concentration curve, decomposition analysis and R for cleaning variables from NDHS 2016, using logistic regression analysis and plots of Kernel Density function.

3.4.2 Econometric Model

The analysis is based on anthropometric indicators and assessment of factors associated with nutritional status of children under five year age. Such calculation is based on three ratio z scores. The calculation of Z scores is based on formula:

$$Z = \frac{(X - \mu)}{\sigma} \tag{1}$$

where,

X= Covariates

Mathematical model of multiple logistic regression model is as follows :

$$g(x) = ln[\frac{\pi(x)}{1 - \pi(x)}] = \beta_0 + \beta_1.x_1 + \beta_2.x_2 + \beta_3..... + \beta_n.x_n \tag{2}$$

where,

X=Value

μ = Median of reference population

σ = Standard deviation of reference population

3.4.2.2 Concentration Index : Measuring Inequality

The Concentration index is complex relative measure of inequality that describes how concentrated our outcome is in each group of our ranking. The concentration index is an

appropriate measure of socioeconomic-related health inequality wealth health is measured on a ration scale with non negative values(Wagstaff et al., 2007). The concentration curve was used to show the socioeconomic inequality in the prevalence of stunting, underweight and wasting. The cumulative percentage of stunting on the y axis are plotted against the cumulative percentage of the population ranked by wealth factor on the x-axis. The gap between 45°and curve explains the degree of social inequality. Higher the gap, more is the degree of health inequality. Curve above the equality line shows that the outcome is more concentrated among lower socio economic status individuals and curve under the line shows the outcome variable is more concentrated among the higher socio economic status individuals in the population (**oanalyzing**).

3.4.2.3 Decomposition of Child Nutrition on Inequality

Blinder-Oaxaca decomposition techniques has been used to explain urban-rural disparities in chronic malnutrition among children. Based on the study done by Sharaf & Rashad (2016), this technique decomposes the gap in HAZ between urban and rural regions into two parts; a part that is due to difference in the distribution of the determinants of HAZ (covariates effect) between the two regions, and another part that is due to the difference in the effect of these determinants (coefficients effect) between the two regions. The decomposition is also carried among Weight for age(WAZ) and Weight for-height(WHZ) variable.

$$y_i{}^{rural} = \beta^{rural} x_i + \epsilon_i{}^{rural} \tag{3}$$

$$y_i{}^{urban} = \beta^{urban} x_i + \epsilon_i{}^{urban} \tag{4}$$

The urban-rural gap in the mean HAZ

$$y_i{}^{urban} - y_i{}^{rural}$$

given as:

$$y_i{}^{urban} - y_i{}^{rural} = \beta^{urban} x_i - \beta^{rural} x_i \tag{5}$$

where x^{urban} and x^{rural} are the explanatory variable at their means for the urban and rural. Meanwhile, difference in the level of covariates, X's and difference in coefficients, β's after decomposing form the overall urban-rural gap. Following equations express the relationship:

$$y^{urban} - y^{rural} = \Delta x \beta^{rural} - \Delta \beta x^{urban} \tag{6}$$

$$y^{urban} - y^{rural} = \Delta x \beta^{rural} - \Delta \beta x^{rural} \tag{7}$$

Where,

$$\Delta x = X^{urban} - X^{rural} \tag{8}$$

And,

$$\Delta \beta = \beta^{urban} - \beta^{rural} \tag{8.1}$$

The decomposition equation could be re-written as in Equation (6):

$$y^{urban} - y^{rural} = \Delta x \beta^{rural} + \Delta \beta x^{rural} + \Delta \beta x \tag{9}$$

$$= E + C + CE \tag{9.1}$$

The Blinder-Oaxaca decomposition can be considered a special case of a more comprehensive decomposition where

$$y^{urban} - y^{rural} = \Delta x(\omega \beta^{urban} + (I - \omega)\beta^{rural}) + \Delta \beta(x^{urban}(I - \omega) + x^{rural} D) \tag{10}$$

where ω is a matrix of weights, and I is an identity matrix.When x is a scalar, the identity matrix would be equal to one. In such case, if the weight(ω) equals zero, equation (10) would yield equation (7) , then we will get equation (8) (Bauer & Sinning, 2008; Sharaf &

Rashad, 2016).

3.4.2.4 Nonlinear Decomposition

A decomposition of the outcome variable similar to (7) is not appropriate in the nonlinear (NL) case, because the conditional expectations E($Y_{ig}|X_{ig}$) may differ from $\bar{X}_g\hat{\beta}_g$ (Bauer & Sinning, 2008). General version of B-O decomposition for non-linear case, rewriting (1) in terms of conditional expectations is:

$$\begin{aligned}\Delta_A^{NL} = E_{\beta_{rural}}(Y_{i.rural}|X_{i.rural}) - E_{\beta_{rural}}(Y_{i.urban}|X_{i.urban}) + \\ E_{\beta_{rural}}(Y_{iurban}|X_{i.urban}) - E_{\beta_{urban}}(Y_{i.urban}|X_{i.urban})\end{aligned} \tag{11}$$

where (E_{β_g}) refers to the conditional expectation of Y_{ig} and $E_{\beta_g}(Y_{ih}|X_{ih}$ refers to the conditional expectation of Y_{ih} evaluated at the parameter vector β_g, with g,h = Urban, Rural and $g \neq h$.

3.4.2.5 Fairlie Decomposition of Nonlinear Decomposition

Since outcome variable from Oaxaca decomposition are mean height for age (HAZ), weight for age(WAZ) and Weight for height(WHZ) and these outcomes are used on linear model. The study performs a Fairlie Decomposition(Fairlie, 2005) for binary variables of malnutrition defined in terms of stunting, wasting and underweight across the covariates and vector of coefficient estimates. Following Fairlie (1999), the decomposition of nonlinear form is as follows

$$\begin{aligned}\bar{Y}^{Urban} - \bar{Y}^{Rural} = \left[\sum_{i-100}^{N^{urban}} \frac{F(X_i{}^{urban}\beta^{rural})}{N^{rural}} - \sum_{i-100}^{N^{rural}} \frac{F(X_i{}^{urban}\beta^{rural})}{N^{urban}}\right] \\ + \left[\sum_{i-100}^{N^{urban}} \frac{F(X_i{}^{urban}\beta^{urban})}{N^{urban}} - \sum_{i-100}^{N^{urban}} \frac{F(X_i{}^{urban}\beta^{rural})}{N^{urban}}\right]\end{aligned} \tag{12}$$

where N^j is the sample size of group j.

Table 3.3: Research Matrix

Objectives	Hypothesis	Data Sources	Outcome Variables	Data Analysis
1. To explore determinants of the gap between urban and rural children if it exists in nutritional outcomes	H_0 : There is no inequality in child nutrition among rural and urban population H_1 : There is inequality in child nutrition among rural and urban population.	DHS	HAZ,WAZ and WHZ	Linear Decomposition and Oaxaca-Blinder Decomposition
2. To quantify the contribution of factors that explain the average gap in an outcome between two groups	H_0 : There exists no regional gap in child malnutrition due to differences in the level of the determinants of child nutritional status, rather than by differences in their effect. H_1: There is regional gap in child malnutrition, mostly due to differences in the level of the determinants of child nutritional status, rather than by differences in their effect	DHS	Stunting, wasting and Underweight	Non-linear:Fairlie Decomposition

Source: Author's Estimation

CHAPTER IV

RESULTS AND DISCUSSIONS

This chapter presents descriptive and inferential results produced in the present study. The results are based on data, variable and methods framed in the previous chapter. The chapter describes, visualises the distribution of anthropometry indicators. Inferential statistics are produced in this chapter using regression model and the outcomes are decomposed using Oaxaca blinder decomposition technique. This chapter presents discussion relating to the results.

4.1 Anthropometry indicators

The anthropometry indicators are useful indicators in understanding health or nutrition well being at individual and at a population level. The present study is based on population level whose scope is assessment of nutritional status within country. Study is primarily focused on determinants and decomposition of inequality across urban and rural resident children. These indicator are stunting, wasting/overweight and underweight. Stunting, child's height and age variable is a chronic deficiency, while wasting child's weight and height is a measure of acute nutritional deficiency. Underweight is an indicator of both acute and chronic status and it is a composite measure based on weight and age. And overweight also is based on child's weight and height, it measures excess weight than is optimally healthy.

4.2 Descriptive Statistics

This section tabulates distribution of outcome variables and independent variable. For three nutritional outcomes we have produced Kernel distribution plots across rural and urban. Sample information, household characteristics, individual characteristics and socio-

Table 4.1: Summary Statistics - Dependent Variables

Characteristics	**Rural, N = 1,025**	**Urban,N = 917**
HAZ standard deviation	-1.47(2.8208)	-149(5.3273)
WAZ standard deviation	-1.29(1.0476)	-1.48(1.0428)
HZ standard deviation	-0.61(1.0820)	-0.70.94(1.0365)

1Mean(SD); n(%)
Author's Estimation

economic variable as as follows: As Table 4.1 shows Height for age Z-score, Weight for age Z-score and Weight for height Z-score mean and standard deviation values. These child nutrition indicators were calculated for 1947 children. The mean value of Height for Age(HAZ) is -1.48 and Weight for age(WAZ) is -1.38. Similarly, weight for height(WHZ) is -0.66 in 2016.

