Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____

Emily Teachout

Approval Sheet

The Equity Gap of Nutritional Health Outcomes of Children Under Five in Three South Asian Countries Since the Advent of the MDGs

By

Emily Teachout

Master of Public Health

Hubert Department of Global Health

_____

Dr. Aryeh Stein, MPH PhD

Committee Chair

The Equity Gap of Nutritional Health Outcomes of Children Under Five in Three South Asian Countries Since the Advent of the MDGs

By

Emily Teachout

B.A.

Florida State University

2010

Thesis Committee Chair: Dr. Aryeh Stein

An abstract of

A thesis submitted to the Faculty of
Rollins School of Public Health

in partial fulfillment of the requirements for the degree of
Master of Public Health
in Hubert Department of Global Health

2017

Abstract

The Equity Gap of Nutritional Health Outcomes of Children Under Five in Three South Asian Countries since the advent of the MDGs

By Emily Teachout

Background:

Over the past decade, there has been an increased focus at a global level on improving the nutrition of children under 5. Progress toward this goal has been monitored since the MDGs in 2000. However, a well-documented criticism of the MDGs is its lack of focus on health equity. The SDGs have been applauded for their renewed focus toward improving equity. Still, neither set of UN development goals have nutritional health indicators stratified by wealth. South Asia experienced a large decrease in undernutrition in children under 5 from 2000-2015. However, we know very little about the regional trends in health equity for children from the poorest households over the period of the Millennium Development Goals.

Methods and Findings:

We conducted a secondary data analysis using 6 DHS surveys from three countries in South Asia: Pakistan (1991 and 2013), Bangladesh (1999 and 2014), and Nepal (2001 and 2011). Survey weights were applied to the data sets to produce population level estimates. We used a variety of methods to explore the changes in the distribution of the prevalence and the odds ratios of stunting across wealth quintiles for children under five. We conducted multivariate logistic regression using SAS 9.2 to produce odds ratios of stunting and wasting by wealth quintile for each survey separately using SAS-callable SUDAAN. We found that across all surveys, the changes in prevalence of stunting at a national population level masked sluggish improvements for children from the poorest 40% of households.

Conclusion:

The poor are being left behind as the South Asia region makes large progress toward the reduction of undernutrition. There is an urgent need for improved targeting of public health resources to the most vulnerable and hard to reach children. Further, there is a need for the UN development goals to include indicators that stratify by economic status so that countries are held accountable for more than an overall prevalence reduction.

Acknowledgements

I would like to thank Dr. Aryeh Stein for his support and guidance over the last two years. He has been a phenomenal resource for me and has taught me a great deal about how to think through scientific evidence critically. I largely credit Dr. Stein with inspiring me to pursue a career in monitoring and evaluation of public health nutrition programs.

I would also like to thank Dr. Annette Schwabe for her mentorship over the past nine years. Dr. Schwabe inspired my pursuit of a career in public health by challenging me to think about the upstream causes of health problems. She is an incredible teacher and a dear friend.

Table of Contents

Appendix A: Extended Tables and Figures

List of Tables and Figures

Manuscript Tables

Manuscript Figures

Appendix Tables

Chapter 1: Introduction

Nutrition was a neglected health problem on the global aid agenda for years as the world came to terms with the immediate needs of an increasingly demanding infectious disease burden. It was not until the last decade that malnutrition began to receive the global attention and funding that it needs [1]. Since 2008, nutrition has received a great deal of spotlight through the Lancet series on Maternal and Child Nutrition (2008& 2013), the Millenium Development Goals (MDGs 2000-2015), the Sustainable Development Goals (SDGs 2015-2030), and the Scaling up Nutrition Movement (SUN). An increase in attention at a policy and funding level has pushed the goal of eliminating childhood malnutrition forward through collective actions by a consortium of global and local actors. It is probable that these factors have collectively contributed the global decrease in the prevalence of malnutrition over the past 15 years that has been widely documented.

In 2008, there was a shift from an emphasis on tracking the prevalence of underweight in children under five to a new indicator of undernutrition. Victora et al. highlighted the weaknesses of using underweight as the primary indicator for undernutrition in the 2008 Lancet series on Maternal and Child Nutrition [2]. The shift in indicators used to measure undernutrition is reflected across global platforms for the reduction of malnutrition such as SUN, the Global Hunger Index (GHI), and the SDGs [2-5]. The MDGs were officially started in 2000 before this shift and the only nutrition indicator included in the goals is prevalence of underweight. The SDGs also track overall prevalence but these UN development goals have shifted their undernutrition indicators to include stunting and wasting. Both sets of development goals only track national prevalence estimates without any stratifying indicators.

While overall national decreases in the prevalence of undernutrition is certainly a triumph for public health, many social scientists and epidemiologists have questioned over the last two decades if we are leaving the poor behind. The hypothesis is that a decrease in overall prevalence may be masking inequities in health outcomes across different socioeconomic groups [6-8]. An increasing gap in health equity between children from the poorest and the wealthiest households may be the result of a variety of factors. Poor intervention targeting that does not take into account the hard to reach subpopulations within a country have been widely documented in the literature as a possible source for inequity in health outcomes.

Health equity literature gained popularity in the 1990's after Wagstaff (1991) presented the use of the Concentration Index (CI) as an ideal measurement for representing inequality in health outcomes. While the question has become of increasing interest in the past decade, there remains a dearth in the literature that explores the equity of stunting children under five during the period of the MDGs (2000-2015). More specifically, there is a scarcity of research that explores time trends in nutritional health equity within and between countries in South Asia in a way that is useful for policy makers, program funders and implementers. The CI works well for taking the temperature of inequality as a comparison in a country overtime or across regions. However, it does not provide useful information about targeting for specific socioeconomic groups and is difficult to interpret and translate into rationale for changed policies or programs [9].

The findings from a study conducted by Van de Poel (2008) suggests that reducing inequalities in health outcomes between groups may not have generalized benefits in terms of prevalence decrease. Thus, the significance of the ensuing study requires two philosophical human rights buy-ins from the reader: 1.) A separation with utilitarian logic and a philosophical

agreement that equity matters and 2.) A shared understanding that leaving poor children behind is unethical.

Based on an affirmation of responsibility to human rights and equity by the UN, we find that the premise for monitoring health equity is justified and greatly needed: "We recognize that, in addition to our separate responsibilities to our individual societies, we have a collective responsibility to uphold the principles of human dignity, equality and *equity* at the global level. As leaders we have a duty therefore to all the world's people, especially the most vulnerable and, in particular, the children of the *world*, to whom the future belongs. -United Nations Millennium Declaration [10]

Purpose of this Study

This study aims to ascertain the gap in the equity of the distribution of poor nutritional health outcomes between the poorest and wealthiest households of children under five pre and post MDGs in Pakistan, Nepal, and Bangladesh.

Significance Statement

This paper contributes to the growing body of literature that attempts to monitor the gaps in equity of nutritional health outcomes over time. The findings from this analysis suggest a need to include an indicator in future UN development goals that stratifies by wealth. This study has important implications for the targeting of public nutrition interventions to reach the poorest of the poor. From what we can tell, this paper is the first to look use the most recent surveys from Pakistan (2014) and Bangladesh (2013) in an equity analysis of time trends in nutritional health outcomes. The results presented here may be useful for policy makers and program designers in the targeting of nutritional health interventions.

Definition of Terms

Inequity	An inequality that is not due to inherent biological differences and implies an injustice[11]
Inequality	Distribution that is uneven across groups [11]
Wealth Index (WI)	A relative score of economic well-being that is built using principal component analysis [12]
Concentration Index (CI)	A score that is used to quantify the level of inequality across quintiles of a socioeconomic proxy variable for a health outcome or health intervention [12]
Stunting	Height-for-age Z scores that fall at or below -2 standard deviations of the mean of the reference population defined by the WHO growth standards in 2006 [13]
Wasting	Weight-for-height Z scores that fall at or below -2 standard deviations of the mean of the reference population defined by the WHO growth standards in 2006 [13]
Millennium Development Goals (MDGs)	UN development goals from 2000-2015 (evaluated using data from 1990 as a baseline for the targets of the goals set) [14]
Sustainable Development Goals (SDGs)	UN development goals that span the years 2015-2030 [15]
Socioeconomic status (SES)	Reference to an individual or groups combined social and economic standing in a society [12]
Global Hunger Index (GHI)	A statistical tool developed by IFPRI that combines 4 different measures of malnutrition and hunger to produce a single index score of hunger for each country [5]
Gini Index	A score that rages from 0-1 that is assigned to each country to measure the amount of inequality between the wealthiest and the poorest in terms of income [16]

Chapter 2: Literature Review

The Global Move Toward Better Nutritional Health Outcomes

Momentum in public health for a greater focus on maternal and child nutrition began after the 2008 Lancet Series, Maternal and Child Undernutrition. This series (later expanded in 2013) emphasized some key aspects of malnutrition that pushed the global movement forward. The publications highlighted the global prevalence of malnutrition, the underlying causes, and the downstream consequences for human capital and national economic growth. The series also shed light on the 1,000-day window for improving nutrition for children. This led to a refocus of nutritional health indicators (from underweight to stunting). The series also outlined key interventions to be scaled up [2, 17-20]. The Scaling Up Nutrition Movement has largely propelled the ideas from this series forward into global and national strategies for decreasing the disease burden of malnutrition [21, 22].

Comparing Indicators from MDGs and SDGs

The MDGs included one indicator for improving nutritional health outcomes of children under five: prevalence of underweight. There are numerous limitations of this indicator that Victora et al. (2008) and others have highlight relating to the specificity of the indicator. As Victora et al. (2008) points out, a change in the weight for age of a child does not take linear growth into consideration. Over the past decade, there has been a move towards using stunting as an indicator of child nutrition health to replace underweight. This is reflected by the change in indicators by the SUN movement, the change to the use of stunting and wasting by the GHI and the new SDG indicators that are based upon the 2025 nutrition targets set by the WHO [3-5]. While the SDGs are designed to be more equity focused, both the MDG indicators and the SDG indicators only evaluate overall prevalence and do not stratify by SES.

Indicators of Malnutrition: Stunting and Wasting

There are multiple forms of measuring undernutrition in children. Stunting and wasting are the most commonly analyzed (as of recent) because their biological etiologies vary. Thus, the nutrition specific interventions that are effective in prevalence reduction in a population are also diverse and should be targeted appropriately [18]. While their proximate determinants vary, the underlying social, political, and economic determinants of both forms of malnutrition are similar [18, 23]. The most effective interventions for undernutrition are targeted during the first 1,000 days, spanning from conception to two years of age [18].

Both stunting and wasting are indices for anthropometric measurements that are determined by comparing the weight-for0height or height-for-age score of the child against the median of the reference population. A child is determined to have stunted growth if his/her height-for-age Z score falls at or below negative two standard deviations of the median of WHO reference population [12, 13]. Likewise, wasting is determined if a child's weight-for-height falls two or more standard deviations below the reference population median. The international standard reference population was created by WHO in 2006 using a diverse sample of breast-fed children from varying regions and ethnicities. This new reference is considered superior and replaces previous guidelines published by the CDC that included only bottle-fed children from the U.S. [12, 13].

Poor nutritional health outcomes are the result of one or a combination of proximal causes: inadequate food intake, inadequate diversity in the diet, and/or infection that leads to malabsorption of nutrients [12]. The long-term and short-term detrimental effects of undernutrition, specifically stunting in the first two years of life, are well-documented in the literature. These consequences include cognitive and physical impairment, lower offspring birth

weight, decreased schooling in later years, and decreased earning potential [2]. From a sociological and public health perspective, undernutrition can also be attributed to a set of distal causes linked to SES. It is important to note the cyclical implications of stunting as related to poverty, schooling, or the generational pre-disposition. These socioeconomic indicators serve as both predictors and long term outcomes of undernutrition in children [2, 24].

Measures of Socioeconomic Status

There are three main ways to measure economic status: household income, household consumption expenditures, and household wealth [12]. While these three may seem to be proxies for each other, they each measure separate aspects of economic status and do not merit the same level of validity as an overall measure of economic well-being. Additionally, it must be noted that these are measures of economic status. They are not direct measures of socioeconomic status. Socioeconomic status usually includes at least one other variable such as occupation or education, in addition to an indicator of economic well-being [25]. However, all three of these economic status indicators are often used as proxies for socioeconomic status when an analysis of equity or equality is being conducted.

While consumption expenditures and household income can be useful in specific contexts, they have important limitations when the investigator is looking at inequalities across SES. Income and household consumption expenditures are difficult to measure accurately, take up a considerably larger amount of time to survey, and require data collection from more than one member of the household [12, 25, 26]. Studies using DHS data most often use household wealth as the variable that represents socioeconomic status. As of the early 2000's, the DHS now includes the Wealth Index as a standard recode variable for all surveys [27]. Additionally, MICS also uses the Wealth Index to measure economic well-being.

The Wealth Index

The Wealth Index (WI) was developed shortly after a conference held by the WHO in the late 1990's entitled "Health Equity for all in the New Millennium"[25]. One of the main rationales for the creation of the WI was a need to provide a way to calculate the equity of health interventions. The WI uses Filmer-Pritchett principal component methodology to determine the weights attached to the different assets and services that are used in the construction of the tool [25, 27]. Some of these assets and services include considerations such as whether the household has a refrigerator, the type of flooring, whether the family has a servant, etc. The wealth index is calculated at a population level, rather than a household level. Each person is given a Wealth Index score [25]. Once the individuals are sorted by score, they are broken into groups of 20th percentiles, thus providing us with the quintiles of wealth that are often seen in health equity literature. The standard recode in each DHS survey includes both a score and a quintile for each household [25]. Each individual in the household will have the same score.

A key limitation to the Wealth Index is that it measures relative, rather than absolute inequality. Thus, comparing the means overtime is insignificant and comparing the actual scores across time or place is also without merit [27]. There is some work being done to develop indexes that can be compared, such as the International Wealth Index and the Comparative Wealth Index. However, these measures will not be discussed at length in this review. For further information, please check references [27, 28].

Stunting and Wasting: Relative vs. Absolute Measures of Wealth

As mentioned previously, the wealth index is a measure of relative wealth and not absolute wealth. Thus, comparisons in absolute terms using the WI cannot be made across time or space. Measures of relative wealth, measured by the WI, are able to detect statistically

significant differences between stunted and non-stunted children. However, a major flaw is that it does not detect much difference between wasted and non-wasted children. The comparative wealth index (CWI) that was proposed in the DHS MR9, however, does detect significant differences between wealth quintiles when the wealth that is being measured is absolute and not relative. This finding logically suggests that stunting may be related to relative inequality but that wasting is more closely associated with absolute inequality [27].

Introduction to Measurements of Inequities in Health Outcomes

Measuring the inequity of health outcomes between different levels of socioeconomic status became of particular interest in the 1990's after Wagstaff's paper that presented the use of the CI [29, 30]. Since this paper, there have been many social scientists and epidemiologists that have evaluated the various strengths and weaknesses of the CI as a measure of inequality [12, 29-34]. The literature has markedly criticized the ability of the CI to correctly represent inequality when the health outcome variable is binary in nature (such as stunting or wasting) [29, 34]. While the concentration index is the most popular way to measure health inequity, there are many other techniques to measure inequalities such as the concentration curve, simple proportions, and multivariate regression. In the case of relationships which follow a linear assumption, the slope index of inequality and the relative index of inequality are also popular choices [30]. Each of these measures has its strengths and limitations. This has resulted in a wide variety of reporting measures in the literature.

