Nutritional Status in Nepal:

Analyzing the Determinants of Nutritional Outcomes along the Distribution

By

Mikaela Hallett

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Approved: Marie-Claire Robitaille

Assistant Professor

Approved: Mark Raymond

Department Chair

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Abstract

Undernutrition in very young children can have long lasting effects for them personally, as well as for the economy that is impacted by their lowered human capital formation. Despite its higher than average undernutrition rate, Nepal's undernutrition problem has rarely been studied. Using Nepal Demographic and Health Surveys 2016, a nationally representative survey, this paper conducts OLS and quantile regression analyses at the 25^{th}, 50^{th}, and 75^{th} percentiles to shed light on the determinants of undernutrition. This study finds that the ecological zone in which a child lives can have a great impact on their nutritional status, with children from mountainous areas being more prone to stunting, and children from the terai being at a far greater risk of wasting, holding everything else constant. Additionally, wealth is found to have a strong effect on a child's height-for-age z-scores, indicating that access to resources is an important determinant for this measure of nutritional status. This is the first paper to use the quantile regression approach in Nepal, and the most recent study to observe the effects of nutrition on Nepal as a whole.

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1. Introduction

According to the World Bank (2012), the first 1000 days of life from conception onwards is the most critical period in which to improve nutrition, beyond which any damage done is essentially irreversible. This damage can present itself by impacting physical growth and brain development, in addition to the formation of human capital (World Bank, 2012) which ultimately is a concern to the entire society. Countries recovering from recent conflict are particularly susceptible to undernutrition and food insecurity as a result of unequal economic growth and distribution of resources (Hong et al, 2006). Nepal endured a decade-long civil war in the late 1990s into the early 2000s, followed by a devastating earthquake in 2015 with subsequent aftershocks that shook the country and impeded their economic development. With a Human Development Index ranking of just 149th out of 189 countries (UNDP, 2018) and more than 1 in 3 children reportedly being stunted (Ministry of Health Nepal, 2017), improving nutrition in Nepal is essential to facilitating economic growth.

Undernutrition in Nepal has historically been high, however, in recent years it has seen improvements. In the case of stunted children, a measure of long-term nutritional status, the rate has fallen significantly from 57 percent in 1996 to 36 percent in 2016. This was not the case, however, for the rate of wasting, a measure of short-term nutritional status, which only decreased by 5 percentage points over this same time period (Ministry of Health Nepal, 2017). The Government of Nepal has taken steps to eradicate undernutrition by ratifying various policies and human rights treaties such as the Multi-Sector Nutrition Plan, the Agriculture Development Strategy, the Sustainable Development Goals (SDGs), and the Convention on the Rights of the Child (National Planning Committee, 2015; Rights & Democracy, 2007). The internationally agreed upon targets for the SDGS are to reduce the rate of stunting by 40 percent and to reduce the instance of wasting to less then 5 percent by 2025 (World Health

Organization, 2018). Although it appears that Nepal has made progress towards meeting the targets for stunting, they must reduce the rate of wasting by 5 percentage points in less than ten years, a reduction that took twenty years to achieve previously. In order to eradicate undernutrition, a better understanding of the factors influencing nutrition for children based on how nutritionally well off they are is instrumental.

Surprisingly, little research has been done on undernutrition in Nepal, with the notable exceptions of Huijbers et al (1996) who focus on the nutritional status of children living in the mountainous areas and Tiwari et al (2017) who focused on how nutritional status is affected by monsoon seasons in Nepal. Additionally, Nepal has been included in two cross-sectional studies on nutritional status (Vollmer et al, 2017; Onis et al, 2000).

Using data from the Demographic and Health Surveys 2016 on individual children under five years of age, this paper explores a variety of environmental, situational, and health factors and how they impact the nutritional status of children along the distribution of nutritional outcomes. This study contributes to the literature by being the most recent research on child nutrition in Nepal as a whole and the first research on Nepal using quantile regressions, which allows an understanding of the determinants of nutrition at different points in the distribution, as proposed by Aturupane (2011).