4.2.1 Socio Economic Factors

Table 4.2: Summary Statistics- Parental Education

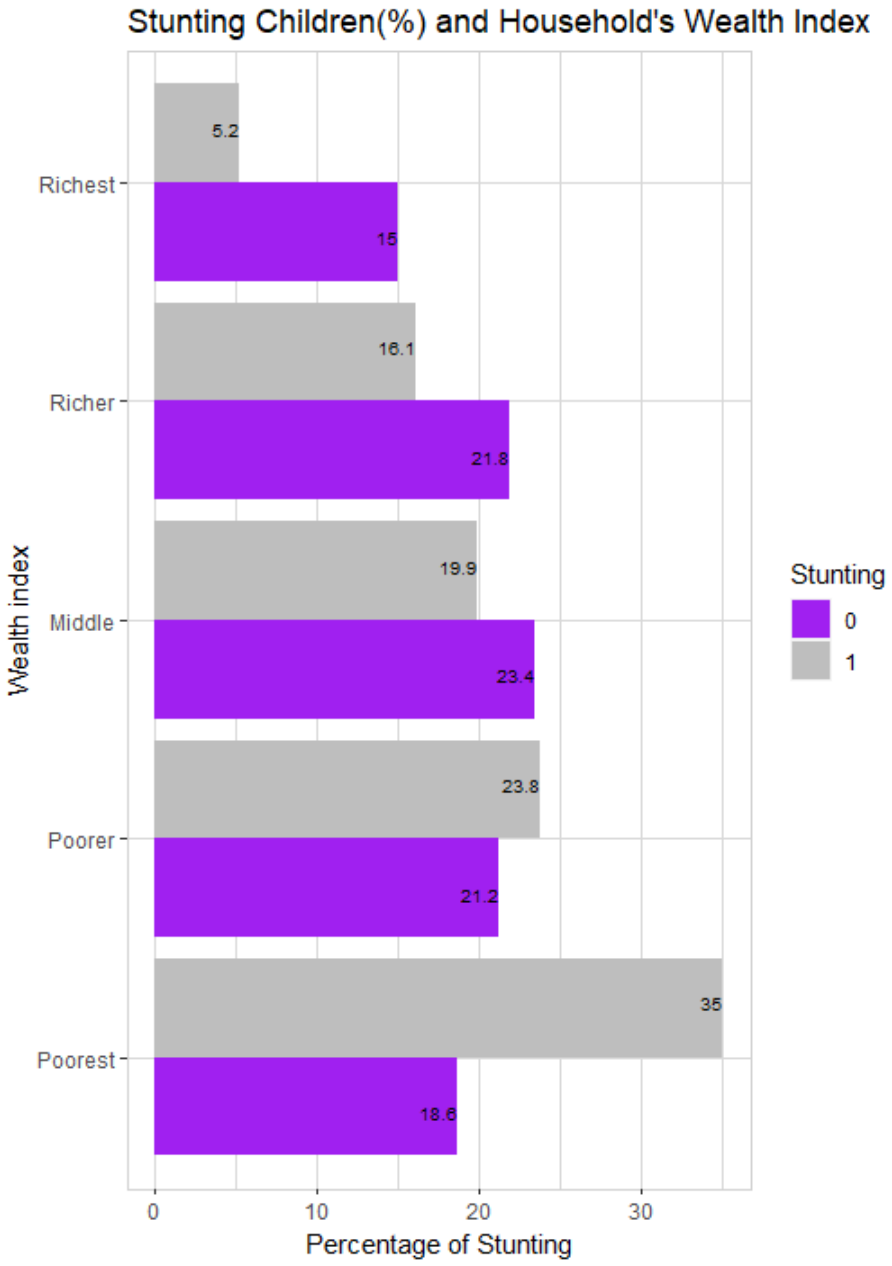
Characteristics	Rural, N = 1,025	Urban, N = 917
Mother's Education		
No Education	301(29%)	411(45%)
Primary	170(17%)	209(23%)
Secondary	377(37%)	229(25%)
Higher	178(17%)	69(7.5%)
Father's Education		
No Education	140(14%)	176(19%)
Primary	211(21%)	240(26%)
Secondary	471(46%)	376(41%)
Higher	203(20%)	125(14%)
Number of HH Children	1.56(0.71)	1.77(0.89)

1Mean(SD); n(%)
Source: Author's Estimation

Table 4.3 and Figure 4.3 show sample distribution across different variables in socio economic factors among rural and household groups. The population sample is distributed with 53% of the children belonging to urban and 47% belong to rural population group. A key variable in influencing child nutritional outcome is mother's education, this variable thus has been classified into No education, Primary, Secondary and Higher for which distribution is 37 %, 19%, 31% and 13%. Similar to the mother's education classification the

father's education was distributed with 16%, 23%, 44% and 17% to no education, primary, secondary and higher sub categories. Financial ability affecting purchase of nutrition rich food is represented by wealth index variable for households of children. The wealth index variable is evenly distributed wealth quintile group of household with 20% poorest group, 22% poorer, 23% middle, 23% richer and richest 21% in year 2016. Sample has also

Figure 4.1: Percentage Prevalance of Stunting among Children Under Five Years of Age from Different Economic Status Household



been described at provincial and ecological zone which represent administrative cluster and geographic region respectively. The child variable is distributed in Koshi at 16%, Madhesh province at 27%, Bagmati 16%, Gandaki 7.8%, Lumbini 18%, Karnali 6.2% and Sudur Paschim province with 8.8%. Thus large sample is found among the highest population province. Meanwhile, population of interest was found to be higher among Terai with 57%, Hill at 37% and Mountain region with mere 7.1%. Nepal geography is diverse and so does distribution of nutritional outcome across these diverse geography. Similarly, child

Table 4.3: Summary Statistics - Ethnicity and Wealth Index

Characteristics	Rural, N = 1,025	Urban, N = 917
Wealth Index		
Poorest	145(14%)	253(28%)
Poorer	210(20%)	217(24%)
Middle	218(21%)	236(26%)
Richer	238(23%)	173(19%)
Richest	214(21%)	38(4.1%)
Ethnicity		
Hill Brahmin	115(11%)	50(5.4%)
Hill Chhetri	164(16%)	159(17%)
Terai Brahmin/chhetri	19(1.9%)	7(0.7%)
Other Terai Caste	159(16%)	238(26%)
Hill Dalit	98(9.5%)	71(7.7%)
Terai Dalit	49(4.8%)	65(7.1%)
Newar	54(5.3%)	16(1.8%)
Hill Janajati	206(20%)	172(19%)
Terai Janajati	107(10%)	57(6.2%)
Muslim	43(4.2%)	83(9.0%)
Other	10(0.9%)	0(0%)

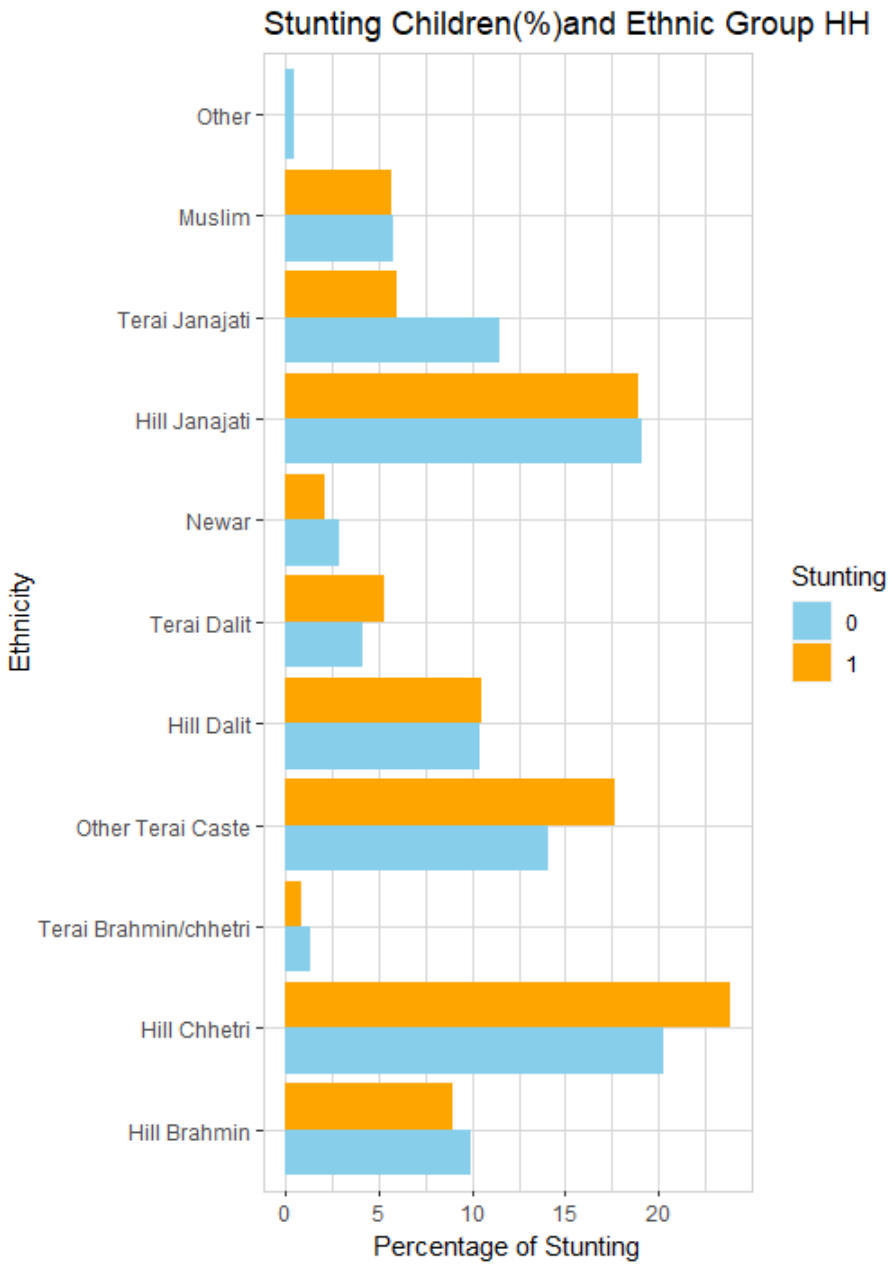
1Mean(SD); n(%)

Source: Author's Estimation

nutrition is effected by the number of children under five in a household, the present study found the average number of children under five from the sample is 1.66 We can say its more close to two children among the sample of study. Among sample, currently breastfeeding variable has been characterised by No or Yes response among which breastfeeding were 74% respondent were found to be doing so and 26% were not breastfeeding at present. Ethnicity in Nepal plays a key role for nutritional results and practices. This variable is taken into account with distribution in the sample with 8.4% Hill Brahmin, 16% to Hill

Chhetri, 1.5% Terai Brahmin/Chhetri, 20% other terai caste, 8.5% are Hill Dalit, 5.4% are Terai Dalit, 3.5% are Newar. 19% are Hill Janajati, 9.7% are Terai Janajati, 6.7% are Muslim and others were mere 0.5% as of year 2016 DHS data.