A troubling limitation to the science of measuring inequality in nutritional health outcomes is that there is a large amount of variation in every aspect of the measures and indices used. In the case of the most commonly used index to determine the amount of inequality, there have been significant changes to the way that the CI should be calculated for dichotomous

variables [29, 31, 34]. Further, the variables that are used to calculate the CI (or other measures of inequality) also vary greatly. For the proxy variable used for Socioeconomic status (SES), some papers look at household consumption through expenditures, others at household income, and more commonly others look at household wealth [12, 25, 27]. For the actual health outcome variables, the variables that we use to track undernutrition have changed from underweight at the beginning of the MDGs to a focus on stunting and wasting around 2008. Even within the most current recommendations for measuring undernutrition, stunting and wasting, there have been changes. The WHO growth standards have changed since 2005, making it difficult to critically evaluate and compare papers written before 2006 to current studies [13]. These changes and differences make for a body of literature over the past 15 years that cannot and should not be interpreted with the same assumptions or credibility.

Concentration Curve and Concentration Index

The CI, with all the flaws and limitations, is still the most commonly used method to measure inequality in health outcomes. The CI is derived from the concentration curve, which is a visual representation of the amount of inequality in a specific health outcome between different SES groups. The concentration curve uses two variables: a measure of health and a measure of SES. This curve plots the cumulative concentration of stunting against the cumulative concentration of the population by wealth quintile. In a society where the health outcome is distributed equitably across all quintiles of health, the curve will be a 45-degree straight line; spanning from the bottom left corner to the top right corner. The farther the curve lies above the 45-degree line, the more the health variable is concentrated among the more socioeconomically disadvantaged group [12].

A concentration curve can be used to look at inequality over time and across countries using what is referred to as the test of dominance by plotting all curves from various years/regions on the same graph. If the curves do not cross, the one that lies the furthest from the 45-degree line is said to pass the test of dominance and be more unequal as a whole [33]. A concentration curve is a great tool to show in a very simple way if inequality exists. However, to get a measure of magnitude, the concentration index needs to be calculated [12, 30, 33].

The CI is defined as two times the area underneath the curve. Defining the CI is more complex, however, with binary health outcomes [12, 30]. When the health outcome is continuous, the CI is bounded between -1 and 1. If a society's health outcome is distributed equally across all the SES quintiles, the CI would be 0. The closer the CI lies to -1, the more disproportionality the negative health outcome is abundant in the poor. However, when the health outcome is dichotomous in nature (such as stunting, wasting, or child mortality), the bounds of the CI depend heavily on the mean of the variable. The minimum and maximum in larger samples tends toward μ-1 and 1-μ [29, 31, 34]. Due to this complication that was first discussed by Wagstaff in 2005, special formulas must be used to correct for this. Over the years, there has been an increasing recognition that the interpretation of a CI is particularly complicated if the health outcome that an investigator would like to evaluate is not continuous.

Various repairs to the formula have been suggested by numerous authors but will not be discussed at length here. The CI is ideal for simple random samples with variables that are continuous. The introduction of dichotomous variables and multivariate relationships appreciably complicate the use of the CI as a measure of inequality and require a more cautious interpretation of comparisons across time and space. Additionally, the CI places a value judgment on inequality in health outcomes and is difficult to interpret without making a comparison to another point in

time or another location [33]. The interpretation will always be relative and it needs to be accompanied by a concentration curve to show a more-than or less-than contrast.

Simple Proportions

The use of simple proportions to evaluate the level of health equity in a country is also a very popular choice [12]. However, it tells an overly simplified story and it does not meet all three of the criterion set by Wagstaff in 1991 as the minimal requirements of a measure of inequality: "1. That it reflects the socioeconomic dimension to inequalities in health 2. That it reflects the experiences of the entire population (rather than just social classes I and V) and 3. That it be sensitive to changes in the distribution of the population across socioeconomic groups" [30]. A simple proportion would not take into account multivariate relationships or relationships between groups that are outside of the poorest of the poor and the wealthiest of the rich [12].

Other Proposed Methods for Dichotomous Variables

More recently, some papers have used logistic regression in combination with a CI and a concentration curve to look at the relationship between socioeconomic status and nutritional health outcomes [35, 36]. The most common comparison made is between the wealthiest and the poorest of the poor. However, relationships between each quintile of SES can be looked at [12]. The sister regression method, linear regression, in the context of the Relative Index of Inequality (RII) was one of the two methods that were documented by Wagstaff (1991) to meet the minimal requirements for a good measure of inequality [30].

There are many benefits of using logistic regression to look at inequalities in health outcomes. First, it is a more common measurement in public health and is more easily interpretable than the CI due primarily to familiarity [9]. To understand a CI or even a

concentration curve, it requires a basic understanding of the calculation, the limitations, and the assumptions that the measurement makes. On the other hand, logistic regression, while not always interpreted with ease, is a familiar form of measurement across public health and other disciplines. Thus, odds ratios may be more easily interpretable by other ministries within countries that make decisions about health financing [9].

Previous Studies that have Explored the Equity Gap in Nutritional Health Outcomes Since the MDGs

There are only a handful of paper that have analyzed trends in health inequities across time and space since the advent of the MDGs [7]. In a working policy paper by Wagstaff (2014) he noted three prior to his that look at whether the health outcomes or interventions since the advent of the MDGs were pro poor [7, 8, 37, 38]. Of these papers, only Wagstaff (2014), Moser (2005), and Suzuki (2012) look at health outcomes and only Wagstaff (2014) includes stunting and wasting as health outcome variables for analysis. For this review of the literature, we have decided to look closely at studies that:

1.) Analyze national level data between the years of 1990 and 2015 and
2.) Include at least two different surveys for analysis over time for at least one country and
3.) Use a measure of equity and
4.) Include either stunting or wasting as a health variable of interest OR analyze a measure of nutritional health in a South Asian country

The following paragraphs look at four studies that have analyzed equity across time and space since the advent of the MDGs.

Study #1: Wagstaff, 2014

Wagstaff (2014) includes 235 surveys from DHS and MICS that span 64 developing countries. The investigators include surveys between the period of 1990 to 2011. Five health outcome variables are included. They also incorporate several public health intervention variables to measure coverage of health services and programs. The Wealth Index is used as the stratifying variable in all analyses. Wagstaff (2014) uses a variety of means to describe the equity of health outcomes and the equity of coverage of health interventions. The most prominent way he describes health equity is by looking at a 40/60 proportion; he compares the means of the poorest 40 percent to the wealthiest 60 percent. The author also includes comparison of equity by including simple proportions of wealthiest-poorest and uses the absolute concentration index.

Results indicate an overall progress toward the health MDGs; prevalence of poor health outcomes has been decreasing. Specifically, 65% of the countries analyzed have reduced the prevalence of stunting in children under five. This paper does make special note that the prevalence of child malnutrition and under five child mortality is increasing among several countries. The authors report that there is not a dramatic difference in the speed at which under five mortality or malnutrition is decreasing across wealth groups [7].

Study #2: Bredenkamp, Buisman, & Van de Poel, 2014

Bredenkamp (2014) used data from 131 DHS and 48 MICS surveys. The authors included surveys between the years of 1990-2011 and included stunting and wasting as variables for analysis. In an additional table, the authors provide access to each country analyzed and the corresponding CI. Of interest to this paper, the Bredenkamp (2014) publication includes data from 4 South Asian countries: Nepal (1996-2011), India (1993-2006), Bangladesh (1997-2007), and Pakistan (1991). The wealth index was used as the stratifying variable of socioeconomic

status. The corrected concentration index was calculated for each measure of malnutrition for each survey.

The results from this study indicate a positive correlation between the magnitude of the CI and the prevalence of stunting; that is, as the prevalence of stunting increased, so too did the size of CI (Spearman Rank Correlation = -0.27, p=0.014). The study concluded a "pattern of persisting inequalities" of health outcomes; health inequities are neither widening nor narrowing [39]. However, the CI for all the South Asian countries included in the analysis with more than one survey year indicate a widening gap in inequalities. The CI for Bangladesh decreased from -0.175 (SE=0.017) in 1997 to -0.219 (SE=0.016) in 2000 to -0.223 (SE=0.018) in 2007. In India, the CI decreased from -0.172 (SE=0.008) in 1993 to -0.242 (SE=0.007) in 2006. In Nepal, the CI decreased from -0.164 (SE=0.019) in 1996 to -0.196 (SE=0.015) in 2001 to -0.264 (SE=0.027) in 2011.

The authors also point to their methods as taking the temperature of equity, rather than a useful diagnostic tool for policy makers within specific countries. Bredenkamp (2014) suggests that countries may wish to take a deeper dive into the distributions of health outcomes in their specific countries. This suggestion is also made by one of the authors in a previous publication that explores the different ways to describe the distributions of SES inequalities such as "mass deprivation, queuing, and exclusion" [40].

Study #3: Greffeuille et al., 2016

The Greffeuille et al. (2016) study uses DHS data from 4 different surveys that took place in Cambodia between the years of 2000-2014. Stunting and wasting are the health outcome variables of interest in their analysis and the wealth index is used as the SES proxy variable. The

investigators take a non-traditional approach at quantifying the gap in health equity by using logistic regression as the analysis tool of choice. Odds ratios (only comparing the wealthiest to the poorest) were presented for each health outcome variable and for each survey year. Z tests were used to test significance.

This paper is unique to others included in this review because health equity is not the main subject of the paper. Rather, the authors seek to describe trends in stunting and wasting over time. Equity is included as an important part of measuring progress over time. The results of the logistic regression were reported wealthiest-poorest rather than poorest-wealthiest. In the year 2000, the odds of stunting were 0.35 (95% CI: 0.27, 0.46) times lower for children from families in the wealthiest quintile of wealth compared to children from families in the poorest quintiles of wealth. In the year 2014, the odds increased just slightly to OR 0.37 (05% CI: 0.29, 0.48) [35].

Study #4: Pathak & Singh, 2011

The final study in this review is included because it explores the equity of health outcomes in another South Asian country that is not included in the manuscript that follows. The nutritional health outcome of interest in this study is underweight, rather than stunting or wasting. The investigators include three DHS surveys from major regions of India between the years of 1992 and 2006. The wealth index is used as the SES proxy variable for the equity analysis. Pathak & Singh (2011) use a combination of methods to explore and describe health equity. First, they use a poor-rich ratio and the CI as summary statistics of inequality. However, it is unclear whether they have adjusted for the complexities of a dichotomous variable. There is no mention of a Corrected Concentration Index being used. The authors also used a pooled

logistic regression and reported predicted probabilities in lieu of odds ratios. Supplementary, the global hunger index was reported to give context.

The prevalence in underweight decreased across states from 53% in 1992 to 47% in 1998 and stagnated at 46% in 2005/2006. Overall results indicate a higher prevalence of underweight amongst the poorest quintile of society. Moreover, the poorest quintile has seen a slower decline in the prevalence of underweight compared to the wealthiest quintile. The results of suggest widening inequalities between the wealthiest and the poorest in India. Additionally, the authors noted an increased CI in states where the overall prevalence of malnutrition was decreasing markedly [36].

Overall Trends in Nutritional Health for South Asia and Identified Regional Challenges

According to a joint report by the WHO UNICEF and the World Bank, Asia is home to more than half of the world's population of stunted children under five. The number of wasted children in South Asia made up more than half of the worlds wasted children under five in 2014. Most these malnourished children live in India and a very minuscule proportion come from the countries of Bhutan, Maldives, and Sri Lanka. Over the past two decades (1990-2012) South Asia has experienced a decrease in the prevalence of stunting that is on track with the global decline at 38% [41]. The South Asia region (specifically Nepal, Pakistan, India, and Bangladesh) have also experienced improvements in women's education, decreases in open defecation, and improved utilization of healthcare over this time period [42].

The ensuing manuscript focuses on three countries in South Asia: Nepal, Pakistan, and Bangladesh.

Nepal

Nepal is a small landlocked country with a population of 27.8 million [43]. After a decade of conflict, the country reached peace in 2006. Nepal has been relatively stable since. However, the country was disrupted by the catastrophic earthquake in 2015, which devastated and displaced thousands. This small country bordered to the North by China and to the East, South, and West by India is characterized by three distinct ecological zones: mountains (7% of population), hill (43% of population), and terai or plains (50% of population). Kathmandu is the country's capital and also the city with the largest population density [44]. Home to 103 ethnic/cast groups, the population of Nepal is also extremely diverse [43].

As of 2011, one fourth of Nepal's population lives below the poverty line. The life expectancy for women is 60.7 years and 60.1 years for males [44]. The Global Hunger Index (GHI)[1] was 21.9 in Nepal in 2016, which is a large decrease from 36.8 in 2000. The Gini Coefficient[2] has remained relatively stable; it was 32.84 in 2010, up just .03 points since 1995. As a point of reference, the Gini coefficient for India was 35.15 in 2011 and their GHI was 28.5 [5, 16].

Pakistan

Pakistan is a predominantly Muslim nation surrounded to the east and south by India, to the North and Northwest by Afghanistan, to the West by Iran, and to the South by the Arabian Sea. Most the country resides in the three most populous provinces: Punjab (56% of populace), Sindh (23% of populace), and Khyber Pakhtunkhwa (17% of populace). The population of

[1] The Global Hunger Index creates a score based on 4 indicators of malnutrition and hunger. Stunting and Wasting replace the previous indicator of underweight that was formerly used to calculate the GHI. A higher GHI indicates a higher prevalence of hunger.
[2] The Gini Coefficient is a measure of income inequality within a society. The higher the coefficient-- the more unequal the society.

Pakistan was 184.5 million as of 2013 and the 6th most populous country in the world. Due to rapid growth and an inability to support such a large population, the government has been developing strategies of population control [45].

Pakistan has been experiencing a deteriorating state of stability and national security, which has resulted in stunted economic growth across all sectors [45]. Surprisingly, the GHI has actually decreased from 37.8 in 2000 to 33.4 in 2016 [5]. While the country has experienced a decrease in hunger measured by the GHI, it is not a sizable difference and the situation is still dire. The Gini Coefficient has also decreased slightly from 32.51 in 2004 to 30.61 in 2013 [16].

Bangladesh

Bangladesh liberated from Pakistan and became and independent country in 1971. The population is estimated at 158 million, 90% of which are Muslim and 9% Hindi. This country, that is bordered almost exclusively by India, is the most densely populated country in the world with 1,070 people per square kilometer. The economy is primarily made up of industry with agriculture as a close second. The life expectancy of Bangladeshi women is 72 years and 60 years for men [46]. From the years 2000 to 2016, the GHI decreased sizably from 38.5 (which occupied the position above India) to 27.1 [5]. The Gini coefficient has remained relatively stable between 2000 and 2010, increasing only slightly from 33.41 to 32.13 respectively [16].

Equity of Program Coverage and Targeting of MCNH Interventions

Equitable coverage of MCNH interventions has become of particular importance over the past decade in response to the increased interest in the equity gap of health outcomes [6, 19, 47-49]. Many have begun to cast doubt about the equity of the coverage of key interventions, especially in the 20 most undernourished countries. Further, whether the interventions are truly

being targeted to reach the populations that are most in need has been called into question [19]. The evidence suggests that inequities in program coverage have either remained constant or have increased in many countries [49]. Amongst the most inequitable MCNH programs is antenatal care (at least 4 visits) [47]. This has major implications for childhood nutritional outcomes in the first two years of life.