The remainder of this paper is structured as follows. Section 2 discusses the previous literature on undernutrition. Section 3 describes the dataset and the estimation strategy employed to conduct the empirical analysis. Section 4 provides descriptive statistics and results from the regression analyses. Section 5 concludes by highlighting the key results, limitations, and providing policy implications.

2. Literature Review

Nepal's historically high rates of undernutrition have often resembled those found in African countries (Hobbs, 2009) where hunger is widely viewed as a threat to livelihoods and life itself. Although people in Nepal face a similar threat from undernutrition, hunger in Nepal is far less buzzworthy than it is in African countries. This has lead to a phenomenon Hobbs (2009) labelled a 'silent crisis' where high rates of people are suffering and little is reported on it.

Nepal is particularly vulnerable to natural disasters such as flooding, droughts, landslides, and fires that have hit the country and caused annual food shortages over the last century (Shively et al, 2011). This is partially due to Nepal's monsoon season where 80 percent of the annual rain falls within the summer months (Tiwari et al, 2017). These events have damaged food supplies and, at times, have left close to 900,000 people at an acute risk of a food crisis (Shively et al 2011; Hobbs, 2009). In addition to food deficits, excess rain fall is linked to an increase in diarrheal episodes and creates a breeding ground for insects that spread disease (Tiwari et al, 2017), increasing rates of wasting.

A decade of civil conflict and political instability have further impacted the nutritional outcomes of Nepali people, particularly those who are food insecure (Hobbs, 2009). As part of the civil conflict in the early 2000s, *bandh's* (a form of a strike) were often called across the country and could last for days or weeks at a time (Hobbs, 2009). For those who are food insecure and rely on their daily wages to purchase their same-day food supply, or those who simply were unable to purchase large quantities of food, these strikes could cause families to go hungry for an indefinite period of time (Hobbs, 2009).

Onis et al (2000) found that rates of stunting not only differ between countries, but there is great variability to be found between regions within countries as well. This variability at the regional level can be observed in Nepal, in particular, when looking at the geographic diversity of nutritional outcomes. There are three ecological zones in Nepal: The terai (low land), hills, and mountainous regions. Mountainous areas are stricken with poverty, rough terrain, and conditions that create food deficits in 13 out of the 16 mountain districts (Rights & Democracy, 2007). Shively et al (2011) found that the highest incidences of stunting and undernutrition in Nepal were found in these mountainous areas. In the terai region, there are high levels of illness often transmitted by insects (Shively et al, 2011). While the World Bank (2012) defines a 'nutrition emergency' as having a rate of wasting above 15 percent, the average wasting level in the terai is 17 percent, with some areas reaching a wasting level of 21 percent (Shively et al, 2011).

Onis et al (2000) claimed that the best indicator of well-being worldwide is to measure a child's growth. Stunting, a low height-for-age, is a measure of long-term undernutrition in children where being malnourished over a long period of time has caused them to grow slower than their healthy counterparts. This can be caused by a lack of nutrients, or an abundance of illness and infection in the first few years of life (Ministry of Health Nepal, 2017). Wasting is a measure of short-term malnutrition where children have a low weight for their height, indicating having recently lost a lot of weight, most often as a result of an acute illness or disease (Ministry of Health Nepal). These measures are the most commonly used indicators of undernutrition in the literature (Borooah, 2004; Hong et al, 2006; Huijbers, 1996; Onis et al, 2000; Tiwari et al, 2017; Vollmer et al, 2017). Stunting is measured by the child's height for age z-score (HAZ) where a z-score more than -2 standard deviations away from the reference median given by the World Health Organization (WHO)[1] is considered stunted, and more than -3 standard deviations away

[1] The WHO reference median is the most appropriate reference group for height-for-age and weight-for-height z-scores as it takes into account children from a variety of ethnic backgrounds.

from the WHO reference is severely stunted. Similarly, wasting is measured as a weight for height z-score more than -2 standard deviations from the WHO reference, and more than -3 standard deviations is considered severely wasted.