Figure 4.2: Percentage Prevalance of Stunting among Children from Different Ethnic Groups Households



4.2.2 Child Factors

Table 4.4: Summary Statistics- Child Factors

Characteristics	Rural, N = 1,025	Urban, N = 917
Diarrhea		
No	949(93%)	856(93%)
Last two weeks	76(7.4%)	61(6.7%)
Anemia		
Not Anemic	5(0.5%)	4(0.5%)
Severe	216(21%)	272(30%)
Moderate	275(27%)	232(25%)
Mild	529(52%)	410(45%)
Mother's height	152.27(28.58)	151.96(28.22)

1Mean(SD); n(%)
Author's Estimation

From the descriptive statistics of Child factors shown in Table 4.4 distribution of children with Diarrohea and Anemia is explained. The data categorize children with no diarrhea and suffered diarrhea in last two weeks with 92% children with no diarrhea among the sample and rest suffered in last two weeks.Anemia variable in the study were categorized among severe, moderate, mild and not anemic. The results were distributed with only .4% suffering severe anemia, 25% suffering moderately, 25% with mild suffering and 49% had no anemia at all. Vaccination is a dummy variable constructed using all vaccination provided in the dataset. The results show 57% of sample to have been totally vaccinated. Among another mother's characteristics is mother's height and the average mother's height is 1.52 metre.

4.2.3 Environmental Factors

Table 4.5 and Figure 4.3 show the distribution of access to drinking water facilities since drinking water facilities and time taken to manage drinking water plays important role

Table 4.5: Summary Statistics - Environmental Factors

Characteristics	Rural, N = 1,025	Urban, N = 917
Drinking Water Source		
pipe water	471(46%)	408(44%)
well water	455(44%)	473(52%)
surface/unprotected source	99(9.6%)	36(3.9%)
Toilet Facility		
Flush Toilet	758(74%)	547(60%)
Pit Ventilated	70(6.8%)	102(11%)
Bucket Hanging Toilet	15(1.5%)	7(0.8%)
No Facility	182(18%)	262(29%)

1Mean(SD); n(%)

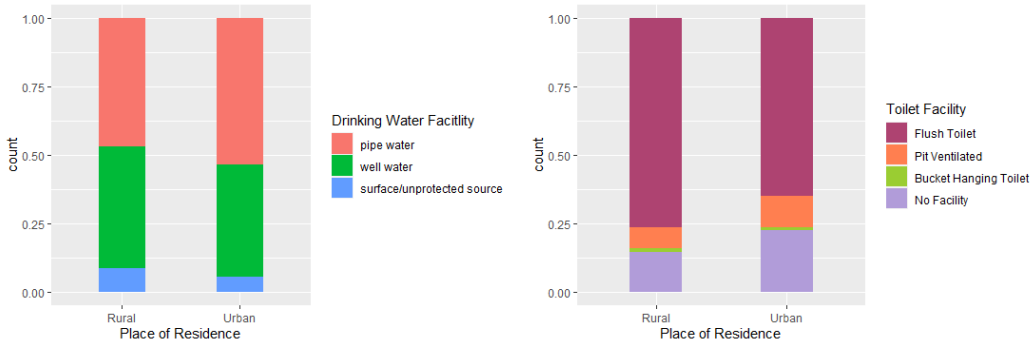
Author's Estimation

for nutritional outcomes especially among the rural group of sample population. The distribution across Rural and Urban household group is similar. Households relying to pipe water source are half as many as sample household in urban and rural household. Similarly, well water dependence is higher among the urban household group(52%) to rural household(44%). Unprotected or surface water source lies around 9.6% among the rural household and 3.9% among the urban household. Another variable among independent variable is toilet facility, shown in figure 4.3. The sanitation facilities in developing country is challenging, however result show highest share of flush toilet among the urban and rural sample population. Among others, no facility household number is higher among urban population with 29% and 18% are rural household group with no toilet facility.

4.3 Kernel Density of Z score

Figure 4.4,4.5 and 4.6 show distribution function for nutritional outcomes height for age, weight for age and weight for height. The mean of such distribution is zero and standard deviation is equal to one. The x axis shows z score standard deviation values. The WHO

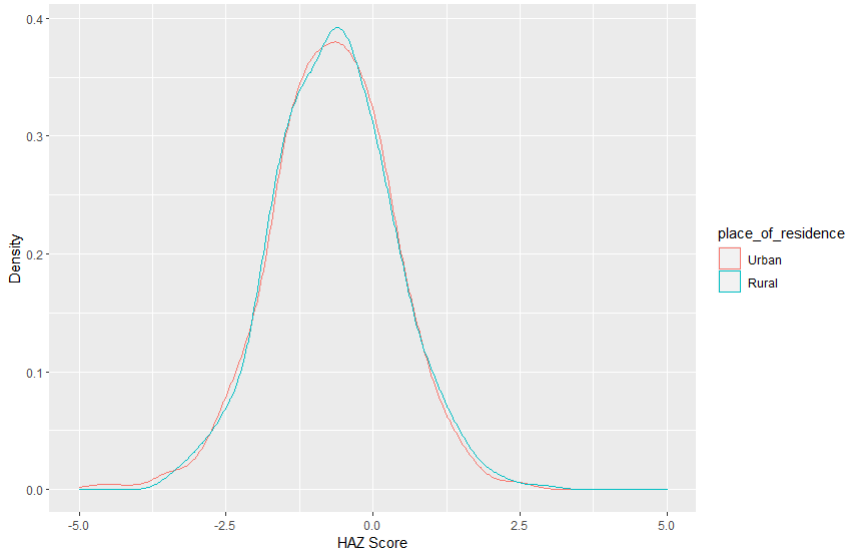
Figure 4.3: Drinking Water Source and Toilet Facility across Urban and Rural households



Child Growth standard for severeness of stunting, wasting and overweight and underweight and overweight for age is less than minus 3 and greater than 3. And moderate results exists at less than minus 2 and greater than 2 standard deviation values. The figure show minus 5 to 5 X axis values and this is done to gather full distribution of outcome variable.

Figure 4.4 shows the kernel density estimations of the distribution of child HAZs. The plot shows that height for age z scores for urban and rural both lie below mean z score. This nutritional outcome prevails around minus 1.25 mean of Z score in standard deviation units for both rural and urban group. Meanwhile, in 4.5 the Kernel Density of Weight for age Z

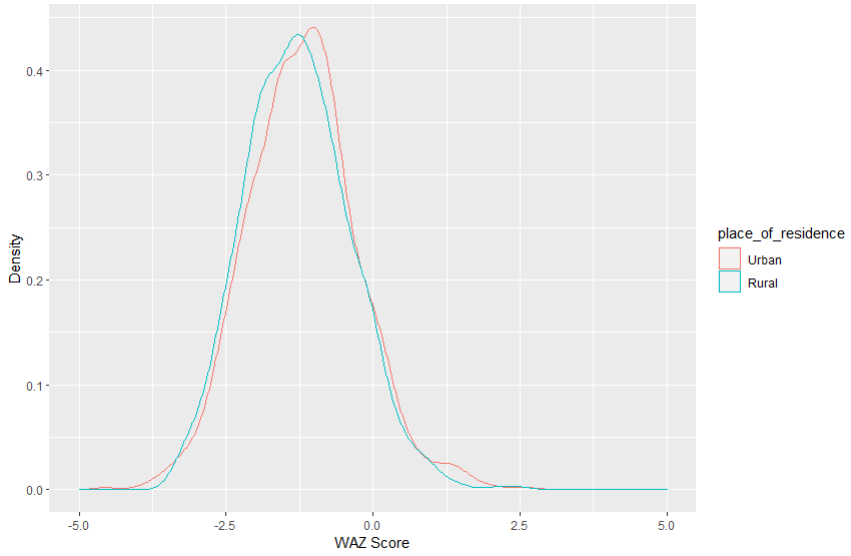
Figure 4.4: Kernel Density of HAZ Scores



scores is shown. The figure depicts below sample mean value of waz score for urban and

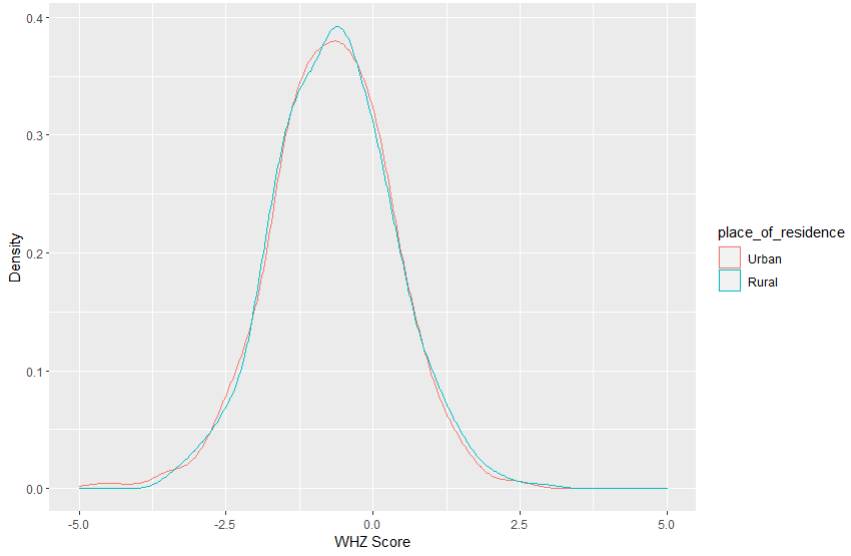
rural resident children. The value of z score lies around -1.25. The urban value is greater than rural based children z score. Similarly, Figure 4.6 shows Kernel distribution of weight

Figure 4.5: Kernel Density of WAZ Scores



for height Z scores. The z score of this outcome also lies below mean and around -1 for both rural and urban group children. The Kernel plots for all three nutrition outcomes show

Figure 4.6: Kernel Density of WHZ Scores



below the sample mean value of Z scores.