Bibliography

1. Gillespie, S., et al., *The politics of reducing malnutrition: building commitment and accelerating progress.* Lancet, 2013. **382**(9891): p. 552-69.
2. Victora, C.G., et al., *Maternal and child undernutrition: consequences for adult health and human capital.* Lancet, 2008. **371**(9609): p. 340-57.
3. *SUN MOVEMENT Strategy Roadmap 2016-2020*.
4. *Official List of Proposed SDG Indicators*. Available from: https://unstats.un.org/sdgs/indicators/indicators-list/.
5. *The Global Hunger Index*. 2016 March 1, 2017]; Available from: http://www.ifpri.org/topic/global-hunger-index.
6. Ruhago, G.M., F.N. Ngalesoni, and O.F. Norheim, *Addressing inequity to achieve the maternal and child health millennium development goals: looking beyond averages.* BMC Public Health, 2012. **12**: p. 1119.
7. Wagstaff, A., Brendenkamp, Caryn, and Buisman, Leander R., *Progress Toward the Health MDGs: Are the Poor Being Left Behind?*, C. Bredenkampb, Editor. 2014, The World Bank Group: Washington, D.C.
8. Moser, K.A., D.A. Leon, and D.R. Gwatkin, *How does progress towards the child mortality millennium development goal affect inequalities between the poorest and least poor? Analysis of Demographic and Health Survey data.* BMJ, 2005. **331**(7526): p. 1180-2.
9. *Summary measures of socioeconomic inequalities in health*. 2013, Ontario Agency for Health Protection and Promotion (Public Health Ontario): Toronto, ON.
10. Assembly, T.U.N.G., *United Nations Millennium Declaration*. 2000.
11. *Merriam-Webster Dictionary*. 2017 4/5/17]; Available from: https://www.merriam-webster.com/.
12. O'Donnell, O., *Analyzing health equity using household survey data : a guide to techniques and their implementation*. WBI learning resources series. 2008, Washington, D.C.: World Bank. xi, 220 p.
13. World Health Organization., *WHO child growth standards : length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age : methods and development*. 2006, Geneva: World Health Organization. vii, 312 p.
14. *UN Millennium Development Goals*. 4/5/2017]; Available from: http://www.un.org/millenniumgoals/.
15. *UN Sustainable Development Goals*. 4/5/2017]; Available from: https://sustainabledevelopment.un.org/sdgs.
16. *Gini Index*. 2016 March 1, 2017]; Available from: http://data.worldbank.org/indicator/SI.POV.GINI.
17. Bhutta, Z.A., et al., *What works? Interventions for maternal and child undernutrition and survival.* Lancet, 2008. **371**(9610): p. 417-40.
18. Black, R.E., et al., *Maternal and child undernutrition: global and regional exposures and health consequences.* Lancet, 2008. **371**(9608): p. 243-60.
19. Bryce, J., et al., *Maternal and child undernutrition: effective action at national level.* Lancet, 2008. **371**(9611): p. 510-26.

20. Morris, S.S., et al., *Effective international action against undernutrition: why has it proven so difficult and what can be done to accelerate progress?* Lancet, 2008. **371**(9612): p. 608-21.
21. Horton, S. and World Bank., *Scaling up nutrition : what will it cost?* Directions in development Human development. 2010, Washington, D.C.: World Bank. xxx, 100 p.
22. UNICEF., *Improving child nutrition : the achievable imperative for global progress*. 2013, New York: United Nations Children's Fund. iv, 124 pages.
23. Black, R.E., et al., *Maternal and child undernutrition and overweight in low-income and middle-income countries.* Lancet, 2013. **382**(9890): p. 427-51.
24. Ruel, M.T., et al., *Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition?* Lancet, 2013. **382**(9891): p. 536-51.
25. Rutstein, S.O., K. Johnson, and ORC Macro. MEASURE/DHS+ (Programme). *The DHS wealth index*. DHS comparative reports. 2004, Calverton, Md.: ORC Macro, MEASURE DHS+. ix, 71 p.
26. Gwatkin, D.R., A. Wagstaff, and A. Yazbeck, *Reaching the poor with health, nutrition, and population services : what works, what doesn't, and why*. 2005, Washington, DC: The World Bank. xxi, 353 p.
27. Rustein, S.a.S.S., *Making the Demographic and Health Surveys Wealth Index Comparable*, in *DHS Methodological Reports*. 2014, ICF Internationsal: Rockville, Maryland, USA.
28. Smits, J., *The International Wealth Index (IWI)*, R. Steendijk, Editor. 2013, Nijmegen Center for Economics (NiCE), Institute for Management Research, Radboud University Nijmegen: The Netherlands. p. 29.
29. Erreygers, G., *Correcting the concentration index.* J Health Econ, 2009. **28**(2): p. 504-15.
30. Wagstaff, A., E. van Doorslaer, and P. Paci, *On the measurement of horizontal inequity in the delivery of health care.* J Health Econ, 1991. **10**(2): p. 169-205; discussion 247-9, 251-6.
31. Erreygers, G., P. Clarke, and T. Van Ourti, *"Mirror, mirror, on the wall, who in this land is fairest of all?"--Distributional sensitivity in the measurement of socioeconomic inequality of health.* J Health Econ, 2012. **31**(1): p. 257-70.
32. Wagstaff, A., *Socioeconomic inequalities in child mortality: comparisons across nine developing countries.* Bull World Health Organ, 2000. **78**(1): p. 19-29.
33. Wagstaff, A., *Inequality aversion, health inequalities and health achievement.* J Health Econ, 2002. **21**(4): p. 627-41.
34. Wagstaff, A., *The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality.* Health Econ, 2005. **14**(4): p. 429-32.
35. Greffeuille, V., et al., *Persistent Inequalities in Child Undernutrition in Cambodia from 2000 until Today.* Nutrients, 2016. **8**(5).
36. Pathak, P.K. and A. Singh, *Trends in malnutrition among children in India: growing inequalities across different economic groups.* Soc Sci Med, 2011. **73**(4): p. 576-85.
37. Suzuki, E., Sharan, M., and Bos, E. , *Poverty and Health Monitoring Report*. 2012, The World Bank: Washington, D.C.

38. Victora, C.G., et al., *How changes in coverage affect equity in maternal and child health interventions in 35 Countdown to 2015 countries: an analysis of national surveys.* Lancet, 2012. **380**(9848): p. 1149-56.
39. Bredenkamp, C., L.R. Buisman, and E. Van de Poel, *Persistent inequalities in child undernutrition: evidence from 80 countries, from 1990 to today.* Int J Epidemiol, 2014. **43**(4): p. 1328-35.
40. Van de Poel, E., et al., *Socioeconomic inequality in malnutrition in developing countries.* Bull World Health Organ, 2008. **86**(4): p. 282-91.
41. *The World Bank. UNICEF- WHO-World Bank Joint Child Malnutrition Estimates.* 2012, United Nations Childrens Fund, World Health Organization, The World Bank: UNICEF, New York; WHO, Geneva; The World Bank, Washington D.C.
42. Headey, D., J. Hoddinott, and S. Park, *Drivers of nutritional change in four South Asian countries: a dynamic observational analysis.* Matern Child Nutr, 2016. **12 Suppl 1**: p. 210-8.
43. *Nepal- National Population Census* G.o.N. Central Bureau of Statistics- National Planning Comission Secretariat, Editor. 2001: Nepal.
44. *Nepal Demographic and Health Survey* M.o.H.a.P.M. [Nepal], Editor. 2011, Ministry of Health and Population, New ERA, and ICF International, Calverton, Maryland: Kathmandu, Nepal.
45. *Pakistan Demographic and Health Survey 2012-13*, N.I.o.P.S.N.P.a.I. International, Editor. 2013, NIPS and ICF International.: Islamabad, Pakistan, and Calverton, Maryland, USA.
46. *Bangladesh Demographic and Health Survey 2014*, M.a.A. National Institute of Population Research and Training (NIPORT), and ICF International, Editor. 2016, NIPORT, Mitra and Associates, and ICF International.: haka, Bangladesh, and Rockville, Maryland, USA.
47. Barros, A.J., et al., *Equity in maternal, newborn, and child health interventions in Countdown to 2015: a retrospective review of survey data from 54 countries.* Lancet, 2012. **379**(9822): p. 1225-33.
48. Barros, A.J. and C.G. Victora, *Measuring coverage in MNCH: determining and interpreting inequalities in coverage of maternal, newborn, and child health interventions.* PLoS Med, 2013. **10**(5): p. e1001390.
49. Boerma, J.T., et al., *Mind the gap: equity and trends in coverage of maternal, newborn, and child health services in 54 Countdown countries.* Lancet, 2008. **371**(9620): p. 1259-67.

Chapter 3: Manuscript

Prepared for Public Health Nutrition (PHN)

Abstract

Objective Since the advent of the Millennium Development Goals (MDGs), many social scientists and epidemiologists have questioned whether overall prevalence indicators are masking underlying inequities in health outcomes across socioeconomic status. The primary objective of the present study is to analyze the time trends in nutritional health equity for children under five in the South Asia region since the advent of the MDGs. The secondary objective of this paper is to demonstrate alternative options to using summary statistics for inequality. This study provides a template on how to capture the multidimensionality of health equity in a manner that is useful for policy makers and program implementers.

Design We conducted a secondary data analysis of 6 DHS surveys from three countries: Pakistan (1991 and 2013), Bangladesh (1999 and 2014), and Nepal (2001 and 2011). We applied survey weights to obtain overall population estimates of the prevalence of stunting. We used multivariate logistic regression for each survey dataset to obtain odds ratios of stunting in children under the age of five by wealth quintile. To control for cluster design, we used Taylor Series in SAS-callable SUDAAN. Additionally, poor-rich ratios were calculated by dividing the prevalence of undernutrition in children under five from the poorest households by those from the wealthiest households.

Setting DHS surveys from Pakistan (1991 and 2013), Bangladesh (1999 and 2014), and Nepal (2001 and 2011)

Subjects Children under the age of five with plausible height and weight scores

Results Since the advent of the MDGs, the decline in the prevalence of stunting at a national level across all three countries has masked sluggish improvements for children from the poorest households. Moreover, the odds of stunting in all three of the most recent national surveys were significantly close to 4 times higher amongst children from the poorest households compared to the children from the wealthiest households.

Conclusions National level progress has been made in the decline of stunting in Bangladesh, Nepal, and Pakistan since the advent of the MDGs. However, the equity gap in the distribution of poor nutritional health outcomes between children from the poorest and the wealthiest households is widening. We demonstrate through this study the importance of presenting prevalence estimates by wealth quintile. The findings from this study have important implications for a new set of UN development indicators that include stratified estimates of the prevalence of undernutrition.

Keywords

Equity, Stunting, MDGs, SDGs, South Asia, Pakistan, Nepal, Bangladesh

Introduction

The nutrition indicators of the Millennium Development Goals (MDGs) were designed to yield country level estimates of the prevalence of undernutrition for children under the age of five [14]. Over the period of the MDGs, the global prevalence of stunting decreased from 32.7% in 2000 to 23.2% in 2015. Asia showed an even steeper decrease in prevalence from 38% to 24% [41]. These are large improvements in the decline of malnutrition. However, many social scientists and epidemiologists have hypothesized over the last decade that a focus on the decrease in overall prevalence of poor health could be masking disparities between socioeconomic subgroups within countries [6-8] . This hypothesis has important implications for human rights, especially because low socioeconomic status both a predictor and a distal outcome of stunted growth [2].

The South Asia region has experienced a decrease in the prevalence of stunting that is comparable the global reduction (~38%). While large improvements have been made, South Asia still has a very high level of undernutrition. This holds true whether undernutrition is measured using the MDG indicator of low-weight or the preferred indicator of stunting[14, 15, 41]. This region has also experienced improvements over the past decade in women's education, decreases in open defecation, and improved utilization of healthcare [42]. Thus, this makes an interesting case for including a multivariate logistic regression method to determine to what extent a family's wealth is contributing to the inequities of nutritional health outcomes in children under five.

The objective of this paper is to explore time trends of inequities in nutritional status of children under the age of five in three South Asian countries. This study presents evidence that measuring overall prevalence of health indicators to capture progress

toward UN development goals is not sufficient. We also explore a rational for a move away from summary measures of inequality. To provide a comprehensive analysis of the trends in health equity, we present changes in prevalence across all wealth quintiles and uses logistic regression to examine odds ratios for stunting and wasting by socioeconomic status (SES).

This study adds depth to previous conclusions drawn by other authors about the persisting and widening gaps in nutritional health equity for children under five in South Asia [7, 8, 36, 39].

Methods

We conducted a secondary data analysis using 6 DHS surveys from three countries in South Asia: Pakistan (1991 and 2013), Bangladesh (1999 and 2014), and Nepal (2001 and 2011). We included countries from South Asia into our analysis if they had 2 data sets available: a survey pre-MDGs (between the years 1990-2005) and a survey toward the end of the MDGs (between 2010-2015). Additionally, we only included surveys with a Wealth Index variable and anthropometric measurements for children under five (with recodes for new WHO growth standards for stunting).

The present analysis includes data from children under the age of five and their household information. We applied pre-calculated DHS survey weights to produce prevalence estimates that are representative of the populations. DHS utilizes a complex cluster sampling methodology to ensure appropriate representation of subpopulations and regions.

Anthropometry

All DHS surveys include recodes for height-for-age Z scores based on the 2006 WHO growth

standards [50]. We coded children as stunted if their height-for-age Z-score was less than negative two standard deviations below the mean of the reference population. We excluded children from the analysis if they had an anthropometric value that was flagged by DHS reviewers or if their value exceeded the plausible limits for height (45-110 cm for children measured lying down and 65-120 cm for children measured standing up)[50].

Wealth Index

The Wealth Index is used to calculate relative (rather than absolute) inequality. In DHS surveys, Filmer-Pritchett principal component methodology is used to construct the index by applying weights to certain household assets and services such as roofing type and whether the household has a servant. The Wealth Index is calculated at a population level, rather than a household level. Each person (rather than each household) contributes to the calculation of the Wealth Index. Once the index has been calculated, it is broken down into quintiles. Each child is assigned to a wealth a quintile based on their household [25, 27]. It is important to understand that the quintiles of wealth are not quintiles of wealth based on the number of children but rather the population.

We excluded all children with a missing household Wealth Index variable from our analysis.

Familial Sociodemographic Factors

We used Region as the demographic variable for this study. In some cases, regions within a country have been re-drawn from one survey year to another. In Bangladesh, we combined the new division of Rangpur with Rajshahi to reflect the previously defined regions for consistency with 1999 divisions. This was not possible with Pakistan and the regions that we have included

in the analyses for the different survey years remain unique to what is defined in each survey year.

We included Mother's Educational Status in this study to provide an additional SES variable. Based on self-reports, mothers were classified as having completed no education, primary education, secondary education, or higher.

Child Characteristics

We also included Sex, Age in Months, and Birth Order as additional characteristics of interest of each child for this study.

Analytical Approaches

We performed all statistical analysis using SAS-callable SUDAAN in SAS 9.2. We controlled for multiple cluster design in the analysis by using the Taylor Series estimation method.