Previous studies on child undernutrition seem to be in agreeance on a number of factors that influence the nutritional status of young children. Across a wide range of studies, child age, mother's education, sex, birth order, economic condition of the household, and region of residence are all common factors used in nutrition analyses. Although some of these variables are calculated using similar measurements across the board, others are more inconsistent. Some literature approximated a mother's education by her total number of years of schooling (Hong et al, 2006; Sreeramareddy, 2013; Tiwari et al, 2017; Vollmer et al, 2017; Huijbers, 1996), others proxied this by mother's literacy (Borooah, 2004; Jayachandran et al, 2017). Sanitation was not often measured, however, studies who did include this estimated the impact of access to safe drinking water and hygienic toilets (Borooah, 2004; Hong et al, 2006), or by crowding, that is, the number of individuals living in a household (Huijbers, 1996).

Previous literature on nutrition in Nepal has focused on nutrition in highland children (Huijbers et al, 1996) and the effects of rainfall shocks on child nutrition (Tiwari et al, 2017). Huijbers et al found a link between nutritional status and a child's socioeconomic status and altitude. Lower caste and higher altitude had a positive effect on nutritional status for children living in the highlands. Research conducted by Tiwari et al (2017) on the impact of rainfall shocks on nutritional status of children found monsoon season to be an important indicator of a child's nutritional status[2]. Separating effects into disease environment and income effects, Tiwari et al (2017) found that a 10 percent increase in rainfall based on historical figures over the most

[2] The absence of rainfall data is a limitation to this study that should be built upon in future research.

recent monsoon season increases weight-for-height. This overall positive effect is an increase of no less than 0.13 standard deviations which includes a larger positive income effect of 0.17 standard deviations, and a smaller negative disease effect of no more than 0.04 standard deviations. The height-for-age of children is only impacted when the rainfall shocks occurred in a child's second year of life and the effect disappears by the time the child turns five.

Currently, the literature on child nutrition in Nepal is relatively sparse, despite there being a great deal of research on undernutrition elsewhere, such as India (Borooah, 2004; Jayachandran, 2017), Cambodia (Hong et al, 2006), and Sri Lanka (Aturupane et al, 2011). There have been few studies in recent years to focus on the realm of child nutrition in Nepal, and those which have, often only take into consideration mean effects on the population. Nepal has been studied as one of many countries in two cross-sectional studies observing rates of undernutrition over time (Onis et al, 2011; Vollmer et al, 2017). These studies have contributed greatly to the literature on the state of undernutrition in Nepal, however, questions still remain. Are there universal policies that can be implemented in Nepal that would ensure all children grow up with an acceptable nutritional status? Are children whom are the worst off affected differently by nutritional determinants than their counterparts who are nutritionally better off? If universal policies do not work, which populations need to be targeted by which specific policies in order to maximize the effects and improve the lives of the children across the country? A quantile regression analysis on nutritional outcomes can observe the impact of various determinants along the distribution, giving researchers, government officials, and aid workers the tools they need to answer these questions.

3. Data and Methodology

3.1 Data

The data used for this paper is from the 2016 nationally representative Demographic and Health Surveys (DHS) for Nepal, the most recent DHS survey conducted in the country. The surveys were implemented by the New ERA, a non-profit research organization based in Kathmandu, Nepal, with the support of the country's Ministry of Health. Taking place over a period of seven months, beginning in mid-June 2016 and coming to an end in January 2017, the Nepal DHS surveys have the goal of providing up-to-date information on health indicators for people in Nepal. (Ministry of Health Nepal, 2017)

The 2016 Nepal DHS uses a stratified random sampling technique to identify households with which to conduct interviews. Nepal is separated into seven provinces which are then respectively divided into urban and rural areas, creating 14 strata. Each province is separated into wards which researchers get from the 2011 census as well as any additional municipalities that have been created between the time of the census and the beginning of the DHS data collection. In rural areas, these wards serve as the primary sampling units (PSUs). In urban areas, due to a large, dense population, wards are then separated into enumeration areas (EAs). Wards are selected with a probability proportional to its size (the number of households within it) and each sample stratum is independently selected. Households are listed for each sample PSU for rural areas or EA for urban areas and then 30 households are randomly selected for interviews with an equal probability. (Ministry of Health Nepal, 2017).