4.4 Inferential Statistics

4.4.1 Concentration Index

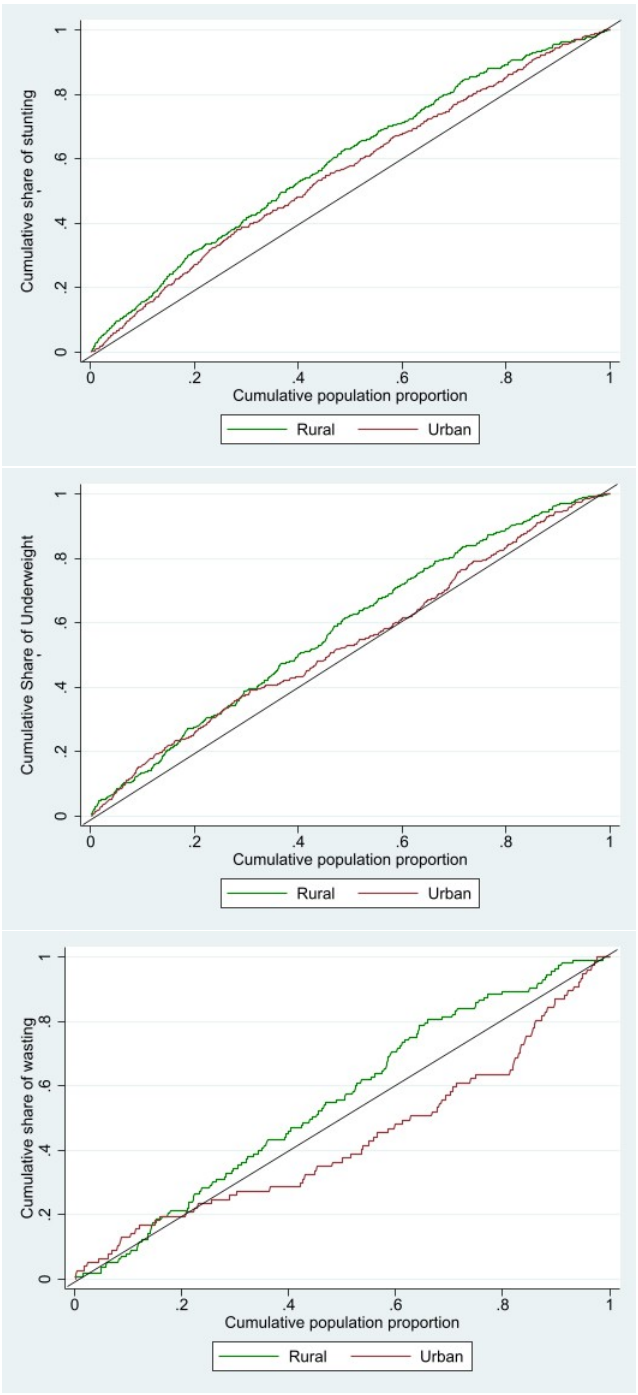
The concentration curve is developed to assess the prevalence of stunting, wasting and underweight across the quin-tiles of wealth group of urban and rural based household children. Figure 4.7 show the concentration curve of Stunting, Underweight and Wasting under five among children in Rural and Urban Nepal. The results indicate that stunting and underweight with higher inequality in rural group and lower inequality for urban.

4.4.2 Logistic Regression results

Logistic regression was carried out to determine the factors associated with under nutrition. Table 4.6 presents the result from Logistic regression that identifies determinants of the child health outcomes. The results are produced among all nutritional outcomes: stunting, wasting and underweight. The general logistic model framed with existence of stunting or with several independent variables are administered. Similarly, for wasting and underweight too the outcomes are tested against similar independent variables.

The inequality is evident from the regression results at 5 % significance level of stunting that prevails among poorer wealth index household. The coefficient of poorer household for underweight is significant at 5%. The results indicate that odds of being stunting is decreased by 36% when child belongs to poorer household. However, no significant result exist for wasting outcome variable. In case of middle wealth index group prevalence of underweight is significant at 5 percent and result indicate odds of being underweight decreases by 46%(CI=0.37-0.79) when children belongs to this wealth index group. Similarly, children from richer wealth index group have risk factor of 59% for low height for age (CI=.028-0.59) at 1 percent level of significance and odds of being underweight decreased by 55%(CI =0.29-0.68) at 1 percent level of significance. Likewise, for richest wealth index group of children analysis of risk factors for stunting and underweight revealed significant result

Figure 4.7: Concentration Curve for Stunting, Underweight and Wasting among children under five years in Rural and Urban group



at 1%, that odds of being stunted decreased by 79%(CI=0.13-0.35) and odds of being underweight decreased by 70%(CI = 0.17-0.53).

Education of mother and father show no-significant results across categories of primary, secondary and higher except for low underweight of higher education attaining mother. The odds of decreased underweight is 40%(CI=0.37-0.98) of children from higher education mother. For other non significant values, the primary education of mother has odd of decreased stunting of 19%(CI=0.61-1.08), of decreased wasting 31%(CI= 0.45-1.11) and odds of decreased underweight is 13%(CI= 0.64-1.18). Secondary level educated mother has odd ratio of low height for age 0.88(CI=0.66-1.18), low weight for age 0.78(CI=0.49-1.26) and low weight for height 0.85(CI= 0.62-1.16). For higher educated mother the odd ratio is 0.78(CI=(0.50-1.20), 0.68(CI=0.31-1.44) for wasting and 0.6(CI=0.37-0.98). Similarly, for father's education primary level education has odd ratio of low height for age of 0.92(CI=0.66-1.29), odd ratio of low weight for age of 1.22(CI=0.71-2.11), odd ratio of low weight for height 0.87(CI=0.61-1.23). Likewise, for secondary level educated father the odd ratio of children with stunting is 1.04 (CI= 0.75-1.45), with wasting is 1.36(CI= 0.82-2.31) and odd of children being low weight for children underweight is 0.92(CI= 0.66-1.29). Child of higher level education of father has odd of being stunted 1.16(CI=0.75-1.78), being wasted 0.85(CI=0.40-1.80) and being underweight 1.06(CI=0.67-1.67).

Provincial distinction for sample whose only significant results are in child's low height for age and low weight for age status. Children belonging to Gandaki provinces have odd of being wasted. The significance of this risk factor is at 5% level of significance. Similarly, for children belonging to Gandaki province risk factor of being wasted decreased by 56%(CI= .18-1.01) and is significant at 5 percent level of significance. For children residing in Lumbini province the risk factor for increased stunting and decreased wasting prevailed at 10 percent and 5 percent level of significance respectively. The risk factor for stunting increased by 39%(CI=.28-0.98) and for wasting decreased by 47% for children from Lumbini province. The risk factor for wasting among children from Karnali province

is significant at 5% where Odd Ratio is 1.85(C.I=1.20-2.85). The risk factor for stunting revealed that the odd of being stunted increased by 85% for children who were from Karnali province compared to children from reference group Bagmati province.

Likewise, the ethnicity variable as independent variable were categorized into 10 sub categories. Hill chhetri household belonging children were likely to have decreased wasting by 49%(CI=0.24-1.07) at 10 percent level of significance. Similarly, risk factor for stunting among Hill dalit children revealed that the odd of being stunted decreased by 46%(CI= 0.40-1.02). The odd of children being underweight belonging to Hill janajati decreased by 61%(CI=0.24-0.64) and is significant at 1 percent level of significance. Terai janajati belonging children reveal odd of risking stunting decreased by 53%(CI= 0.34-0.50) and significant at 10 percent level of significance. The odd of wasting increases by 107%(CI= 0.92-4.83) and is significant at 10 percent level of significance.

The odds of being stunted and underweight by decreased by identical 8% at one percent level of significance for mother's height variable. The mild anemia for underweight is significant at 10 percent with odds being decreased by 70%(CI= 0.57-0.93). The all vaccination variable which is a dummy variable from vaccination based responses showed that the risk factor of stunting reveals that odd of being stunted decreased by 24%(CI= 0.60-0.95) at 5 percent level of significance. The odd of being underweight decreased by 27%(CI= 0.57 -0.93) at one percent level of significance.

The drinking water source however, produce no significant results for undernutrition outcomes. Toilet facility is categorized among flush, pit/ventilated, bucket/hanging toilet and no facility, only no facility variable shows significant result at 5 percent with odds being stunted increased by 51%(CI=1.10-2.07). The odd of being underweight increased by 32%(CI=0.95-1.83) among no facility related household children at 10 percent significance.