We utilized the Concentration Curve as a visual representation of the trends in health equity. This curve plots the cumulative concentration of stunting against the cumulative concentration of the population by wealth quintile. In a perfectly equal society, where stunting was distributed evenly across all quintiles of wealth, the line would fall on a 45-degree axis of equality. If the line plotted for a given survey year falls above the line of equality, there is a greater proportion of the health burden that is concentrated amongst the poor [12, 30, 33]. When we graph two survey years on the same graph, we can determine whether inequality is greater one year over the other using the Test of Dominance. If the lines do not cross and one line lies above the other, that population is said to be more unequal [12, 33].

We estimated overall weighted means of stunting, as well as weighted means stratified by wealth quintile to examine prevalence estimates. We used rich-poor ratios to represent a relative gap in the inequality of stunting between children from the poorest and the wealthiest quintiles of household wealth. This ratio is calculated by dividing the percentage of children in the poorest quintile who are stunted by the percentage of children from the wealthiest quintile who are stunted [51]. Additionally, we examined the absolute percent decrease in stunting by wealth quintile. We conducted multivariate logistic regression to produce odds ratios of stunting by wealth quintile. We conducted separate analyses were done for stunting by wealth quintile in each survey year for each country; the analysis was not pooled. Unless otherwise noted, all odds ratios presented in the ensuing sections are adjusted for the variables included in this study.

Results

Key Findings:

The national prevalence of stunting decreased across Bangladesh, Nepal and Pakistan over the period of the MDGs. In each country, the wealthiest 60% (the upper 3 quintiles of wealth) saw larger decreases in prevalence of stunting compared to the bottom 40% (the lower 2 quintiles of wealth). In Bangladesh and Pakistan, the largest improvements were seen in the middle quintile of wealth. The odds of stunting are close to 4 times as high for children from the poorest households compared to children from the wealthiest households in all three of the most recent national surveys. These findings were significant in each country. However, we are not confident that the odds ratios have increased over time because all the confidence intervals overlap for the two-time periods for each country. Finally, poor-rich ratios have increased across all three countries.

Figures 1, 2, and 3 show the cumulative concentration of the health burden of stunting by wealth quintile (Y axis) plotted against the cumulative concentration of the population (X axis) for each country included in the analysis. In Bangladesh, Nepal, and Pakistan the health burden of stunting is disproportionately concentrated among children from families in the poorest quintiles of wealth in each country and for each survey year. Further, the graphs show that the inequality in the distribution of stunting is widening in all three countries over time. The following paragraphs explore the patterns in these inequities in the distribution of stunting by wealth quintile.

Bangladesh

Overall Prevalence. The prevalence of stunting in Bangladesh decreased from 51.5% in 1999 to 36.6% in 2014.

Prevalence by Wealth Quintile. Bangladesh has seen a sizeable decrease in the prevalence of stunting from 1999 to 2014. However, the magnitude of the decrease varies greatly by wealth quintile (Figure 4). The smallest decline in prevalence of stunting was in the poorest quintile of wealth. In 1999, we estimate that 61.8% of children under the age of five from families in the bottom quintile of wealth had stunted growth. In 2014, the prevalence of stunting for children from the poorest households is estimated to be 49.5%. This is higher than the national average of stunting for children under five in Bangladesh (36.6%) in 2014 and is very close to the prevalence that was seen in the wealthiest quintile almost 15 years prior (51.5%). The percent decrease of stunting for children from families within the poorest quintile of wealth was 19.9% from 1999 to 2014. The percent decrease of stunting for children from families within the wealthiest quintile of wealth was 38.0% from 1999 to 2014.

Poor-Rich Ratios. The poor-rich ratio for stunting in 1999 was 1.95. In 2014, the poor-rich ratio increased to 2.53. This result stems from an accelerated decrease in prevalence amongst children from families in the top wealth quintile compared to the bottom quintile of wealth.

Odds Ratios. In 2014, the odds of stunting were 3.78 (95% CI: 2.47, 5.78) times higher for children from the poorest households compared to children from the wealthiest households. In 1999, the odds of stunting were 2.35 (95% CI: 1.57, 3.52) times higher for children from the poorest households compared to children from the wealthiest households (Table 2). Since the 95% confidence intervals overlap across these years, it is difficult to say whether there has been a significant change in these estimates since the advent of the MDGs.

Nepal

Overall Prevalence. The overall prevalence of stunting in Nepal has declined from 56.9% in 2001 to 40.8% in 2011.

Prevalence by Wealth Quintile. The prevalence of stunting in children under the age of five has decreased across all household wealth quintiles except for the poorest (Figure 5). In 2011, we estimate that 56.3% of children from the poorest 20% of households were stunted. This is a slight increase from 56.1% in 2001. The next smallest decrease in prevalence was in the second poorest wealth quintile (56.1% in 2001 to 45.6% in 2011). The prevalence of stunting within this subgroup still exceeds the national prevalence estimate. The largest decrease in prevalence in a wealth quintile was among children from the wealthiest 20% of households. There was a decline from 2001 prevalence estimates of 59.8% to the most recent estimates of 25.3%. The percent change of stunting for children from families within the poorest quintile of wealth was an

increase of 0.36% from 2001 to 2011. The percent decrease of stunting for children from families within the wealthiest quintile of wealth was 57.7% from 2001 to 2011.

Poor-Rich Ratios. The poor-rich ratio for stunting in Nepal increased from 0.94 in 2001 to 2.23 in 2011. This increase is attributable to a large decrease in the prevalence of stunting in the top quintile of wealth and no improvement in the lowest quintile.

Odds Ratios. Findings for Nepal indicate the odds of stunting for a child under the age of five from a household in the lowest quintile compared to the highest quintile of wealth were not significant in 2001(OR= 1.08; (95% CI: 0.63, 1.86)). In 2011, the odds ratio was significant but the confidence intervals were wide (OR=3.92; (95% CI: 1.71, 9.00) (Table 3). We are not confident that the change in odds ratios between 2001 and 2011 are reflective of a true increase since the confidence intervals between the two time periods cross.

Pakistan

Overall Prevalence. The national prevalence estimates of stunting in children under the age of five in Pakistan has declined from 54.5% in 1991 to 44.6% in 2013.

Prevalence by Wealth Quintile. In alignment with the pattern seen in Bangladesh and Nepal, the smallest decrease in prevalence of stunting over the MDG period occurred in the subgroup of children from the poorest 20% of households (Figure 6). Moreover, the 2013 prevalence estimates for children from the poorest 40% of households (61.9% in quintile 1 and 56.0% in quintile 2) are much higher than the national prevalence estimates of 44.6%. The largest decline in stunting prevalence occurred for the group of children from households in wealth quintile 3. The percent change of stunting for children from families within the poorest quintile of wealth

decreased by 3.8% from 2001 to 2011. The percent decrease of stunting for children from families within the wealthiest quintile of wealth was 40.8% from 2001 to 2011.

Poor-Rich Ratios. The Poor-rich ratio for stunting in Pakistan in 1991 was 1.65. This ratio increased to 2.68 in 2013. This increase is due to a small decrease in the prevalence within the bottom quintile of wealth and a larger decrease for children from the wealthiest quintile.

Odds Ratios. In Pakistan, the odds of stunting in 1991 for a child under the age of five from a household in the lowest quintile of wealth was 2.74 (95% CI: 1.55, 4.86) times higher than the odds of stunting for a child from a household in the top wealth quintile. In 2014, the odds of stunting for a child from a household in the poorest quintile of wealth was 4.64 (95% CI: 2.63, 9.13) times higher than the odds of stunting for a child from a household in the top wealth quintile. The estimates from 2013 should be interpreted with caution, as the confidence intervals are very wide (Table 4).

Discussion

Our study explored the time trends in the inequities of the distribution of stunting in children under the age of five in three South Asian countries. To our knowledge, this analysis is the first to examine trends in the equity of the distribution of stunting across wealth quintiles using the two most recent DHS surveys from Pakistan and Bangladesh. We found that the equity gap in undernutrition has widened since the advent of the MDGs in Bangladesh, Nepal, and Pakistan. Across all three countries, a large decrease in the national prevalence estimates masked a much slower decline in the prevalence of stunting in children who are from the poorest 40% of households.

We used a variety of measures to capture the multidimensionality of health inequality and found that the pattern of the inequities behind the widening gap differed in each of the three countries. In Bangladesh, the relative difference in the prevalence of stunting between children from the poorest household and children from the wealthiest households remained constant between 1999 and 2014. There was about a 30%-point difference in the prevalence of stunting between the rich and the poor in each year. However, if we look at the percent change in the decline within wealth quintiles from year to year, the wealthiest 20% experienced a much larger objective decrease in prevalence. There was a 38.0% decline in stunting in children from the wealthiest quintile of households compared to 19.9% decline in children from the poorest quintile of households. In Nepal, there was a slight increase in the prevalence of stunting for children from the poorest quintile of wealth. Conversely, there was a very large decrease in the prevalence of stunting for children from household in the wealthiest quintile. In Pakistan, the prevalence of stunting decreased across all quintiles of wealth but the largest decrease was in children from the wealthiest quintile.

In public health, what we measure is what gets funded. The UN development goal indicators give reason for concern about what is happening to the health of the poorest and hardest to reach populations. Both the MDGs and the SDGs use overall prevalence indicators to monitor progress toward the nutritional health goals [14, 15]. This is problematic, as demonstrated in this study, because overall prevalence measures can mask health disparities that are persisting or increasing amongst the most vulnerable subpopulations. The magnitude of the importance of the indicators of UN development goals can be demonstrated by looking at the table listed in the first few pages of every national DHS report published over the period of the MDGs. There is a table at the

beginning of each report that preambles the introduction to show how each country is progressing (page xxiii) [44-46]. The UN development goal indicators guide policy and programs.

This study highlights the importance of using a variety of methods to explore the inequities in health outcomes across the different wealth quintiles. Previous studies conducted on the equity of nutritional health outcomes rely heavily on summary measures, such as the Concentration Index (CI) [7, 36, 39, 40]. Wagstaff (1991) and others have acclaimed the CI as a superior measure of the representation of inequality for its ability to capture socioeconomic inequalities and summarize them into an index within a country[30]. However, summary measures can only provide a synopsis of how the country is doing as a whole [39, 40]. The change in value of the CI means very little unless it is being compared across regions or over time. For example, the difference between a CI of 0.61 and 0.53 is only meaningful if it is being presented as a decrease over time in the total inequality. A summary index does not have the ability to show a pattern in the inequality that is persisting, growing, or decreasing within and across different SES subgroups [40]. The interpretation of these measures is ambiguous and lacks a sense of urgency to act when national prevalence estimates look so favorable. There are specific patterns that arise by looking specifically at stratified prevalence estimates by wealth quintile across time that provide valuable insight and an urgency for policy makers and program implementers.

The major strength of the present study is that it utilizes a variety of measures to describe inequity to provide a full picture of the trends in health equity. However, we were limited in our analysis to the data made publicly available by the DHS in each country. In

Pakistan, the period between surveys is 22 years and in Nepal it is only 10 years. Due to the limited number of countries included in this analysis and the wide variation in the time periods analyzed, the inferences as to the cause of the widening disparities should be made with caution.

The increasing disparity presented in this study could be the result of a variety of factors. One of these factors may be public health intervention strategies designed to make large improvements in health quickly by targeting easy to reach subpopulations. This type of targeting strategy creates gaps in the equity of coverage between the wealthiest and the poorest subpopulations within a country [49]. To ensure that the most underserved populations are being reached, the development indicators must be specific to different socioeconomic groups. Monitoring progress by SES subgroup may help to ensure a more equitable targeting strategy of public health resources.

Conclusion

This study builds upon previous research done in the field of health equity and provides additional evidence for the need to incorporate indicators stratified by wealth in the UN development goals. The results from this analysis indicate a need for pro-poor targeting strategies to address undernutrition among children from the poorest households. Undernutrition in the first 1,000 days of life have lifelong cognitive, physical, and economical repercussions for children [2, 18]. Addressing the equity gap in the prevalence of stunting and wasting between the wealthy and the poor is a human rights issue and should be treated with such urgency.

Table 1. Surveys Included in the Analysis

Country	Year	Sample Size
Bangladesh	1998	5,351
	2014	6,965
Pakistan	1991	4,043
	2014	3,071
Nepal	2001	5,058
	2011	2,335

Table 2. Odds Ratios: Stunting for Children Under Five in Bangladesh by Wealth Quintile

Odds Ratios: Stunting Bangladesh				
Quintiles of Wealth	**1999**		**2014**	
	OR	**95% CI**	**OR**	**95% CI**
1	2.35	1.57, 3.52	3.78	2.47, 5.78
2	1.65	1.13, 2.40	3.65	2.44, 5.47
3	1.95	1.34, 2.85	2.38	1.51, 3.74
4	1.38	0.92, 2.08	2.43	1.59, 3.71
5	(REF)	(REF)	(REF)	(REF)

Table 3. Odds Ratios: Stunting for Children Under Five in Nepal by Wealth Quintile

Odds Ratios: Stunting Nepal				
Quintiles of Wealth	**2001**		**2011**	
	OR	**95% CI**	**OR**	**95% CI**
1	1.08	0.63, 1.86	3.92	1.71, 9.00
2	0.85	0.52, 1.38	2.22	0.91, 5.40
3	0.99	0.62, 1.57	1.98	0.88, 4.45
4	0.73	0.48, 1.13	1.16	0.48, 2.81
5	(REF)	(REF)	(REF)	(REF)

Table 4. Odds Ratios: Stunting for Children Under Five in Pakistan by Wealth Quintile

Odds Ratios: Stunting Pakistan				
Quintiles of Wealth	**1991**		**2013**	
	OR	**95% CI**	**OR**	**95% CI**
1	2.74	1.55, 4.86	4.64	2.36, 9.13
2	2.78	1.59, 4.86	3.58	1.77, 7.25
3	2.70	1.57, 4.67	1.72	0.89, 3.35
4	1.44	0.90, 2.30	1.63	0.84, 3.16
5	(REF)	(REF)	(REF)	(REF)

Figure 1.