11,473 households were selected, within which 13,089 women between the ages of 15-49 were identified as being eligible to be interviewed as part of the woman's questionnaire. The 2016 Nepal DHS had an overall household response rate of 99 percent, and a woman response rate of

98 percent. Those interviewed are asked questions regarding their background information including their age, education levels, use of birth control, and domestic violence. Researchers also collected information on 5,038 individual children under five years of age. A Biomarker questionnaire was conducted by researchers to collect data on the height and weight of 2,339 children under five years of age. (Ministry of Health Nepal, 2017)

3.2 Estimation Strategy

Sustainable Development Goal 17.18 is "to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts" (United Nations, n.d.). This disaggregation is important in order to understand how different populations are impacted by the world around them. Nepal has three vastly different ecological zones: the terai, hills, and mountainous regions. There is also a great deal of diversity in income and without the inclusion of disaggregating these variables, it would be impossible to find the variation in effects that are present. For instance, disaggregation is highly important to show that children in mountainous areas are much more prone to stunting, while children in the terai suffer to a greater extent from wasting. Additionally, disaggregation is important for policy implications so as to ensure nutritionally deficient populations are being targeted with the most effective assistance.

OLS regressions, although commonly used in the literature on child nutritional status, also come with downfalls. Although in some cases, averages can give researchers a glimpse at a situation, they are not overly useful when trying to consider how members of a population may be affected differently. Following research done by Borooah (2004) on India, both OLS regressions as well as quantile regressions at the 25^{th}, 50^{th} and 75^{th} percentile are run on height-for-age and weight-for-height in children under five in Nepal. This allows researchers to observe what factors affect undernutrition in children in Nepal based on where they fall in the distribution of nutritional outcomes and how they may differ from the population average.

The following equation is thus estimated:

$$Y = \beta_0 + H\beta_1 + M\beta_2 + D\beta_3 + u \qquad (1)$$

Regressions are done using height-for-age (HAZ) and weight-for-height (WHZ) z-scores, respectively, as the dependant variable Y. HAZ and WHZ are continuous variables and are commonly used and widely accepted in the literature as good indicators of nutritional status (Borooah, 2004; Tiwari et al, 2017).

H measures indicators of the household a child grows up in, the people who live in it and where it is situated. There is evidence that suggests the ecological zone in which a child lives can influence their well-being in various ways. Dichotomous variables are used for living in the mountainous region and living in the terai region, respectively, with the hills used as the reference category. The mountains and terai are used specifically due to the literature suggesting a greater incidence of stunting in the mountains, while wasting is a far greater problem in the terai (Shively et al, 2011). These variables take the value of 1 when a child resides in either respective area, and 0 otherwise. Household members can influence nutritional status of children through care-taking, distributing resources, and supporting the children while ill. Households with more members may have to spread resources thinner than households without as many hungry mouths to feed, thus influencing the nutritional status of the children in the household. A continuous variable for birth order is used to calculate the effect of being a later-born child, and thus having a greater number of people to share resources with during your critical period for nutritional improvement (World Bank, 2012). The age of a mother at the time of her child's birth can be an indicator of the mother's experience in, and knowledge of, caring for children (Borooah, 2004). Children born to older mothers are thought to be better off than the children of younger mothers due to the experience gap that is inherently created with time. A mother's age at birth is a continuous variable calculated in years in addition to years squared so as to account for non-linear effects of age. Non-linear effects are measured due to the decreasing knowledge gap over time. This is explained by the experience obtained as a woman ages. A woman who gives birth at age 20 likely has more experience and knowledge of caring for a child than a mother at age 15, however, the difference between a woman giving birth at age 30 and 35 will likely be less substantial as the majority of experience and knowledge will have already been obtained. Likewise, there has been a link created between a mother's education and her children's nutritional status. Borooah (2004) expressed the importance of children having educated mothers, explaining that an educated mother is more likely to take on the responsibility of taking a sick child to a health clinic, as she is more comfortable discussing her child's well-being with health care workers. Although often ignored in studies of nutrition, Vollmer et al (2016) found that a father's educational attainment had a similar effect on his children's nutritional status as a mother's and thus ought to be included in studies of childhood nutrition. Both mother and father's education level is calculated using respective single years of schooling and single years of schooling squared to account for non-linear effects that schooling has on nutritional outcomes. Education is estimated using non-linear effects as education tends to have decreasing returns to scale over time.