Table 4.6: Logistic Regression

	Stunting			Wasting			Underweight		
Estimates	*Odds Ratios*	*95% CIs*	*p-values*	*Odds Ratios*	*95% CIs*	*p-values*	*Odds Ratios*	*95% CIs*	*p-values*
Urban	1.00	0.80 – 1.24	0.999	0.79	0.56 – 1.13	0.201	0.93	0.74 – 1.18	0.569
Mountain	0.86	0.58 – 1.29	0.466	1.19	0.57 – 2.66	0.652	1.00	0.65 – 1.54	0.990
Hill	1.18	0.68 – 2.04	0.551	0.86	0.31 – 2.42	0.765	1.32	0.73 – 2.41	0.363
Primary	0.81	0.61 – 1.08	0.157	0.69	0.42 – 1.11	0.129	0.87	0.64 – 1.18	0.378
Secondary	0.88	0.66 – 1.18	0.399	0.78	0.49 – 1.26	0.311	0.85	0.62 – 1.16	0.300
Higher	0.78	0.50 – 1.20	0.262	0.68	0.31 – 1.44	0.327	0.60**	0.37 – 0.98	0.044
Primary	0.92	0.66 – 1.29	0.633	1.22	0.71 – 2.11	0.471	0.87	0.61 – 1.23	0.426
Secondary	1.04	0.75 – 1.45	0.798	1.36	0.82 – 2.31	0.246	0.92	0.66 – 1.29	0.631
Higher	1.16	0.75 – 1.78	0.511	0.85	0.40 – 1.80	0.684	1.06	0.67 – 1.67	0.798
Province 1	0.79	0.50 – 1.22	0.286	0.94	0.51 – 1.76	0.840	1.11	0.70 – 1.76	0.656
Madesh	1.05	0.66 – 1.66	0.831	0.27	0.08 – 0.72	0.015	0.70	0.40 – 1.21	0.205
Gandaki	1.18	0.75 – 1.86	0.484	0.44*	0.18 – 1.01	0.060	0.70	0.41 – 1.19	0.193
Lumbini	1.39*	0.95 – 2.06	0.094	0.53**	0.28 – 0.98	0.045	1.02	0.67 – 1.55	0.928
Karnali	1.85*	1.20 – 2.85	0.005	0.61	0.29 – 1.28	0.190	1.35	0.85 – 2.16	0.208
Sudur Paschim	1.18	0.77 – 1.81	0.447	1.07	0.57 – 2.01	0.843	1.05	0.66 – 1.65	0.844
Poorer	0.64**	0.47 – 0.87	0.004	0.75	0.43 – 1.29	0.297	0.62*	0.44 – 0.87	0.006
Middle	0.42	0.29 – 0.60	0.001	0.54	0.29 – 0.99	0.047	0.54**	0.37 – 0.79	0.002
Richer	0.41	0.28 – 0.59	0.001	0.86	0.46 – 1.62	0.650	0.45	0.29 – 0.68	0.001
Richest	0.21	0.13 – 0.35	0.001	0.77	0.32 – 1.78	0.555	0.30	0.17 – 0.53	0.001
Yes	1.31*	1.00 – 1.72	0.055	1.79**	1.10 –3.00	0.022	2.00	1.48 – 2.73	0.001
Hill Chhetri	0.77	0.51 – 1.17	0.213	0.51*	0.24 – 1.07	0.071	0.79	0.50 – 1.25	0.316
Terai Br/ch[1]	0.87	0.27 – 2.55	0.812	1.67	0.32 – 6.86	0.498	0.75	0.22 – 2.32	0.633
Other Terai Caste	1.02	0.57 – 1.83	0.936	1.14	0.45 – 2.97	0.786	0.89	0.48 – 1.67	0.724
Hill Dalit	0.64 *	0.40 – 1.02	0.063	0.96	0.45 – 2.06	0.905	0.81	0.49 – 1.35	0.422
Terai Dalit	0.87	0.43 – 1.77	0.696	2.08	0.71 – 6.17	0.183	0.70	0.33 – 1.48	0.350
Newar	0.82	0.38 – 1.70	0.600	0.38	0.06 – 1.56	0.233	0.51	0.19 – 1.22	0.146
Hill Janajati	0.73	0.48 – 1.12	0.150	0.33	0.14 – 0.77	0.010	0.39***	0.24 – 0.64	0.001
Terai Janajati	0.47*	0.27 – 0.83	0.009	2.07*	0.92 – 4.83	0.084	0.80	0.45 – 1.44	0.458
Muslim	0.95	0.49 – 1.84	0.888	3.43**	1.32 – 9.21	0.013	0.99	0.49 – 1.99	0.976
Mother's height	0.92***	0.90 – 0.93	0.001	0.98	0.95 – 1.00	0.178	0.92***	0.91 – 0.94	0.001
In Last two weeks	0.80	0.53 – 1.20	0.291	1.18	0.62 – 2.09	0.596	1.08	0.71 – 1.63	0.717
Severe	0.53	0.11 – 2.06	0.381	0.38	0.08 – 2.76	0.260	0.43	0.10 – 1.66	0.226
Moderate	0.52	0.10 – 2.03	0.368	0.43	0.09 – 3.14	0.329	0.42	0.10 – 1.63	0.218
Mild	0.40	0.08 – 1.55	0.204	0.28	0.06 – 1.99	0.132	0.30*	0.07 – 1.15	0.082
All Vaccination	0.76**	0.60 – 0.95	0.019	1.36	0.92 – 2.01	0.124	0.73*	0.57 – 0.93	0.010
Well water	0.93	0.61 – 1.42	0.750	0.99	0.50 – 2.00	0.985	1.05	0.67 – 1.65	0.842
Surface/unprotected	0.98	0.65 – 1.47	0.933	0.90	0.40 – 1.85	0.797	1.13	0.73 – 1.74	0.575
Pit/Ventilated	1.14	0.80 – 1.62	0.473	0.91	0.49 – 1.61	0.762	0.95	0.65 – 1.38	0.803
Bucket/Hanging	0.36	0.08 – 1.11	0.113	0.95	0.14 – 3.65	0.946	0.80	0.22 – 2.32	0.711
No Facility	1.51**	1.10 – 2.07	0.011	1.15	0.70 – 1.87	0.585	1.32*	0.95 – 1.83	0.098
Observations	1947			1947			1947		
R^2	0.137			0.08			0.125		

*p<0.1,**p<0.005, ***p<0.001

1-Terai Brahmin/Chhetri

2- Drinking Water Source

Source: Author's Estimation

4.4.3 Decomposition

Decomposition results of height for age, weight for age and weight for height variable is presented in Table 5.1. The results are produced by linear decomposition tool across covariates. The table shows overall decomposition results, endowments, coefficient and interaction effects of urban-rural gap. The gap is significantly explained by endowments at five percent for mean haz. The decomposition result show that urban and rural mean gap is negative .0207. The endowment effect is predominantly due to wealth index as it contributes by 52% in gap in mean haz scores. Similarly wealth index contributes 45.88% in urban rural gap in mean waz due to endowment effect. It is only significant at 1 percent significance level. Similarly, rural urban gap for mean whz is explained by wealth index by 0431% and it is significant at one percent significant level. Mother's education contributes to gap induced by endowment effect by 38.202% across urban and rural group for mean haz outcome. The gap in urban and rural mean waz is explained by 36.36% from mother's education. This variable contributes 30.359% whz outcome variable. Mother's education is significant at 5% and 1% level for mean haz and waz but not significant relation exist in explaining whz gap in urban rural.

Child number under five contributes to gap by 17.134% to mean haz score across urban and rural group. It only contributes to gap in whz by 7% , contribution in waz is less than 1 percent. Likewise, Father's education contributes to endowment gap in mean haz by negative 18% mean waz by less than one percent and whz by 6%. Breastfeed contributes negatively by less than one percent explaining urban rural gap in haz score. And its contribution across waz and whz is 4% and 8% respectively in endowment generated urban rural gap. Ethnicity, mother's height, diarrhea and anemia, all vaccination variable also contribute to less than one percent in urban rural gap of haz, waz and whz. Maternal autonomy is contributing 23% to the urban rural gap through endowment effect for mean haz. The same variable only contributes to 7% and 4% for urban rural gap in mean waz and whz outcomes.

The coefficient effects are significant for wealth index, mother's height and all vaccination. The contribution on coefficient effects from wealth index are higher with more than thousand percentage in haz, waz and whz. The mothers education is contributing by negative 63% for coefficient effect on mean haz urban rural gap. For mean waz it is one thousand percent and for mean whz it is negative 600%. Child number under Five contributes to urban rural gap through coefficient effect by less than one percent in all nutritional outcomes haz, waz and whz. In addition, father's education contributes by 27% to mean haz urban rural gap. The mean waz and whz gap is negative. Breastfeed also contributes to coefficient effect in urban rural gap in mean haz by positive 108% whereas to mean waz and whz it contributes by negatively. Ethnicity plays positive role in coefficient effect in urban rural gap in mean haz outcome by 250% and mean waz outcome by 976% where it plays negative role in coefficient effect to mean whz. Mother's Height is contributing to the gap of urban and rural mean haz in coefficient by negative 100% where its role is positive in coefficient effect of waz and whz by thirteen hundred and two sixty percentage. Diarrhea is negatively contributing to urban rural gap of mean haz and whz gap by 290% and 604% respectively. It contributes positively in coefficient effect of mean waz for urban rural gap. Anemia is contributing by 205% in mean haz and 23% for mean whz whereas negative 86% is contribution to coefficient effect for mean waz outcomes.

Mother's Autonomy are negatively across urban rural gap for mean haz, waz and whz by 117%, 1013% and less than one percent respectively. All vaccination contributes positively to urban rural gap for mean haz and mean waz with 105% and 2334% contribution while negatively contributing to mean whz outcome by 282 percentage.