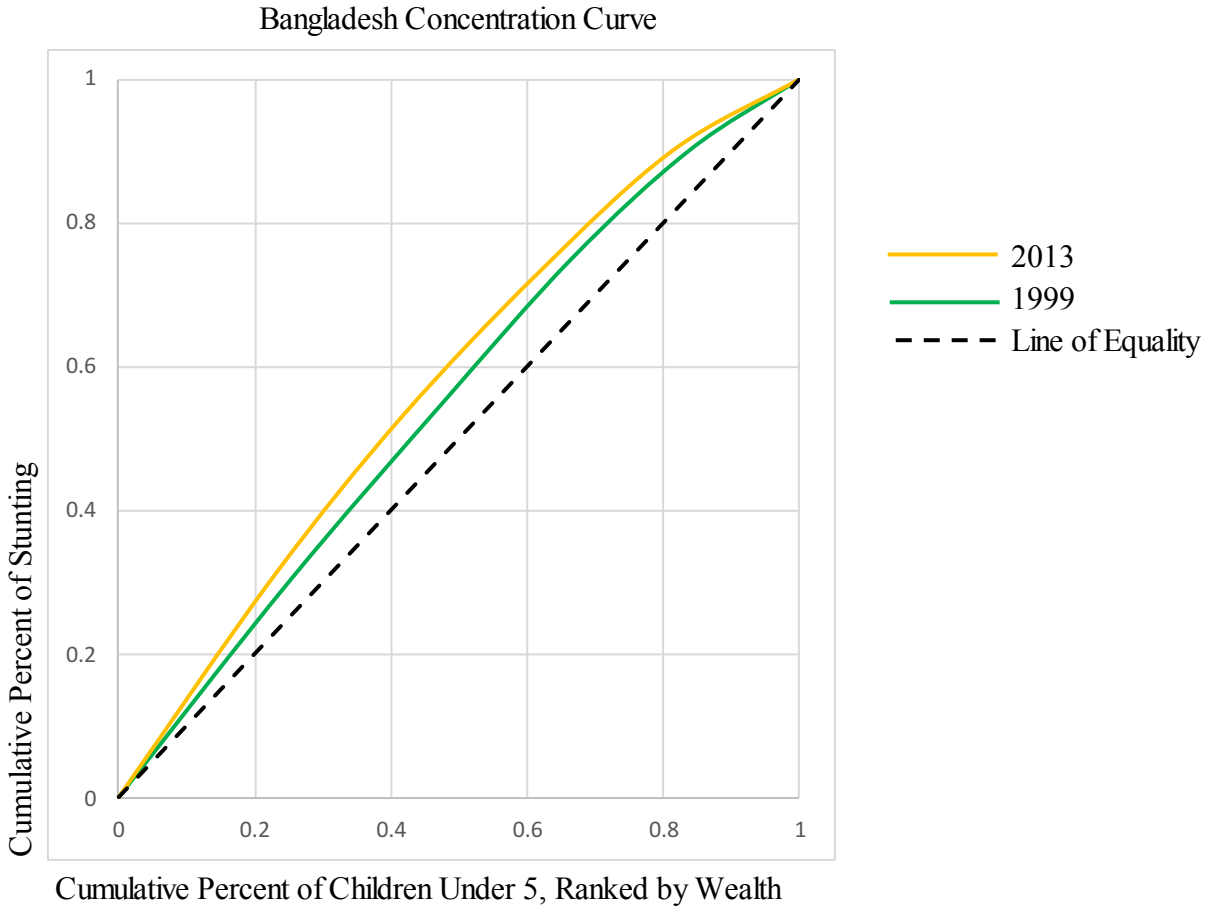

Bangladesh Concentration Curve
Cumulative Percent of Stunting
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
Cumulative Percent of Children Under 5, Ranked by Wealth
2013
1999
Line of Equality

Figure 2.

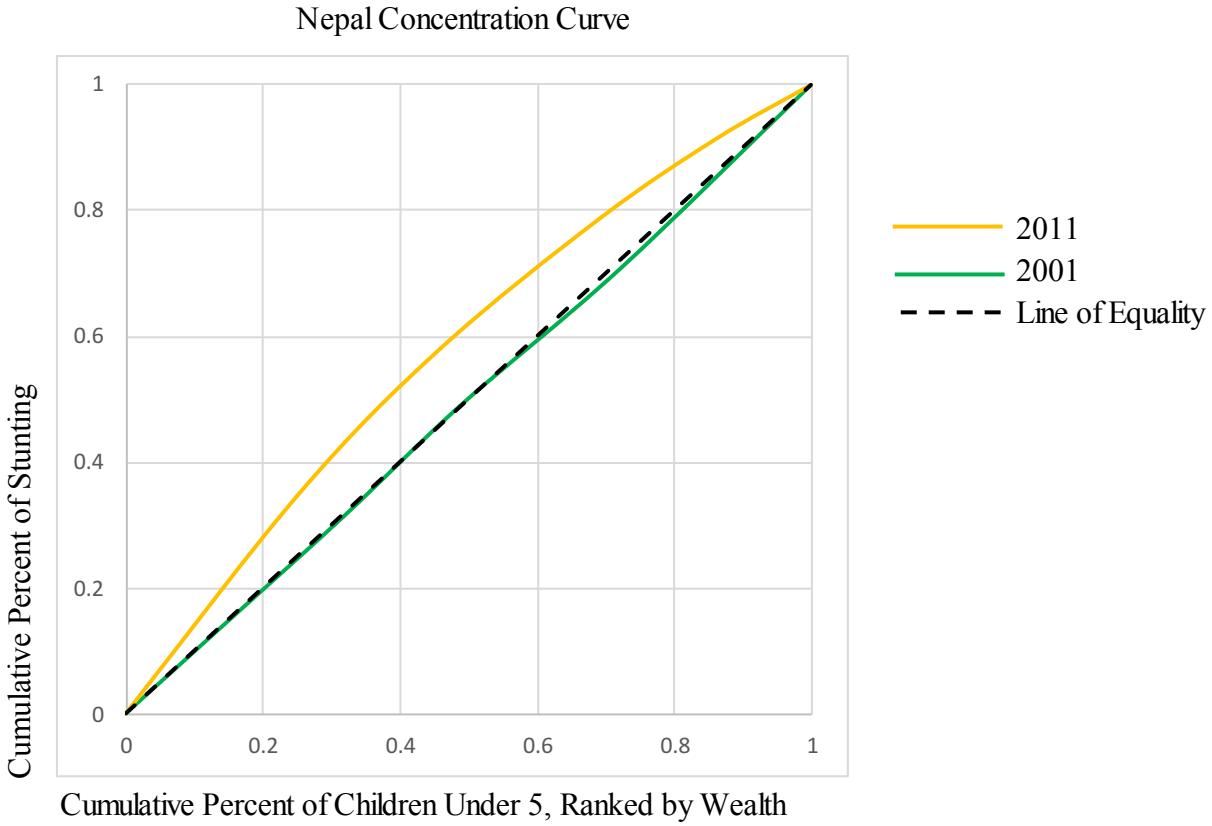

Nepal Concentration Curve
Cumulative Percent of Stunting
0
0.2
0.4
0.6
0.8
1
Cumulative Percent of Children Under 5, Ranked by Wealth
2011
2001
Line of Equality

Figure 3.

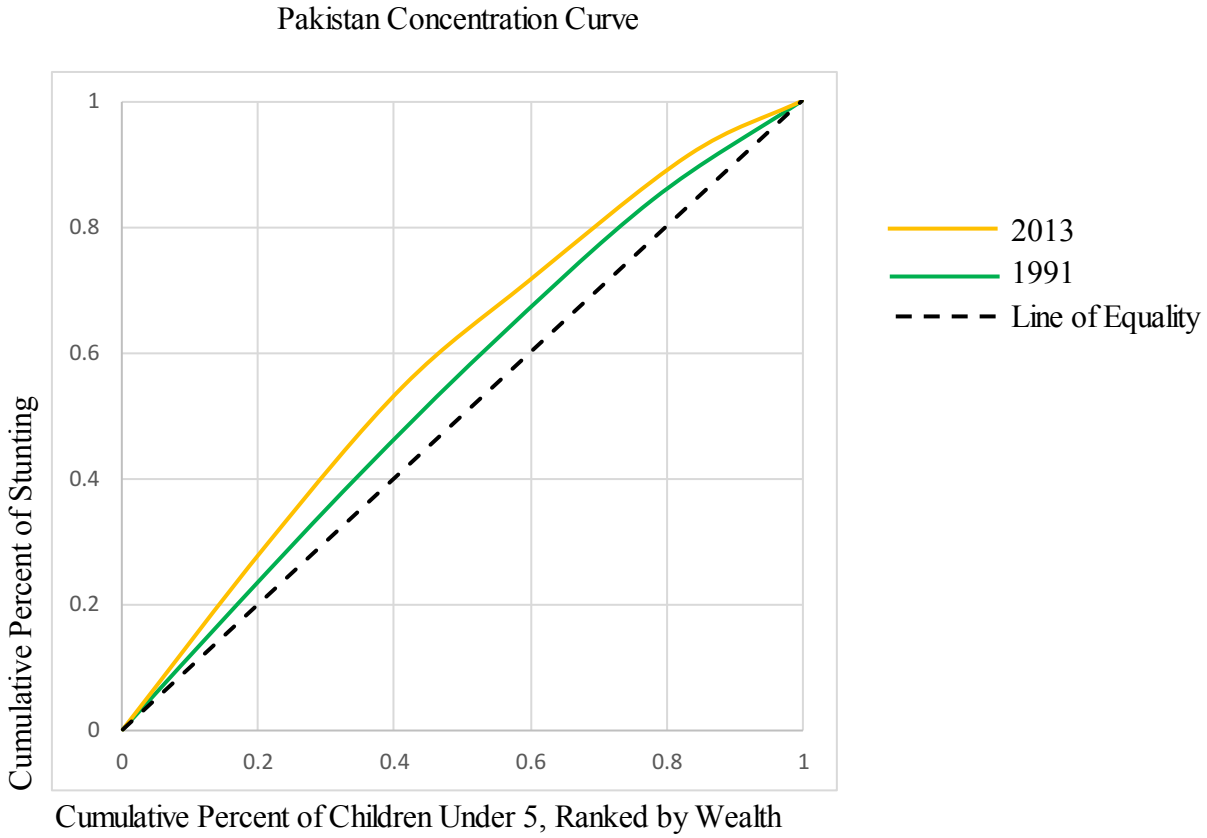

Pakistan Concentration Curve
Cumulative Percent of Stunting
0
0.2
0.4
0.6
0.8
1
Cumulative Percent of Children Under 5, Ranked by Wealth
2013
1991
Line of Equality

Figure 4.

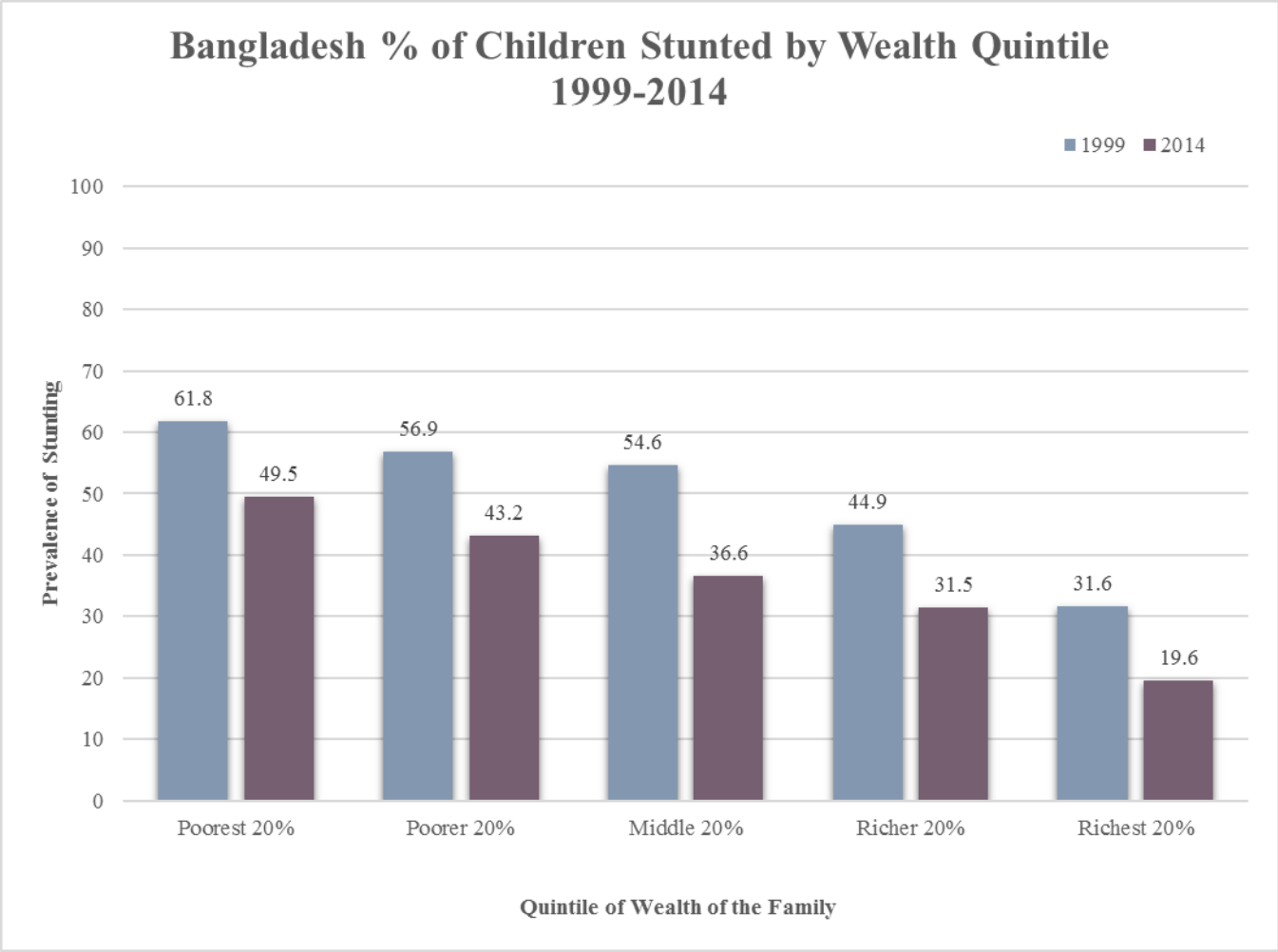

Bangladesh % of Children Stunted by Wealth Quintile 1999-2014
1999
2014
Prevalence of Stunting
100
90
80
70
60
50
40
30
20
10
0
61.8
49.5
56.9
43.2
54.6
36.6
44.9
31.5
31.6
19.6
Poorest 20%
Poorer 20%
Middle 20%
Richer 20%
Richest 20%
Quintile of Wealth of the Family

Figure 5.