There are a variety of health factors[3] (M) that can influence the nutritional outcomes of children. Borooah (2004) used access to improved toilet facilities and safe drinking water on his study on

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[3] The presence of a separate kitchen has been thought to give women control over a space in the household which could aid in the nutritional outcomes of the children (Borooah, 2004). Low birth weight can be caused by various nutritional deficiencies that began prior to birth and may lead to persisting

height-for-age in India. Improved toilet facilities are defined by the Ministry of Health, Nepal (2017) as unshared “flush/pour toilet to piped sewer systems, septic tanks, and pit latrines; ventilated improved pit (VIP) latrines; pit latrines with slabs; and composting toilets” and drinking water was defined as being safe if it came from an improved source (such as piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, and rainwater). An improved source of water protects from contaminants making it safer to drink and lessening the risk of contracting illnesses such as diarrhea. Both the presence of improved toilet facilities and access to an improved water source are measured as dichotomous variables in this study with a value of 1 when they are present, and 0 otherwise.

Discrimination in Nepal exists on a variety of platforms, intersecting many groups. Hinduism is the most highly practiced religion in Nepal and, as a result, the caste system is present throughout the country. This has created an environment of inequality and ostracization which negatively impacts the lower ranking castes, Muslims, and indigenous people to Nepal. As a result, these factors are included in this study as three distinctive, dichotomous variables separating lower caste, upper caste, and indigenous people to Nepal where membership in one of these groups takes on the value 1, and a value of 0 otherwise. Women are also highly discriminated against, which affects the intra-household distribution of resources leaving women to eat last in 70 percent of households (Rights & Democracy, 2007). A female dichotomous variable is created, taking on the value of 1 if a person is a female, and 0 if male.

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effects in nutritional outcomes throughout childhood. Measures of low birth weight and the presence of a separate kitchen were omitted from the regressions due to a high number of missing variables that could lead to selection bias in the results. Borooah (2004) used a child living in a village which had ‘easy’ access to a health clinic, as it increased the likelihood of a child in ill health being seen by a health care worker. The database used did not measure presence of health facilities, however, this is imperfectly controlled for through the use of rural/urban, and regional effects. As a result, a limitation of this study is its lacking the estimation of the effects of access to health care, the presence of a separate kitchen and a low birth weight on the nutritional status of children.

This discrimination against women was found to translate to the well-being of girls born with older sisters in India (Jayachandran et al, 2017). Later-born children may have lower nutritional outcomes than their older siblings due to resources being spread thinner between more children during their critical period of growth, however, Jayachandran et al (2017) found an even greater effect of girls born with older sisters. This was due to the preference for sons in India. Jayachandran et al (2017) explain that when there is a preference for sons, the birth of a daughter increases the number of children a family plans to have so as to adjust for a future that includes a male heir. This results in a reduction in resources for the most recently born daughter as parents save for the coveted son. Due to Nepal and India being culturally very similar, having an older sister may have a similar effect for girls in Nepal. As such, a dichotomous elder sister variable is calculated which takes on the value of 1 if the index child is female and has at least one older sister, and the value of 0 otherwise.