4.4.4 Oaxaca Decomposition

The result from the threefold decomposition presented in Table 4.7 and Table 5.2, show that out of 1947 sample, 1088 were rural group children and 859 were urban group. The mean

Table 4.7: Oaxaca Decomposition- Outcome variables

	(1) haz	(2) waz	(3) whz
Urban‘	-1.496	-1.487	-0.709
	(0.000)	(0.000)	(0.000)
Rural	-1.475	-1.292	-0.616
	(0.000)	(0.000)	(0.000)
Difference	-0.0207	-0.195	-0.0936
	(0.921)	(0.000)	(0.093)
Endowments	-0.178***	-0.231	-0.139
	(0.007)	(0.000)	(0.000)
Coefficients	0.203	-0.00293	-0.0489
	(0.443)	(0.962)	(0.459)
Interaction	-0.0458	0.0382	0.0940**
	(0.818)	(0.346)	(0.030)

*p<0.1,**p<0.05, ***p<0.01

Source: Author's Estimation

outcome of two groups urban and rural for children of haz score are -1.496 and -1.475. The urban rural gap in mean haz score is -0.0207. Similarly WAZ standard deviation values are -1.487 in urban region -1.292 in rural region and for WHZ outcome urban value is -0.709 and rural is -0.616. The difference of -0.195 and -0.0936 for WAZ and WHZ are explained by Blinder-Oaxaca decomposition. The negative difference in urban rural haz score show that rural HAZ score are actually higher than the urban HAZ scores. Similarly negative differences across WAZ and WHZ show consistent result of higher nutritional outcomes in rural region than in urban region. The negative contribution implies that rural household capitalize respective variables better than urban in nutrition. Among covariates, wealth effects contributes the most for endowment effect induced urban rural gap in mean haz. The wealth index variable contributes 52% in endowment effect.

Mother's education contributes 38% percentage to the endowments induced urban rural gap in haz. This variable contributes to mean waz urban rural gap caused by endowment by 36 percent and to mean whz. Child number under five contributes to urban rural gap in mean haz, waz and whz by 17%, less than one percent and 30 percent respectively. Wealth

index is prime contributor and significant with 52.19%, 45% and 43% respectively across mean haz, waz, whz. Father's education contributes negatively by 17% on urban rural gap of mean haz caused due to endowment effect. Similarly, it contributes by less than one percent and 6% across mean waz and mean whz. Breastfeed also contributes to endowment effect on urban rural gap by negatively below one percent for mean haz outcome, by 3% to mean waz outcome and by 8% to mean whz outcomes. Ethnicity variable does not contribute more than one percent in all three outcomes for endowment effect induced gap. So do mother's height and diarrhea with fewer than one percent in contribution along three outcomes. Urban rural gap due to endowments is contributed from anemia by 3%, 6ând 9% for mean haz. waz and whz outcomes. Larger contribution is there from maternal autonomy in the gap. Maternal autonomy contributes 23% to mean haz, 7% to waz and 4% to whz outcome's urban rural gap. All vaccination however contributes negatively by less than one percent for mean haz, waz and whz outcomes.

Coefficient effect from mother's education is negative 63% for mean haz, negative thousand percent for waz and negative 500 percent for whz. Likewise, children number under five contributes negatively by 235%, 2000 percent and 100 percent to coefficient effect induced urban rural gap. Wealth index coefficient effect is positive for mean haz and whz urban rural gap. The contribution being 128 percent, negative 1100 and 1200 percent for mean haz, waz and mean whz gap of urban rural group. Father's education also contributes positively for mean haz and mean whz through coefficient effects on urban rural gap. Only 27% for mean haz, negative 4000 percent for waz and 300 percent for whz contribution from father's education. Breastfeed contributes positively by 108% in mean haz urban rural gap, by negative 1800% and negative 546%. Ethnicity however has positive contribution on coefficient effect induced urban rural gap. The values are 250%, 976% and 176% for mean haz, waz and whz respectively. The mother's height contributes negatively to coefficient effect induced urban rural gap for mean haz, positively across mean waz and whz outcomes. It contributes by negative 109% in mean haz, 1300% in waz and 760% in

whz outcome. Likewise, diarrhea and maternal autonomy both contribute negatively for mean haz urban rural gap and positively for mean waz and whz urban rural gap induced from coefficient effects. The values are negative 290%, 7780% and 170% for diarrhea and negative 117 percent, 1000 percent and 49 percent for mean haz, waz and whz outcome gaps. Anemia however contributes positively by 205% and 66% to mean haz and mean whz. The contribution is negative 6825 percent for mean waz urban rural gap.

Interaction is explained by significant mother's education variable by negative 60% which shows nutritional outcomes of rural children have higher impacts than to urban based children. Meanwhile other significant contributor to gap in interaction is wealth index for wasting, my 180% showing wealth in urban areas to have more contribution.

4.4.5 Fairlie Decomposition

Since the outcome variable of HAZ is mean outcome variable, Wagstaff et al. (2007) refer this indicator as less interesting than the difference in the proportion of group 1 and group 2 children that are stunted. A nonlinear decomposition approach is also administered, where outcome variables are binary variables i.e existence stunting or not. Stunting for HAZ less than -2 and no stunting for HAZ greater than or equal to -2, wasting for WAZ less than -2 and no wasting for WAZ greater than or equal to -2 and underweight for WHZ less than -2 and no underweight for WHZ greater than -2 are generated before the non-linear decomposition is administered. The difference in stunting across urban and rural is .08588026. Meanwhile, the difference in wasting and underweight is identical and its value is 0.08400634. The result of Fairlie non-linear decomposition are presented in Table 4.9. Toilet facility is significant contributor to urban rural gap is at five percent for binary outcomes of stunting, wasting and underweight. The toilet facility contributes to 11.18% in urban rural stunting gap. Among other covariate, anemia is also significant at five percent in wasting gap at five percent significant level. This variable contributes to 4.91% in urban rural gap in wasting. For underweight gap across urban rural, anemia contributes to 4.98%. Likewise

Table 4.8: Non-linear decomposition by Urban

Description	**Stunting**	**Wasting**	Underweight
Number of observation	1947	1832	1832
No. of obs Urban	859	815	815
No. of obs Rural	1088	1017	1017
Pr(Y|Urban)	.43422584	.45766871	.45766871
Pr(Y|Rural)	.34834559	.3726647	.3726647
Difference	.08588026	.08500401	.08500401
Total explained	.08400634	.08400634	.08400634

Source: Author's Estimation

mother's height and wealth index are significant across all nutritional outcomes stunting, wasting and underweight at 1 percent significance level. The percentage contribution of mother's height is 7.81%, 10.552% and 10.68% for stunting, wasting and underweight gap respectively. And wealth index explains stunting gap by 65.5%, wasting and underweight gap by identical 71.17%.

Mother's education contributes 5% in stunting , 6% in wasting and 6% underweight. Father's education contributes positively 3 percent in stunting but negatively 1 percent in wasting and underweight gap in urban rural group. Ethnicity contributes less than 1 percent in stunting, wasting and underweight. Diarrhea contributes negatively across stunting, wasting and underweight in urban rural gap by less than one percent. Meanwhile, mother's autonomy contributes to urban rural gap for stunting by less than 1 percent, wasting by 1 percent and underweight by 1 percent. Likewise drinking water source contributes negatively to urban rural gap among all three undernutrition. The contribution in stunting is negative 5%, wasting is negative 7% and underweight is negative 7%.

Table 4.9: Fairlie Decomposition

Variables	stunting	wasting	underweight
Mother's education	0.00428	0.00516	0.00517
	(0.603)	(0.520)	(0.520)
	4.98%	6.070%	6.08%
Father's Education	-0.00262	-0.000944	-0.000949
	(0.563)	(0.820)	(0.820)
	3.050%	-1.11%	-1.116 %
Ethnicity	0.000338	0.000722	0.000653
	(0.423)	(0.133)	(0.137)
	0.393%	0.849%	0.768%
Mother's Height	0.00671	0.00897	0.00908
	(0.000)	(0.000)	(0.000)
	7.81%	10.552%	10.68%
Wealth index	0.0563	0.0605	0.0605
	(0.000)	(0.000)	(0.000)
	65.5 %	71.17%	71.173%
Diarrhea	-0.000154	-0.000115	-0.0000813
	(0.670)	(0.722)	(0.768)
	- 0.179%	-0.135%	-0.095%
Anemia	0.00346	0.00418**	0.00424**
	(0.134)	(0.049)	(0.049)
	4.02 %	4.91 %	4.98 %
Mother's Autonomy	0.000414	0.00121	0.00116
	(0.863)	(0.604)	(0.605)
	0.482 %	1.42%	1.364%
Toilet Facility	0.00961**	0.0102* *	0.0100**
	(0.016)	(0.012)	(0.013)
	11.18%	11.999 %	11.76 %
Drinking water Source	-0.00473	-0.00607	-0.00617
	(0.223)	(0.139)	(0.138)
	-5.50 %	-7.14%	-7.258%
N	1947	1832	1832

*p<0.1 , **p<0.005,***p<0.001

Source: Author's Estimation

4.5 Discussion

The logistic regression method provide underlying factors of undernutrition. The outcome variable is represented by existence of stunting, wasting and underweight. The odds of being underweight decreased among children from mother whose education level is higher, the results validate to the maternal education being significant for less risk to underweight. Similarly, father education have no significant results on increased or decreased nutrition outcome. Children from Lumbini province have odds of increased stunting meanwhile odds of decreased wasting. Children from Karnali province have likelihood of stunted increased by 85 percent. This validates the argument that nutrition outcomes are poor among children residing in geographically challenged region. Meanwhile, children from poorer household have odds of being stunted decreased by 36% and being underweight decreased by 38% compared to poorest household. Children from middle wealth index group also have likelihood of decreased underweight by 46%. No toilet facility has odds of increased stunting and underweight by 51% and 32% respectively, studies(Sharaf & Rashad (2016)) have however included this as economic status represented by wealth index.