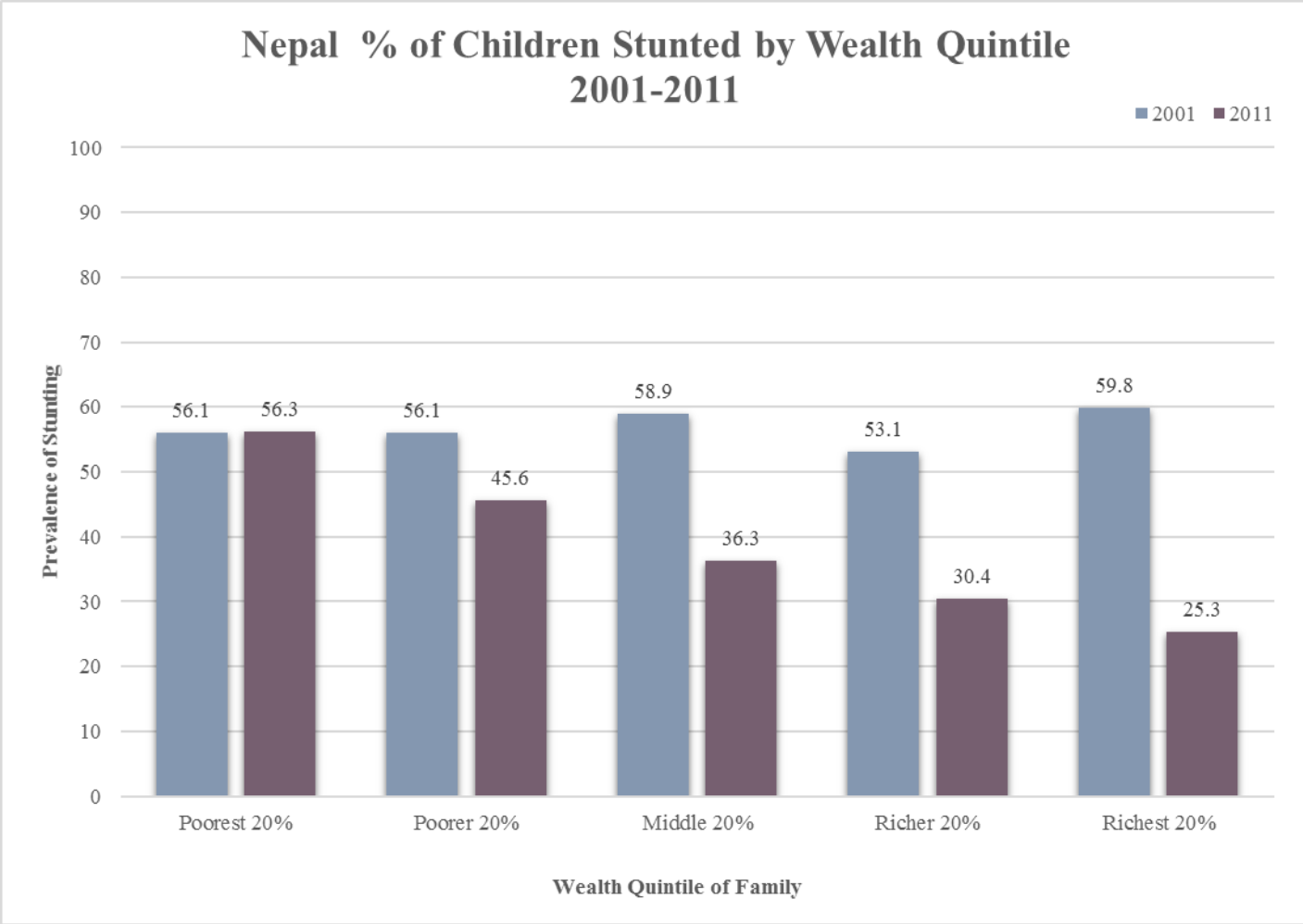
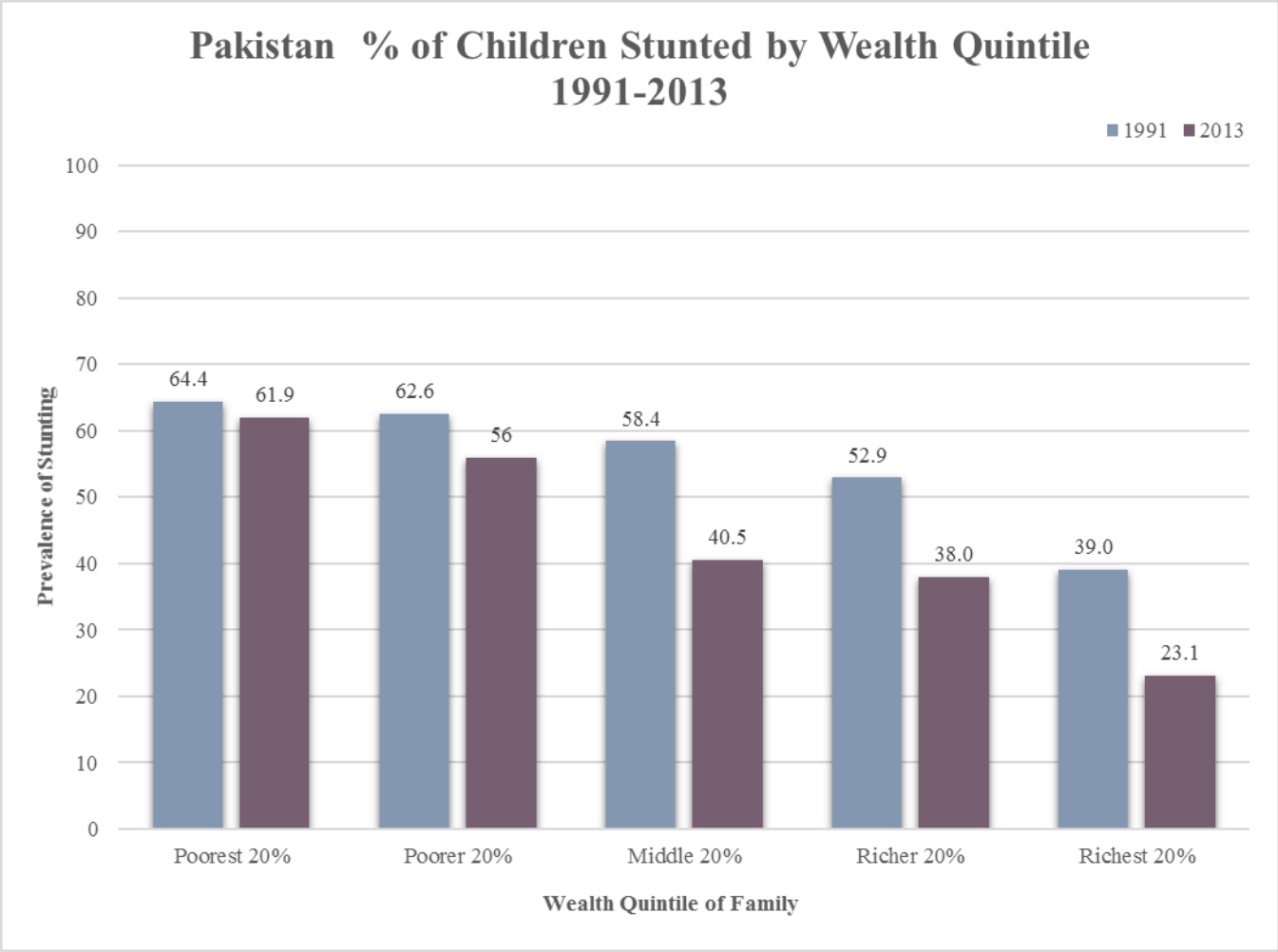

Nepal % of Children Stunted by Wealth Quintile 2001-2011
2001
2011
Prevalence of Stunting
100
90
80
70
60
50
40
30
20
10
0
56.1
56.3
56.1
45.6
58.9
36.3
53.1
30.4
59.8
25.3
Poorest 20%
Poorer 20%
Middle 20%
Richer 20%
Richest 20%
Wealth Quintile of Family

Figure 6.


Pakistan % of Children Stunted by Wealth Quintile 1991-2013
1991
2013
Prevalence of Stunting
100
90
80
70
60
50
40
30
20
10
0
64.4
61.9
62.6
56
58.4
40.5
52.9
38.0
39.0
23.1
Poorest 20%
Poorer 20%
Middle 20%
Richer 20%
Richest 20%
Wealth Quintile of Family

Bibliography

1. *UN Millennium Development Goals*. 4/5/2017]; Available from: http://www.un.org/millenniumgoals/.
2. *The World Bank. UNICEF- WHO-World Bank Joint Child Malnutrition Estimates.* 2012, United Nations Childrens Fund, World Health Organization, The World Bank: UNICEF, New York; WHO, Geneva; The World Bank, Washington D.C.
3. Moser, K.A., D.A. Leon, and D.R. Gwatkin, *How does progress towards the child mortality millennium development goal affect inequalities between the poorest and least poor? Analysis of Demographic and Health Survey data.* BMJ, 2005. **331**(7526): p. 1180-2.
4. Wagstaff, A., Brendenkamp, Caryn, and Buisman, Leander R., *Progress Toward the Health MDGs: Are the Poor Being Left Behind?*, C. Bredenkampb, Editor. 2014, The World Bank Group: Washington, D.C.
5. Ruhago, G.M., F.N. Ngalesoni, and O.F. Norheim, *Addressing inequity to achieve the maternal and child health millennium development goals: looking beyond averages.* BMC Public Health, 2012. **12**: p. 1119.
6. Victora, C.G., et al., *Maternal and child undernutrition: consequences for adult health and human capital.* Lancet, 2008. **371**(9609): p. 340-57.
7. *UN Sustainable Development Goals*. 4/5/2017]; Available from: https://sustainabledevelopment.un.org/sdgs.
8. Headey, D., J. Hoddinott, and S. Park, *Drivers of nutritional change in four South Asian countries: a dynamic observational analysis.* Matern Child Nutr, 2016. **12 Suppl 1**: p. 210-8.
9. Bredenkamp, C., L.R. Buisman, and E. Van de Poel, *Persistent inequalities in child undernutrition: evidence from 80 countries, from 1990 to today.* Int J Epidemiol, 2014. **43**(4): p. 1328-35.
10. Pathak, P.K. and A. Singh, *Trends in malnutrition among children in India: growing inequalities across different economic groups.* Soc Sci Med, 2011. **73**(4): p. 576-85.
11. Shireen Assaf, M.T.K., and Thomas Pullum, *An Assessment of the Quality of DHS Anthropometric Data, 2005-2014*, in *DHS Methodological Reports 16*, S. Moore, Editor. 2015, ICF International Maryland, USA.
12. Rustein, S.a.S.S., *Making the Demographic and Health Surveys Wealth Index Comparable*, in *DHS Methodological Reports*. 2014, ICF Internationsal: Rockville, Maryland, USA.
13. Rutstein, S.O., K. Johnson, and ORC Macro. MEASURE/DHS+ (Programme). *The DHS wealth index*. DHS comparative reports. 2004, Calverton, Md.: ORC Macro, MEASURE DHS+. ix, 71 p.
14. O'Donnell, O., *Analyzing health equity using household survey data : a guide to techniques and their implementation*. WBI learning resources series. 2008, Washington, D.C.: World Bank. xi, 220 p.
15. Wagstaff, A., *Inequality aversion, health inequalities and health achievement.* J Health Econ, 2002. **21**(4): p. 627-41.
16. Wagstaff, A., E. van Doorslaer, and P. Paci, *On the measurement of horizontal inequity in the delivery of health care.* J Health Econ, 1991. **10**(2): p. 169-205; discussion 247-9, 251-6.

17. Wagstaff, A., P. Paci, and E. van Doorslaer, *On the measurement of inequalities in health.* Soc Sci Med, 1991. **33**(5): p. 545-57.
18. *Bangladesh Demographic and Health Survey 2014*, M.a.A. National Institute of Population Research and Training (NIPORT), and ICF International, Editor. 2016, NIPORT, Mitra and Associates, and ICF International.: haka, Bangladesh, and Rockville, Maryland, USA.
19. *Nepal Demographic and Health Survey* M.o.H.a.P.M. [Nepal], Editor. 2011, Ministry of Health and Population, New ERA, and ICF International, Calverton, Maryland: Kathmandu, Nepal.
20. *Pakistan Demographic and Health Survey 2012-13*, N.I.o.P.S.N.P.a.I. International, Editor. 2013, NIPS and ICF International.: Islamabad, Pakistan, and Calverton, Maryland, USA.
21. Van de Poel, E., et al., *Socioeconomic inequality in malnutrition in developing countries.* Bull World Health Organ, 2008. **86**(4): p. 282-91.
22. Boerma, J.T., et al., *Mind the gap: equity and trends in coverage of maternal, newborn, and child health services in 54 Countdown countries.* Lancet, 2008. **371**(9620): p. 1259-67.
23. Black, R.E., et al., *Maternal and child undernutrition: global and regional exposures and health consequences.* Lancet, 2008. **371**(9608): p. 243-60.

Appendix A: Extended Tables and Figures

Table 1A. Cross-tabulations Full Table: Bangladesh

Bangladesh								
	Sample Size		Weghted N (%)		Weghted Stunting N (row%, col %)		Weghted Wasting N (row%, col%)	
	1998	2014	1998	2014	1998	2014	1998	2014
Age								
0-11 mo	1109	1344	1140.6 (21.0)	1,407.2 (19.6)	319.7 (28.0, 11.4)	247.7 (17.6, 19.5)	175.5 (15.4, 25.6)	269.2 (19.1, 25.6)
12-23 mo	1129	1456	1140.1 (21.0)	1,541.7 (21.5)	621.5 (54.5, 22.2)	600.2 (38.9, 22.9)	207.3 (18.2, 30.2)	236.6 (15.4, 22.5)
24-35 mo	1036	1405	1043.9 (19.2)	1,405 (19.8)	645.8 (61.9, 23.1)	592.7 (41.6, 22.6)	103.6 (9.9, 15.1)	185.2 (13.0, 17.6)
36-47 mo	991	1377	1008.1 (18.5)	1,377 (19.5)	628.1 (62.3, 22.4)	636.1 (45.4, 24.3)	93.2 (9.3, 13.6)	167.8 (12.0, 16.0)
48-59 mo	1086	1383	1103.6 (20.3)	1,400.3 (19.5)	586.2 (53.1, 20.9)	544.8 (38.9, 20.8)	106.1 (9.6, 15.5)	193.0 (13.8, 18.4)
Sex of Child								
Female	2639	3394	2680.3 (49.3)	3,452.8 (48.1)	1373.2 (52.2, 49.0)	1,237.8 (35.9, 47.2)	317.0 (11.8, 46.2)	481.0 (13.9, 45.7)
Male	2712	3571	2755.9 (50.7)	3,719.9 (51.9)	1428.1 (51.8, 50.1)	1,383.7 (37.2, 52.8)	368.7 (13.4, 53.8)	570.7 (15.3, 54.3)
Wealth Index Quintile								
Poorest 20%	1247	1515	1365.7 (25.1)	1,629 (22.7)	844.2 (61.8, 30.1)	805.6 (49.5, 30.7)	224.0 (16.4, 32.7)	284.6 (17.5, 27.1)
Poorer 20%	1106	1307	1202.9 (22.1)	1,349.5 (18.8)	684.0 (56.9, 24.4)	582.9 (43.2, 22.2)	167.3 (13.9, 24.4)	227.9 (16.9, 21.7)
Middle 20%	997	1379	1049.8 (19.3)	1,421 (19.8)	573.5 (54.6, 20.5)	520.3 (36.6, 19.9)	121.0 (11.5, 17.7)	187.9 (13.2, 17.9)
Richer 20%	919	1420	939.7 (17.3)	1,420 (19.9)	422.1 (44.9, 15.1)	449.3 (31.5, 17.1)	206.6 (11.4, 15.6)	191.9 (13.4, 18.2)
Richest 20%	1082	1344	878.1 (16.2)	1,345.2 (18.8)	277.2 (31.6, 9.9)	263.5 (19.6, 10.1)	66.8 (7.6, 9.8)	159.5 (11.9, 15.2)
Mothers Highest Year of Education								
No Education	2385	1934	2524.3 (46.4)	1,169.5 (16.3)	1494.4 (59.2, 53.4)	557.7 (47.7, 21.3)	372.6 (14.8, 54.3)	177.0 (15.1, 16.8)
Primary	1559	3219	1583.8 (29.1)	2,008 (28.0)	840.1 (53.1, 30.0)	887.2 (44.2, 33.8)	187.9 (11.9, 27.4)	318.0 (15.8, 30.2)
Secondary	1150	736	1120.5 (20.6)	3,323 (46.3)	424.2 (37.9, 15.1)	1,043 (31.4, 39.8)	107.4 (9.6, 15.7)	471.2 (14.2, 44.8)
Higher	257	1076	207.6 (3.8)	671.1 (9.4)	42.6 (20.5, 1.5)	133.1 (19.8, 5.1)	17.9 (8.6, 2.6)	85.6 (12.8, 8.1)
Region								
Barisal	469	812	333.6 (6.1)	411.8 (5.7)	175.5 (52.6, 6.3)	165.4 (40.2, 6.3)	44.8 (13.4, 6.5)	73.0 (17.7, 7.0)
Chittagong	1166	1320	1204.7 (22.2)	1,516.4 (21.1)	637.2 (52.9, 22.8)	579.9 (38.2, 22.1)	151.6 (12.6, 22.1)	242.9 (16.0, 23.1)
Dhaka	1287	1213	1703.6 (31.3)	2,517 (35.1)	878.2 (51.6, 31.4)	869.1 (34.5, 33.2)	204.3 (12.0, 29.8)	309.3 (12.3, 29.4)
Khulna	796	774	562.6 (10.4)	546.2 (7.6)	257.1 (45.7, 9.2)	153.6 (28.1, 5.9)	62.0 (11.0, 9.1)	75.6 (13.8, 7.2)
Rajshahi	942	875	1233.1 (22.7)	754.8 (10.5)	608.9 (49.4, 21.7)	235.5 (31.2, 9.0)	168.6 (13.7, 24.6)	134.9 (17.9, 12.8)
Rangpur	n/a	865	n/a	728.0 (10.2)	n/a	269.4 (37.0, 10.3)	n/a	130.6 (17.9, 12.4)
Sylhet	691	1106	398.7 (7.3)	698.2 (9.7)	244.4 (61.3, 8.7)	348.5 (49.9, 13.3)	54.5 (13.7, 7.9)	85.5 (12.2, 8.1)
Birth Order Number								
1	1524	2700	1537.6 (28.3)	2,754 (38.4)	792.0 (51.5, 28.3)	884.1 (32.1, 33.7)	179.3 (11.7, 23.7)	397.7 (14.4, 37.8)
2	1364	2091	1383.6 (25.5)	2,154.9 (30.0)	673.7 (48.7, 24.1)	774.2 (35.9, 29.5)	162.4 (11.7, 23.7)	325.5 (15.1, 31.0)
3	898	1104	917.8 (16.9)	1,174.4 (16.4)	434.2 (47.3, 15.5)	437.8 (37.3, 16.7)	114.6 (12.5, 16.7)	166.1 (14.1, 15.8)
4	569	547	587.5 (10.8)	577.0 (8.0)	320.9 (54.6, 11.5)	259.6 (45.0, 9.9)	86.7 (14.8, 12.6)	75.0 (13.0, 7.1)
5	378	256	377.5 (6.9)	249.3 (3.5)	215.9 (58.2, 7.7)	123.9 (49.7, 4.7)	54.9 (14.6, 8.0)	26.2 (18.6, 4.4)
6	248	141	249.2 (4.6)	135.4 (1.9)	126.0 (50.6, 4.5)	67.9 (50.1, 2.6)	29.2 (11.7, 4.3)	26.7 (19.7, 2.5)
7	173	65	177.4 (3.3)	69.8 (1.0)	104.8 (59.1, 3.7)	44.6 (63.9, 1.7)	27.2 (15.3, 4.0)	9.8 (14.1, 0.9)
8	95	29	96.5 (1.8)	26.5 (0.4)	60.9 (63.2, 2.2)	13.6 (51.5, 0.5)	13.6 (14.1, 2.0)	2.3 (8.3, 0.2)
9	51	18	52.5 (1.0)	17.8 (0.3)	38.4 (73.2, 1.4)	7.8 (43.9, 0.3)	8.5 (16.1, 1.2)	1.1 (6.3, 0.1)
10	31	9	33.4 (0.6)	7.1 (0.1)	20.4 (61.0, 0.7)	4.5 (63.5, 0.2)	4.6 (13.8, 0.7)	0.5 (7.0, 0.1)
11	17	2	19.9 (0.4)	3.1 (0.04)	10.8 (54.4, 0.4)	0.75 (24.2, 0.03)	2.7 (13.7, 0.4)	0.75 (26.2, 0.1)
12	3	1	3.3 (0.1)	1.35 (0.02)	3.3 (100.0, 0.1)	1.35 (100.0, 0.1)	2.1 (64.2, 0.3)	0 (0,0)
13	0	2	0 (0)	1.8 (0.02)	0 (0,0)	1.35 (76.9, 0.1)	0 (0, 0)	0 (0,0)

Table 1B. Odds Ratios Full Table: Bangladesh

Bangladesh								
	Stunting				Wasting			
	1999		2014		1999		2014	
	OR	95% CI	OR	95% CI	OR	CI	OR	CI
Quintiles of Wealth Index								
1	2.35	1.57, 3.52	3.78	2.47, 5.78	2.55	1.46, 4.46	1.33	0.73, 2.41
2	1.65	1.13, 2.40	3.65	2.44, 5.47	2.19	1.18, 4.06	1.22	0.67, 2.23
3	1.95	1.34, 2.85	2.38	1.51, 3.74	2.56	1.47, 4.45	1.02	0.51, 2.02
4	1.38	0.92, 2.08	2.43	1.59, 3.71	1.82	1.07, 3.08	0.86	0.47, 1.57
5	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Sex of Child								
Male	1.05	0.92, 1.19	1.09	0.96, 1.23	1.15	0.96, 1.37	1.12	0.91, 1.37
Female	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Highest Educational Level of Mother								
No education	3.08	2.07, 4.58	1.66	1.16, 2.37	1.01	0.57, 1.80	1.09	0.73, 1.62
Primary	2.76	1.86, 4.09	1.67	1.28, 2.18	0.87	0.49, 1.57	1.12	0.79, 1.60
Secondary	1.87	1.27, 2.75	1.27	0.99, 1.63	0.82	0.45, 1.48	1.05	0.78, 1.42
Higher	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Region								
Barisal	1.22	0.99, 1.51	1.34	1.03, 1.75	1.12	0.74, 1.69	0.98	0.74, 1.29
Chittagong	1.39	1.14, 1.70	1.46	1.21, 1.77	0.97	0.74, 1.27	0.93	0.73 1.19
Dhaka	1.23	1.02, 0.84	1.25	1.01, 1.53	0.93	0.71, 1.23	0.67	0.51, 0.89
Khulna	1.02	0.84, 1.24	0.87	0.70, 1.08	0.90	0.66, 1.24	0.76	0.57, 1.02
Sylhet	1.71	1.39, 2.11	1.80	1.48, 2.19	0.95	0.69, 1.31	0.63	0.46, 0.86
Rajshahi	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Birth Order Number	0.95	0.86, 1.04	1.14	0.99, 1.32	1.13	1.01, 1.28	0.94	0.75, 1.17
Current Age of Child	1.28	1.23, 1.34	1.23	1.18, 1.29	0.82	0.77, 0.88	0.89	0.83, 0.95

Table 1C. Stunting Contingency Table: Bangladesh

	Sample Size		Weghted N (%)		Weghted Wasting N (row%, col%)	
Stunting	1999	2014	1999	2014	1999	2014
Yes	2717	2567	2801.2 (51.5)	2,621.5 (36.55	365.7 (13.1, 53.3)	399.0 (15.2, 37.9)
No	2634	4398	2635.0 (48.5)	4,551.2 (63.45	320.1 (12.2, 46.7)	652.8 (14.3, 62.1)

Table 1D. Wasting Contingency Table: Bangladesh

	Sample Size		Weghted N (%)		Weghted Stunting N (row%, col %)	
Wasting	1999	2014	1999	2014	1999	2014
Yes	671	1025	685.8 (12.6)	1,051.7 (14.7)	365.7 (53.3, 13.1)	399.0 (37.9, 15.2)
No	4680	5940	4750.4 (87.4)	6,121.0 (85.3)	2435.5 (51.3, 86.9)	2,222.6 (36.3, 84.8)

Table 1E. Combined Undernourished Contingency Table: Bangladesh

Combined Undernourished		
	1999	2014
Total children who are malnourished (stunted or Wasted)	3121.3 (57.4)	3,274.2 (45.6)
Total children who are neither stunted nor wasted	2314.9(42.6)	3898.4 (54.4)

Table 2A. Cross-tabulations Full Table: Pakistan

Pakistan								
	Sample size		Weghted N (%)		Weghted Stunting N (row%, col %)		Weghted Wasting N (row%, col%)	
	1991	2014	1991	2014	1991	2014	1991	2014
Age								
0-11 mo	901 (22.3)	580	929.2 (23.1)	649.4 (19.1)	250.6 (27.0, 11.4)	180.0 (27.7, 11.9)	193.3 (20.8, 39.3	113.1 (17.4, 31.1)
12-23 mo	828 (20.5)	551	844.5 (21.0)	630.4 (18.6)	453.1 (53.7, 20.6)	298.2 (47.3, 19.7)	90.4 (10.7, 18.4)	100.3 (15.9, 27.6)
24-35 mo	817 (20.21)	652	825.8 (20.5)	723.8 (21.3)	538.4 (65.2, 24.5)	382.4 (52.8, 25.2)	88.6 (10.7, 18.0)	52.0 (7.2, 14.3)
36-47 mo	820 (20.28)	633	805.2 (20.0)	661.1 (19.5)	541.2 (67.2, 24.6)	321.0 (48.6, 21.2)	74.8 (9.3, 15.2)	61.9 (9.4, 17.0)
48-59 mo	677 (16.74)	655	626.3 (15.6)	731.1 (21.5)	415.3 (66.3, 18.9)	333.7 (45.7, 22.0)	44.6 (7.1, 9.1)	36.2 (5.0, 10.0)
Sex of Child	0							
Female	2,024 (50.1)	1,513	1987.6 (49.3)	1,683.2 (49.6)	1,025 (51.6, 46.6)	697.6 (41.5, 46.0)	203.6 (10.2, 41.4	363.6 (10.7, 100.(
Male	2,019 (49.9)	1,558	2,043.3 (50.7)	1,712.8 (50.4)	1,173.4 (57.4, 53.4)	817.8 (47.8, 54.0)	288.0 (14.1, 58.6	194.2 (11.3, 53.4)
Wealth Index Quintile	0							
Poorest 20%	431 (10.7)	634	685.9 (17.0)	720.5 (21.2)	441.8 (64.4, 20.1)	446.1 (61.9, 29.4)	134.2 (19.6, 27.3	126.8 (17.6, 34.9)
Poorer 20%	535 (13.2)	613	711.0 (17.6)	680.5 (20.0)	444.8 (62.6, 20.2)	380.7 (56.0, 25.1)	103.7 (14.6, 21.1	67.0 (9.9, 18.4)
Middle 20%	775 (19.2)	554	771.4 (19.1)	627.8 (18.5)	450.3 (58.4, 20.5)	254.0 (40.5, 16.8)	86.2 (11.2, 17.5)	59.4 (9.5, 16.3)
Richer 20%	1,106 (27.4)	658	973.2 (24.1)	798.7 (23.5)	514.6 (52.9, 23.4)	303.2 (38.0, 20.0)	92.8 (9.5, 18.9)	64.2 (8.0, 17.7)
Richest 20%	1,196 (29.6)	612	889.4 (22.1)	568.4 (16.7)	347.1 (39.0, 15.8)	131.2 (23.1, 8.7)	74.8 (8.4, 15.2)	46.2 (8.1, 12.7)
Mothers Highest Year of Education	0							
No Education	2,991 (74.0)	1,606	3,056.7 (75.8)	1,834.4 (54.0)	1,832.0 (59.9, 83.3)	1,012 (55.2, 66.8)	414.5 (13.6, 84.3	244.3 (13.3, 67.2)
Primary	436 (10.8)	497	438.1 (10.9)	597.2 (17.6)	211.5 (48.3, 9.6)	272.4 (45.6, 18.0)	44.4 (10.1, 9.0)	52.3 (8.8, 14.4)
Secondary	560 (13.9)	626	496.4 (12.3)	664.3 (19.6)	151.6 (30.5, 6.9)	168.5 (25.4, 11.1)	31.2 (6.3, 6.4)	50.0 (7.5, 13.8)
Higher	56 (13.9)	342	39.8 (1.0)	300.0 (8.8)	3.4 (8.6, 0.2)	62.1 (20.7, 4.1)	1.4 (3.6, 0.3)	17.0 (5.7, 4.7)
	2385							
Region	0							
Punjab	1,396 (34.5)	1,018	2,401.3 (59.6)	2,130.9 (62.8)	1,182 (49.3, 53.8)	846.8 (39.7, 55.9)	315.9 (13.2, 64.3	201.3 (9.5, 55.4)
Sindh	1,165 (28.8)	704	938.7 (23.3)	769.6 (22.7)	561.7 (59.8, 25.6)	435.6 (56.6, 28.7)	122.7 (13.1, 25.0	104.0 (13.5, 28.6)
NW Frontier/ Khyber Pakhtunkhwa	1,087 (26.9)	541	588.3 (14.6)	377.5 (11.1)	378.9 (64.4, 17.2)	155.9 (41.3, 10.3)	44.0 (7.5, 8.9)	44.0 (11.7, 12.1)
Balochistan	395 (9.8)	292	102.7 (2.6)	79.4 (2.3)	75.2 (73.2, 3.4)	65.1 (81.9, 4.3)	9.1 (8.8, 1.8)	10.5 (13.2, 2.9)
Gilgit Baltistan	n/a	301	n/a	24.3 (0.7)	n/a	9.0 (36.9, 0.6)	n/a	2.0 (8.2, 0.6)
Islamabad	n/a	215	n/a	14.3 (0.4)	n/a	3.2 (22.0, 0.2)	n/a	1.8 (12.8, 0.5)
Birth Order Number								
1	705 (17.44)	693	711.1 (17.6)	779.9 (23.0)	370.3 (52.1, 16.8)	323.6 (41.5, 21.4)	85.8 (12.1, 17.5)	78.9 (10.1, 21.7)
2	652 (16.1)	637	697.0 (17.3)	733.0 (21.6)	376.4 (54.0, 17.1)	294.9 (40.2, 19.5)	100.2 (14.4, 20.4	81.8 (11.2, 22.5)
3	600 (14.8)	489	604.2 (15.0)	558.1 (16.4)	304.7 (50.4, 13.9)	247.0 (44.3, 16.3)	59.3 (9.8, 12.1)	53.0 (9.5, 14.6)
4	514 (12.7)	382	506.7 (12.6)	403.7 (11.9)	262.1 (51.7, 11.9)	176.9 (43.8, 11.7)	49.2 (9.7, 1.8)	33.9 (8.4, 9.3)
5	466 (11.5)	289	451.3 (11.2)	294.8 (8.7)	243.6 (54.0, 11.1)	123.2 (41.8, 8.1)	56.0 (12.4, 11.4)	35.1 (11.9, 9.7)
6	366 (9.1)	206	346.2 (8.6)	226.1 (6.7)	207.8 (60.0, 9.5)	139.1 (61.5, 9.2)	40.5 (11.7, 8.2)	35.8 (15.8, 9.8)
7	266 (6.6)	156	238.9 (5.9)	172.8 (5.1)	138.7 (58.1, 6.3)	98.1 (56.8, 6.5)	30.4 (127, 6.2)	23.8 (13.7, 6.5)
8	190 (4.7)	98	175.2 (4.4)	103.2 (3.0)	111.9 (63.9, 5.1)	51.7 (50.1, 3.4)	27.4 (15.6, 5.6)	11.6 (11.2, 3.2)
9	132 (3.3)	48	128.9 (3.2)	49.9 (1.5)	80.18 (62.2, 3.7)	23.1 (46.3, 1.5)	15.0 (11.6, 3.0)	1.8 (3.6, 0.5)
10	75 (1.9)	31	81.2 (2.0)	28.2 (0.8)	55.8 (68.3, 2.5)	11.6 (41.1, 0.8)	12.3 (15.1, 2.5)	1.2 (4.1, 0.3)
11	34 (0.8)	21	41.1 (1.0)	26.8 (0.8)	21.9 (53.2, 1.0)	14.3 (53.6, 1.0)	8.1 (19.8, 1.7)	6.7 (25.1, 1.9)
12	25 (0.6)	12	34.2 (0.9)	11.3 (0.3)	18.3 (53.5, 0.8)	5.7 (50.2, 0.4)	3.1 (9.2, 0.6)	0 (0, 0)
13	13 (0.3)	7	12.4 (0.3)	5.5 (0.2)	5.3 (42.6, 0.2)	3.6 (65.0, 0.2)	4.4 (35.1, 0.9)	0.2 (2.8, 0.1)
14	0 (0)	2	0 (0, 0)	2.7 (0.1)	0 (0, 0)	2.7 (100.0, 0.2)	0 (0, 0)	0 (0, 0)
15	2 (0.1)	0	0.3 (0.1)	0 (0, 0)	0.1 (26.6, 0.0)	0 (0, 0)	0 (0, 0)	0 (0, 0)
16	3 (0.1)	0	1.5 (0.1)	0 (0, 0)	(1.5 (100.0, 0.1)	0 (0, 0)	0 (0, 0)	0 (0, 0)