From linear decomposition results in Table 5, the endowment effects are found to be significant across all nutritional outcomes haz, waz and whz. From the endowment or covariates mother's education is the significant contributor in inequality for among children across rural urban in stunting similar to results of West et al. (2018),Singh et al. (2020). Oaxaca decomposition showed that gap in urban- rural nutritional outcomes are mainly caused by explained part, part due to differences in independent variables. Among the covariates wealth index and mothers education are significant contributor to the explained gap. Similar study carried on Nepal (Headey & Hoddinott, 2015) outlined improvement in stunting to changes changes in female education. Other article include the works of Srinivasan et al. (2013),McGovern et al. (2017),Pravana et al. (2017),Emamian et

al. (2014). Maternal autonomy is significant in urban rural gap of stunting outcome similar to the findings of Nie et al. (2019). Wealth index is contributing to urban-rural gap in outcome variable through contribution in explained part by 52 percent. Thus, wealth index was the most important factor, similar to the findings of Sharaf & Rashad (2016) where wealth index was significant contributor in Yemen and Jordan. Huda et al. (2018) have also decomposed undernutrition results whose result show economic status of household as one of greatest contributor to inequality. Non linear decomposition results show improvement of 7, 8 and 10 percent across stunting, wasting and underweight respectively in urban children compared to rural. Diarrhea contributes negatively for urban and rural gap for all nutritional outcomes thus children residing in rural are more prone to existence of stunting, wasting and underweight. In different outcomes parameter as children's dietary diversity, Asif & Akbar (2022) have found mother's education at second most important contributing factor of gap in dietary diversity among rural-urban areas. Jeon et al. (2015) decomposed mothers education and obesity relationship in non-linear relationship whose results support that there are increased vulnerability to the risk of obesity among less educated groups and should therefore be regarded as a main cause of increasing health inequalities. Likewise father's education contributes merely by 3 percent in urban rural gap in stunting and negatively for wasting and underweight. Similar results in the works of Asif & Akbar (2022) have shown that fathers education is a contributing factor to haz with mere 3 percent. Pravana et al. (2017) have also shown significant association among father's association and severe acute malnutrition their study. Toilet facility are significant to stunting, wasting and underweight results which are similar to the works of Singh et al. (2020). So all three decomposition Linear decomposition, Blinder Oaxaca decomposition and Non-linear based Fairlie decomposition show wealth index contributes largely to urban rural gap.

CHAPTER V

SUMMARY AND CONCLUSION

The study uses DHS 2016 datasets to decompose urban-rural differences in child nutrition outcomes using HAZ, WAZ and WHZ scores. For nonlinear based decomposition dichotomous variables of each outcomes are created as stunting, wasting and underweight respectively.

The findings from the data analysis provide interesting results in urban and rural nutritional outcome. The overall analysis provide that rural household capitalise socio-economic, environmental and child factors better than urban in nutrition. The methodology produced decomposition results in terms of covariates, coefficient and interaction effects. The concentration indices result of stunting and underweight of children under five show higher inequality in rural group and lower inequality for urban based children. Similarly, the likelihood of stunting, wasting and underweight among the variables of interest showed poorer household children to suffer from stunting and underweight more than higher wealth index group. The likelihood of underweight decreased among the children from poorer wealth index group and middle wealth index group. The odd ratio indicate that higher chances of stunting among children from household of Terai Janajati ethnic group. From the findings, another key determinant into increased stunting and underweight is the toilet facility. Household with no toilet facility had odds of increased stunting and underweight among children.

Likewise, the decomposition results quantify contribution from variables to endowment effect, coefficient and interaction induced gap across urban rural groups. Decomposition results show that significant results exist among endowment effect of covariates and in mean

height for age. Similarly, interaction effect show significant results on weight for height. Oaxaca decomposition of independent variables results show that mother's education is significant contributor across urban and rural gap in height for age and height for weight outcomes. Wealth index also shows significant contribution to urban rural gap prevailing in nutritional outcomes. Only anemia is significant contributor to urban rural gap in weight for age, however only significant at one percent to endowment induced effect. Wealth index is also significant contributor to coefficient effect on urban rural gap. Mother's height is also significant contributor to underweight urban rural gap on coefficient effect. Similarly vaccination also contributes to coefficient effect induced urban rural gap. Meanwhile, through interaction of endowment and coefficients, wealth index contributes to urban rural gap on wasting outcomes.

Similarly, non linear based decomposition results shows stunting, wasting and underweight across urban is higher in comparison to rural household children. Further decomposition across independent variables show that anemia contributed strongly on wasting and underweight outcome gap across urban and rural group. This result is consistent across linear and non-linear decomposition. Toilet facility also contributes significantly to urban rural gap to stunting, wasting and underweight. This underlines the importance of toilet facility to address nutritional outcome. Thus consistent results exist on contribution of mother's education and wealth index to urban rural gap in nutrition outcome for height for age, weight for height score were evident, meanwhile gap in urban rural weight for age.

REFERENCES

Aguayo, V. M., Sharma, A., & Subedi, G. R. (2015). Delivering essential nutrition services for children after the nepal earthquake. *The Lancet Global Health*, *3*(11), e665–e666.

Asif, A. M., & Akbar, M. (2022). A non-linear decomposition analysis of children's dietary diversity scores: Explaining rural-urban inequality. *Quality & Quantity*, 1–12.

Bauer, T. K., & Sinning, M. (2008). An extension of the blinder–oaxaca decomposition to nonlinear models. *AStA Advances in Statistical Analysis*, *92*(2), 197–206.

Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., Webb, P., Lartey, A., Black, R. E., Group, T. L. N. I. R., et al. (2013). Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? *The lancet*, *382*(9890), 452–477.

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., De Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., et al. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *The lancet*, *382*(9890), 427–451.

Conway, K., Akseer, N., Subedi, R. K., Brar, S., Bhattarai, B., Dhungana, R. R., Islam, M., Mainali, A., Pradhan, N., Tasic, H., Thakur, D. N., Wigle, J., Maskey, M., & Bhutta, Z. A. (2020). Drivers of stunting reduction in Nepal: a country case study. *The American Journal of Clinical Nutrition*, *112*(Supplement$_2$), 844S–859S. https://doi.org/10.1093/ajcn/nqaa218

Department of Health Services. (2021). Annual Report FY 2076/77. https://dohs.gov.np/wp-content/uploads/2021/07/DoHS-Annual-Report-FY-2076-77-for-website.pdf

Emamian, M. H., Fateh, M., Gorgani, N., & Fotouhi, A. (2014). Mother's education is the most important factor in socio-economic inequality of child stunting in iran. *Public health nutrition*, *17*(9), 2010–2015.

Fairlie, R. W. (1999). The absence of the african-american owned business: An analysis of the dynamics of self-employment. *Journal of Labor Economics*, *17*(1), 80–108.

Fairlie, R. W. (2005). An extension of the blinder-oaxaca decomposition technique to logit and probit models. *Journal of economic and social measurement*, *30*(4), 305–316.

Firestone, R., Punpuing, S., Peterson, K. E., Acevedo-Garcia, D., & Gortmaker, S. L. (2011). Child overweight and undernutrition in thailand: Is there an urban effect. *Social science & medicine*, *72*(9), 1420–1428.

Fotso, J.-C. (2006). Child health inequities in developing countries: Differences across urban and rural areas. *International journal for equity in health*, *5*(1), 1–10.

Headey, D. D., & Hoddinott, J. (2015). Understanding the rapid reduction of undernutrition in nepal, 2001–2011. *PloS one*, *10*(12), e0145738.

Houweling, T. A., Kunst, A. E., & Mackenbach, J. P. (2003). Measuring health inequality among children in developing countries: Does the choice of the indicator of economic status matter? *International journal for equity in health*, *2*(1), 1–12.

Huda, T. M., Hayes, A., El Arifeen, S., & Dibley, M. J. (2018). Social determinants of inequalities in child undernutrition in bangladesh: A decomposition analysis. *Maternal & child nutrition*, *14*(1), e12440.

Jann, B. (2008). The blinder–oaxaca decomposition for linear regression models. *The Stata Journal*, *8*(4), 453–479.

Jeon, H., Salinas, D., & Baker, D. P. (2015). Non-linear education gradient across the nutrition transition: Mothers' overweight and the population education transition. *Public health nutrition*, *18*(17), 3172–3182.

Karn, S., Adhikari, D. P., Paudyal, N., Aryal, B., Adhikari, R., Steffen, M., et al. (2019). Child undernutrition and feeding practices in nepal: Trends, inequities, and determinants. *DHS Further Analysis Report*, (122).

Kolenikov, S., Angeles, G., et al. (2004). The use of discrete data in pca: Theory, simulations, and applications to socioeconomic indices. *Chapel Hill: Carolina Population Center, University of North Carolina*, *20*, 1–59.

Krishna, A., Mejıa-Guevara, I., McGovern, M., Aguayo, V. M., & Subramanian, S. (2018). Trends in inequalities in child stunting in south asia. *Maternal & Child Nutrition*, *14*, e12517.

McGovern, M. E., Krishna, A., Aguayo, V. M., & Subramanian, S. (2017). A review of the evidence linking child stunting to economic outcomes. *International journal of epidemiology*, *46*(4), 1171–1191.

Ministry of Health- Nepal, New ERA and ICF. (2017). Nepal demographic and health survey 2016.

Nie, P., Rammohan, A., Gwozdz, W., & Sousa-Poza, A. (2019). Changes in child nutrition in india: A decomposition approach. *International journal of environmental research and public health*, *16*(10), 1815.

Pravana, N. K., Piryani, S., Chaurasiya, S. P., Kawan, R., Thapa, R. K., & Shrestha, S. (2017). Determinants of severe acute malnutrition among children under 5 years of age in nepal: A community-based case–control study. *BMJ open*, *7*(8), e017084.

Rijal, P., Sharma, A., Shrestha, S., & Upadhyay, S. (2011). Nutritional assessment of children at nepal medical college teaching hospital. *Health Renaissance*, *9*(3), 184–188.

Ruducha, J., Bhatia, A., Mann, C., & Torlesse, H. (2022). Multisectoral nutrition planning in nepal: Evidence from an organizational network analysis. *Maternal & child nutrition*, *18*, e13112.

Sah, N. (2004). Determinants of child malnutrition in nepal: A case analysis from dhanusha, central terai of nepal. *J Nepal Health Res Counc*, *2*(2), 50–55.

Sharaf, M. F., & Rashad, A. S. (2016). Regional inequalities in child malnutrition in egypt, jordan, and yemen: A blinder-oaxaca decomposition analysis. *Health economics review*, *6*(1), 1–11.

Singh, S. K., Srivastava, S., & Chauhan, S. (2020). Inequality in child undernutrition among urban population in india: A decomposition analysis. *BMC public health*, *20*(1), 1–15.

Srinivasan, C. S., Zanello, G., & Shankar, B. (2013). Rural-urban disparities in child nutrition in bangladesh and nepal. *BMC public health*, *13*(1), 1–15.

Unicef et al. (2013). Improving child nutrition: The achievable imperative for global progress. *New York: UNICEF*, *114*.

Wagstaff, A., O'Donnell, O., Van Doorslaer, E., & Lindelow, M. (2007). *Analyzing health equity using household survey data: A guide to techniques and their implementation*. World Bank Publications.

Wagstaff, A., Van Doorslaer, E., & Watanabe, N. (2003). On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in vietnam. *Journal of econometrics*, *112*(1), 207–223.

West, J., Syafiq, A., Crookston, B., Bennett, C., Hasan, M. R., Dearden, K., Linehan, M., Hall, C., Torres, S., et al. (2018). Stunting-related knowledge: Exploring sources of and factors associated with accessing stunting-related knowledge among mothers in rural indonesia. *Health*, *10*(09), 1250.

ANNEX

Table 5.1: Decomposition

Variables	Endowment			Coefficient			Interaction		
	HAZ	WAZ	WHZ	HAZ	WAZ	WHZ	HAZ	WAZ	WHZ
Mother's Education	-0.0680**	-0.084	-0.0422 *	-0.129	0.0406	0.290*	0.0249	-0.00787	-0.0561*
	-0.046	0	-0.089	-0.696	-0.762	-0.072	-0.696	-0.762	-0.078
	38.20%	36.36%	30.35%	-63.54%	-1385.66%	-593.047	-54.36%	-20.60%	-59.68%
Child No. under Five	-0.0305	-0.000022	0.00985	-0.479	-0.0593	-0.0548	-0.0641	-0.00793	-0.00733
	-0.178	-0.998	-0.416	-0.343	-0.581	-0.63	-0.352	-0.584	-0.631
	17.13%	0.01%	30.35%	-235.96%	2023.89%	112.07%	139.95%	-20.75%	-7.79%
Wealth Index	-0.0929**	-0.106	-0.0600**	0.261	-0.323**	-0.601	-0.0561	0.0695**	0.129
	-0.019	0	-0.012	-0.382	-0.023	0	-0.384	-0.027	0
	52.19%	45.88%	43.16%	128.57%	-11023.89%	1229.039	122.48%	181.93%	137.23%
Father's Education	0.0319	-0.00149	-0.00902	0.0557	0.125	-0.146	-0.00467	-0.0104	0.0122
	-0.257	-0.884	-0.441	-0.938	-0.459	-0.416	-0.938	-0.464	-0.423
	-17.92%	0.64%	6.48%	27.43%	-4266.21%	298.56%	10.19%	-27.22%	12.97%
Breastfeed	0.00115	-0.00868	-0.0115	0.22	0.0554	0.267	0.00743	0.00187	0.00902
	-0.876	-0.159	-0.107	-0.664	-0.801	-0.243	-0.669	-0.802	-0.29
	-0.64%	3.75%	8.27%	108.37%	-1890.78%	-546.012	-16.22%	4.89%	9.59%
Ethnicity	-0.00024	0.00075	0.000306	0.508	-0.0286	-0.0862	0.00326	-0.000183	0.000553
	-0.886	-0.812	-0.821	-0.156	-0.766	-0.39	-0.813	-0.852	-0.817
	0.13%	0.32%	-0.22%	250.24%	976.10%	176.27%	-7.11%	-0.47%	-0.58%
Mother's Height	-0.000538	-0.000848	-0.000552	-0.222	-0.383	-0.371	0.000443	0.000763	0.000741
	-0.823	-0.82	-0.819	-0.543	-0.15	0	-0.83	-0.821	-0.819
	0.30%	0.36%	0.39%	-109.36%	13071.67%	758.69%	-0.96%	1.99%	0.78%
Diarrhea	-0.000372	-0.000664	0.000173	-0.592	-0.228	-0.084	0.00405	0.00156	0.000574
	-0.806	-0.669	-0.884	-0.225	-0.278	-0.707	-0.632	-0.638	-0.76
	0.21%	0.28%	-0.01%	-291.62%	7781.56%	171.77%	-8.84%	4.08%	0.61%
Anemia	-0.00591	-0.0141*	-0.0127	0.418	0.2	-0.0325	-0.0196	-0.00941	0.00153
	-0.541	-0.081	-0.137	-0.644	-0.347	-0.882	-0.646	-0.362	-0.882
	3.32%	6.10%	9.13%	205.91%	-6825.93%	66.46%	42.79%	-24.63%	1.62%
Maternal Autonomy	-0.0417*	-0.0178	-0.00588	-0.238	-0.0297	-0.024	0.0409	0.0051	0.00412
	-0.087	-0.1	-0.588	-0.534	-0.716	-0.776	-0.537	-0.716	-0.777
	23.42%	7.70%	4.23%	-117.24%	1013.65%	49.08%	-89.30%	13.35%	4.38%
All Vaccination	0.0029	0.00234	0.00101	0.214	-0.0684	-0.1388**	0.00339	-0.00108	-0.00218
	-0.741	-0.739	-0.744	-0.297	-0.275	-0.028	-0.75	-0.749	-0.741
	-1.62%	-1.01%	-0.72%	105.41%	2334.47%	282.20%	-7.40%	-2.83%	-2.32%

Table 5.2: Oaxaca Decomposition - Independent Variables

Variables	Endowment			Coefficient			Interaction		
	HAZ	WAZ	WHZ	HAZ	WAZ	WHZ	HAZ	WAZ	WHZ
Mother's Education	-0.0680**	-0.084	-0.0422 *	-0.129	0.0406	0.290*	0.0249	-0.00787	-0.0561*
	-0.046	0	-0.089	-0.696	-0.762	-0.072	-0.696	-0.762	-0.078
	38.20%	36.36%	30.35%	-63.54%	-1385.66%	-593.047	-54.36%	-20.60%	-59.68%
Child No. under Five	-0.0305	-0.000022	0.00985	-0.479	-0.0593	-0.0548	-0.0641	-0.00793	-0.00733
	-0.178	-0.998	-0.416	-0.343	-0.581	-0.63	-0.352	-0.584	-0.631
	17.13%	0.01%	30.35%	-235.96%	2023.89%	112.07%	139.95%	-20.75%	-7.79%
Wealth Index	-0.0929**	-0.106	-0.0600**	0.261	-0.323**	-0.601	-0.0561	0.0695**	0.129
	-0.019	0	-0.012	-0.382	-0.023	0	-0.384	-0.027	0
	52.19%	45.88%	43.16%	128.57%	-11023.89%	1229.039	122.48%	181.93%	137.23%
Father's Education	0.0319	-0.00149	-0.00902	0.0557	0.125	-0.146	-0.00467	-0.0104	0.0122
	-0.257	-0.884	-0.441	-0.938	-0.459	-0.416	-0.938	-0.464	-0.423
	-17.92%	0.64%	6.48%	27.43%	-4266.21%	298.56%	10.19%	-27.22%	12.97%
Breastfeed	0.00115	-0.00868	-0.0115	0.22	0.0554	0.267	0.00743	0.00187	0.00902
	-0.876	-0.159	-0.107	-0.664	-0.801	-0.243	-0.669	-0.802	-0.29
	-0.64%	3.75%	8.27%	108.37%	-1890.78%	-546.012	-16.22%	4.89%	9.59%
Ethnicity	-0.00024	0.00075	0.000306	0.508	-0.0286	-0.0862	0.00326	-0.000183	0.000553
	-0.886	-0.812	-0.821	-0.156	-0.766	-0.39	-0.813	-0.852	-0.817
	0.13%	0.32%	-0.22%	250.24%	976.10%	176.27%	-7.11%	-0.47%	-0.58%
Mother's Height	-0.000538	-0.000848	-0.000552	-0.222	-0.383	-0.371	0.000443	0.000763	0.000741
	-0.823	-0.82	-0.819	-0.543	-0.15	0	-0.83	-0.821	-0.819
	0.30%	0.36%	0.39%	-109.36%	13071.67%	758.69%	-0.96%	1.99%	0.78%
Diarrhea	-0.000372	-0.000664	0.000173	-0.592	-0.228	-0.084	0.00405	0.00156	0.000574
	-0.806	-0.669	-0.884	-0.225	-0.278	-0.707	-0.632	-0.638	-0.76
	0.21%	0.28%	-0.01%	-291.62%	7781.56%	171.77%	-8.84%	4.08%	0.61%
Anemia	-0.00591	-0.0141*	-0.0127	0.418	0.2	-0.0325	-0.0196	-0.00941	0.00153
	-0.541	-0.081	-0.137	-0.644	-0.347	-0.882	-0.646	-0.362	-0.882
	3.32%	6.10%	9.13%	205.91%	-6825.93%	66.46%	42.79%	-24.63%	1.62%
Maternal Autonomy	-0.0417*	-0.0178	-0.00588	-0.238	-0.0297	-0.024	0.0409	0.0051	0.00412
	-0.087	-0.1	-0.588	-0.534	-0.716	-0.776	-0.537	-0.716	-0.777
	23.42%	7.70%	4.23%	-117.24%	1013.65%	49.08%	-89.30%	13.35%	4.38%
All Vaccination	0.0029	0.00234	0.00101	0.214	-0.0684	-0.1388**	0.00339	-0.00108	-0.00218
	-0.741	-0.739	-0.744	-0.297	-0.275	-0.028	-0.75	-0.749	-0.741
	-1.62%	-1.01%	-0.72%	105.41%	2334.47%	282.20%	-7.40%	-2.83%	-2.32%