Table 2B. Odds Ratios Full Table: Pakistan

Pakistan								
	Stunting				Wasting			
	1991		2013		1991		2013	
	OR	95% CI	OR	95% CI	OR	CI	OR	CI
Quintiles of Wealth Index								
1	2.74	1.55, 4.86	4.64	2.36, 9.13	3.49	1.59, 7.65	1.82	0.56, 5.96
2	2.78	1.59, 4.86	3.58	1.77, 7.25	1.65	0.70, 3.88	0.77	0.31, 1.92
3	2.70	1.57, 4.67	1.72	0.89, 3.35	1.95	0.74, 5.16	1.18	0.48, 2.93
4	1.44	0.90, 2.30	1.63	0.84, 3.16	1.14	0.50, 2.60	0.69	0.29, 1.65
5	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Sex of Child								
Male	1.35	1.09, 1.68	1.32	1.06, 1.65	1.41	1.09, 1.83	1.21	0.88, 1.66
Female	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Highest Educational Level of Mother								
No education	11.17	3.49, 35.76	2.37	1.45, 3.85	2.95	0.38, 23.14	2.52	1.14, 5.58
Primary	8.65	2.57, 29.19	2.18	1.29, 3.71	2.54	0.31, 20.85	1.75	0.80, 3.82
Secondary	5.07	1.61, 15.96	1.04	.66, 1.63	1.65	0.20, 13.89	1.46	0.59, 3.60
Higher	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Region								
Punjab	0.45	0.29, 0.68	0.18	0.10, 0.30	1.63	0.94, 2.82	0.89	0.43, 1.83
Sindh	0.83	0.53, 1.30	0.31	0.18, 0.54	1.74	1.02, 2.97	1.03	0.55, 1.92
NW Frontier (Khyber Pakhtunkhwa)	0.81	0.51, 1.28	0.16	0.09, 0.28	0.83	0.47, 1.49	1.11	0.56, 2.20
Balochistan	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Gilgit Baltistan	N/a	N/a	0.11	0.05, 0.22	N/a	N/a	0.55	0.23, 1.32
Islamabad (ICT	N/a	N/a	0.13	0.07, 0.24	N/a	N/a	1.73	0.74, 4.03
Birth Order Number	1.07	1.00, 1.14	1.06	0.91, 1.24	1.07	0.98, 1.16	1.01	0.84, 1.21
Current Age of Child	1.59	1.49, 1.70	1.14	1.07, 1.22	0.74	0.68, 0.81	0.69	0.60, 0.79

Table 2C. Stunting Contingency Table: Pakistan

Stunting	Sample size		Weghted N (%)		Weghted Wasting N (row%, col%)	
	1991	2014	1991	2014	1991	2014
Yes	2,269 (56.12)	385 (45.1)	2,198.5 (54.5)	1,515.4 (44.6)	231.6 (10.5, 47.1)	173.1 (11.4, 47.6)
No	1,774 (43.9)	586 (54.9)	1,842.4 (45.5)	1,880.5 (55.4)	260.0 (14.2, 52.9)	190.6 (10.1, 52.4)

Table 2D. Wasting Contingency Table: Pakistan

Wasting	Sample size		Weghted N (%)		Weghted Stunting N (row%, col %)	
	1991	2014	1991	2014	1991	2014
Yes	427 (10.6)	320	492.6 (12.2)	363.6 (10.7)	231.6 (47.1, 10.5)	173.1 (47.6, 11.4)
No	3,616 (89.4)	2,751	3,539 (87.8)	3,032.3 (89.3)	1,966.9 (55.6, 89.5)	1,342.3 (44.3, 88.6)

Table 2E. Combined Undernourished Contingency Table: Pakistan

Combined Undernourished		
	1991	2014
Total children who are	2,459.5 (61.0)	1,705.9 (50.2)
Total children who are neither stunted nor wasted	1,571.4 (39.0)	1,690.0 (49.8)

Table 3A. Cross-tabulations Full Table: Nepal

Nepal								
	Sample size		Weghted N (%)		Weghted Stunting N (row%, col %)		Weghted Wasting N (row%, col%)	
	2001	2011	2001	2011	2001	2011	2001	2011
Age								
0-11 mo	918	452	1058.8 (19.8)	461.3 (19.4)	585.0 (55.3, 19.2)	84.1 (18.2, 8.7)	113.8 (10.8, 17.9)	73.6 (16.0, 27.3)
12-23 mo	946	445	1076.7 (20.2)	484.1 (20.3)	604.8 (56.2, 19.9)	170.4 (35.2, 17.6)	140.2 (13.0, 22.1)	82.6 (17.1, 30.7)
24-35 mo	895	485	1015.4 (19.0)	478.9 (20.1)	596.6 (58.8, 19.6)	256.0 (53.5, 26.4)	127.3 (12.5, 20.0)	40.1 (8.4, 14.9)
36-47 mo	1006	499	1123.3 (21.0)	502.3 (21.1)	630.7 (56.2, 20.7)	267.1 (53.2, 27.5)	113.1 (10.1, 17.8)	39.9 (7.9, 14.8)
48-59 mo	945	454	1063.5 (19.9)	453.6 (19.1)	623.9 (58.7, 20.5)	192.9 (42.5, 19.9)	141.1 (13.3, 22.2)	33.1 (7.3, 12.3)
Sex of Child								
Female	2546	1,122	2905.4 (50.7)	1172.4 (49.3)	1622.9 (57.3, 49.7)	464.6 (39.6, 47.9)	349.0 (12.0, 51.4)	119.4 (10.2, 44.3)
Male	2512	1,213	2831.3 (49.4)	1207.7 (50.7)	1641.5 (56.5, 50.3)	505.8 (41.9, 52.1)	330.1 (11.7, 48.6)	149.9 (12.4, 55.7)
Wealth Index Quintile								
Poorest 20%	759	712	777.4 (13.6)	608.3 (25.6)	435.9 (56.1, 13.4)	342.6 (56.3, 35.3)	98.1 (12.6, 14.5)	76.7 (12.6, 28.5)
Poorer 20%	964	478	1045.9 (18.2)	483.2 (20.3)	586.7 (56.1, 18.0)	220.1 (45.6, 22.7)	133.1 (12.7, 19.6)	58.1 (12.0, 21.6)
Middle 20%	883	443	979.1 (17.1)	554.7 (23.3)	576.9 (58.9, 17.7)	201.3 (36.3, 20.7)	135.4 (13.8, 19.9)	73.3 (13.2, 27.2)
Richer 20%	1134	356	1336 (23.3)	406.2 (17.1)	709.4 (53.1, 21.7)	123.5 (30.4, 12.7)	135.9 (10.2, 20.0)	34.4 (8.5, 12.8)
Richest 20%	1318	346	1597.8 (27.9)	327.7 (13.8)	955.5 (59.8, 29.3)	82.9 (25.3, 8.5)	176.5 (11.1, 26.0)	26.7 (8.1, 9.9)
Mothers Highest Year of Education								
No Education	3655	1,079	4197.5 (73.2)	1128.4 (47.4)	2433.1 (58.0, 74.5)	539.6 (47.8, 55.6)	491.4 (11.7, 72.4)	157.5 (14.0, 58.5)
Primary	714	456	804.2 (14.0)	469.4 (19.7)	432.0 (53.7, 13.2)	196.2 (41.8, 20.2)	94.2 (11.7, 13.9)	54.3 (11.6, 20.2)
Secondary	624	668	669.7 (11.7)	656.0 (27.6)	362.4 (54.1, 11.1)	205.6 (31.6, 21.2)	82.3 (12.3, 12.1)	42.9 (5.5, 15.9)
Higher	65	132	65.4 (1.1)	126.4 (5.3)	36.8 (56.3, 1.1)	28.9 (22.9, 3.0)	11.2 (17.1, 1.7)	14.5 (11.5, 5.4)
Region								
Mountain	622	452	310.6 (5.4)	188.5 (7.9)	173.4 (55.8, 5.3)	101.1 (53.6, 10.4)	12.9 (4.1, 1.9)	20.1 (10.6, 7.5)
Hill	1829	948	2321.3 (40.5)	939.8 (39.5)	1384.1 (59.6, 42.4)	396.1 (42.2, 40.8)	278.8 (12.0, 41.1)	103.8 (11.0, 38.5)
Terai	2607	935	3104.9 (54.2)	1251.8 (52.6)	1706.8 (55.0, 52.3)	473.2 (37.8, 48.8)	387.4 (12.5, 57.0)	145.4 (11.6, 54.0)
Birth Order Number								
1	1229	787	1378.7 (24.0)	834.6 (35.1)	762.5 (55.3, 23.4)	298.7 (35.8, 30.8)	177.2 (12.9, 26.1)	74.9 (9.0, 27.8)
2	1161	637	1301.6 (22.7)	627.4 (26.4)	760.5 (58.4, 23.3)	239.2 (38.1, 24.7)	154.5 (11.9, 22.8)	69.7 (11.1, 25.9)
3	865	379	1002.4 (17.5)	383.6 (16.1)	558.5 (55.7, 17.11)	148.0 (38.6, 15.3)	99.2 (9.9, 14.6)	50.0 (13.0, 18.6)
4	646	235	750.8 (13.1)	224.2 (9.4)	415.4 (55.3, 12.7)	117.5 (52.4, 12.1)	99.1 (13.2, 14.6)	28.7 (12.8, 10.6)
5	444	107	502.0 (8.8)	109.3 (4.6)	289.0 (8.9, 2.5)	57.0 (52.1, 5.9)	61.0 (12.2, 9.0)	9.5 (8.7, 3.5)
6	281	76	322.7 (5.6)	76.2 (3.2)	186.3 (57.7, 5.7)	37.1 (48.6, 3.8)	32.0 (9.9, 4.7)	14.1 (18.6, 5.3)
7	169	49	187.1 (3.3)	56.7 (2.4)	111.7 (59.7, 3.4)	34.4 (60.7, 3.6)	19.2 (10.3, 2.8)	8.8 (15.6, 3.3)
8	125	29	143.0 (2.5)	32.1 (1.4)	88.8 (62.1, 2.7)	17.1 (52.4, 1.8)	17.6 (12.3, 2.6)	6.5 (20.4, 2.4)
9	61	21	67.6 (1.2)	21.0 (0.9)	39.5 (58.5, 1.2)	10.4 (49.7, 1.1)	9.8 (14.6, 1.5)	4.2 (20.1, 1.6)
10	44	11	47.3 (0.8)	11.0 (0.5)	34.8 (73.5, 1.1)	8.0 (72.2, 0.8)	5.0 (10.6, 0.7)	2.8 (25.1, 1.0)
11	18	3	18.6 (0.3)	2.0 (0.1)	6.4 (34.6, 0.2)	1.2 (58.1, 0.1)	1.3 (7.0, 0.2)	0 (0,0)
12	13	1	12.8 (0.;2)	1.9 (0.1)	7.8 (60.9, 0.2)	1.9 (100.0, 0.2)	2.1 (16.7, 0.3)	0 (0,0)
13	2	0	2.3 (0.1)	0 (0,0)	2.3 (100.0, 0.1)	0 (0,0)	1.0 (43.5, 0.2)	0 (0,0)

Table 3B. Odds Ratios Full Table: Nepal

Nepal								
	Stunting				Wasting			
	2001		2011		2001		2011	
	OR	95% CI	OR	95% CI	OR	CI	OR	CI
Quintiles of Wealth Index								
1	1.08	0.63, 1.86	3.92	1.71, 9.00	1.07	0.55, 2.05	2.02	0.51, 7.91
2	0.85	0.52, 1.38	2.22	0.91, 5.40	1.02	0.53, 1.96	1.32	0.34, 5.06
3	0.99	0.62, 1.57	1.98	0.88, 4.45	1.61	0.86, 3.05	2.44	0.62, 9.55
4	0.73	0.48, 1.13	1.16	0.48, 2.81	1.05	0.48, 2.30	1.21	0.30, 4.81
5	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Sex of Child								
Male	1.03	0.90, 1.17			0.95	0.77, 1.19	1.34	0.98, 1.83
Female	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Highest Educational Level of Mother								
No education	1.07	0.57, 2.04	1.32	0.66, 2.62	0.68	0.27. 1.69	0.98	0.4, 2.37
Primary	0.88	0.44, 1.77	1.30	0.64, 2.66	0.67	0.25, 1.85	0.79	0.31, 2.01
Secondary	0.94	0.48, 1.86	1.19	0.64, 2.23	0.68	0.27, 2.71	0.46	0.19, 1.11
Higher	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Region								
Mountain	1.01	0.77, 1.34	1.20	0.87, 1.67	0.29	0.14, 0.58	0.82	0.49, 1.37
Hill	1.2	0.99, 1.45	0.85	0.64, 1.13	0.96	0.75, 1.24	1.00	0.68, 1.47
Terain	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)	(REF)
Birth Order Number	1.03	0.95, 1.12	1.12	0.80, 1.57	1.00	0.87, 1.15	1.32	0.83, 2.11
Current Age of Child	1.02	0.99, 1.06	1.33	1.24, 1.43	1.02	0.97, 1.07	0.73	0.63, 0.86

Table 3C. Stunting Contingency Table: Nepal

	Sample size		Weghted N (%)		Weghted Wasting N (row%, col%)	
Stunting	2001	2011	2001	2011	2001	2011
Yes	2871	992	3264.2 (56.9)	970.4 (40.8)	377.9 (11.6, 55.6)	97.5 (10.1, 36.2)
No	2187	1,343	2472.4 (43.1)	1409.7 (59.2)	301.22 (12.2, 44.4)	171.7 (12.2, 63.8)

Table 3D. Wasting Contingency Table: Nepal

	Sample size		Weghted N (%)		Weghted Stunting N (row%, col %)	
Wasting	2001	2011	2001	2011	2001	2011
Yes	565	255	679.1 (11.8)	269.2 (11.3)	377.9 (55.6, 11.6)	97.5 (36.2, 10.1)
No	4493	2,080	5057.7 (88.2)	2110.9 (88.7)	2886.5 (57.1, 88.4)	872.9 (41.4, 90.0)

Table 3E. Combined Undernourished Contingency Table: Nepal

Combined Undernourished		
	2001	2011
Total children who are malnourished (stunted or Wasted)	2,565.4 (62.2)	1,142.1 (48.0)
Total children who are neither stunted nor wasted	2,171.2 (37.8)	1,238.0 (52.0)