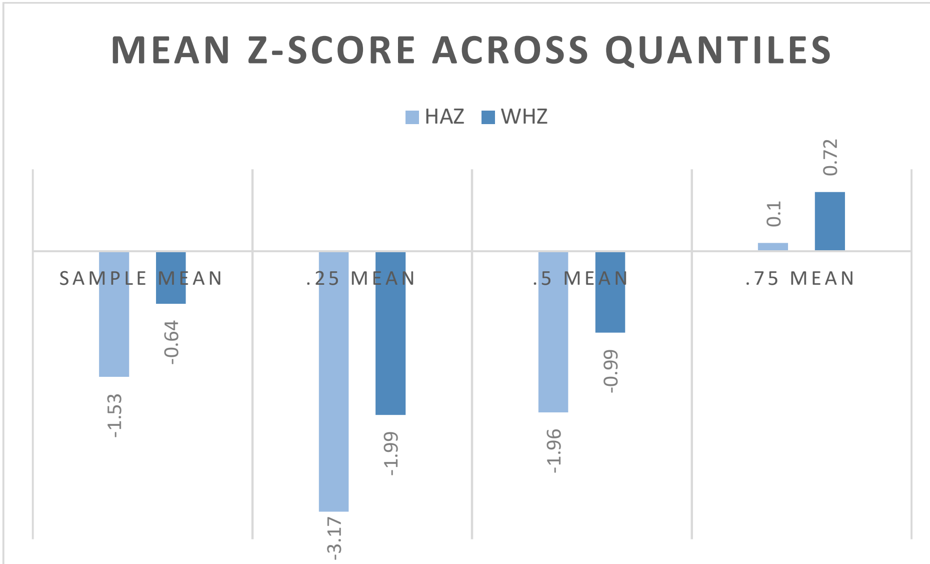
Interviews are conducted with women on behalf of their children. As such, children are not independently and identically distributed among the population, and data is clustered at the mother level. The standard errors are thus corrected for clustering.

Results

4.1 Descriptive Statistics

Of the children in this sample, 36 percent had a height-for-age z-score below -2 standard deviations from the WHO reference median and thus were considered stunted and 12.7 percent were severely stunted (z-score below -3 standard deviations from the WHO reference median). 9.8 percent of children were found to be wasted, and just 1.9 percent were severely wasted.

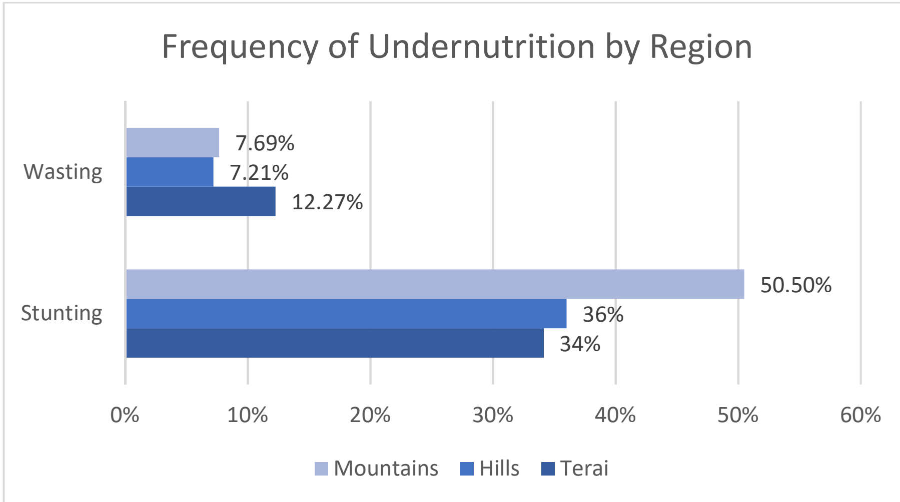
Figure 1:



The 25th percentile of height-for-age z-scores have a range of -5.59 to -2.37, and weight-for-height a range of -4.69 to -1.36. The 50th percentile HAZ has a z-score below -1.57, while WHZ is below -0.65. This is in contract to the 75th percentile of HAZ which has a range of -0.72 to 3.95 and WHZ a range of 0.05 to 2.99. For both HAZ and WHZ, only children in the 75th percentile of nutritional outcomes have z-scores above that of the WHO reference median. Mean z-scores for both height-for-age and weight-for-height are illustrated in Figure 1.

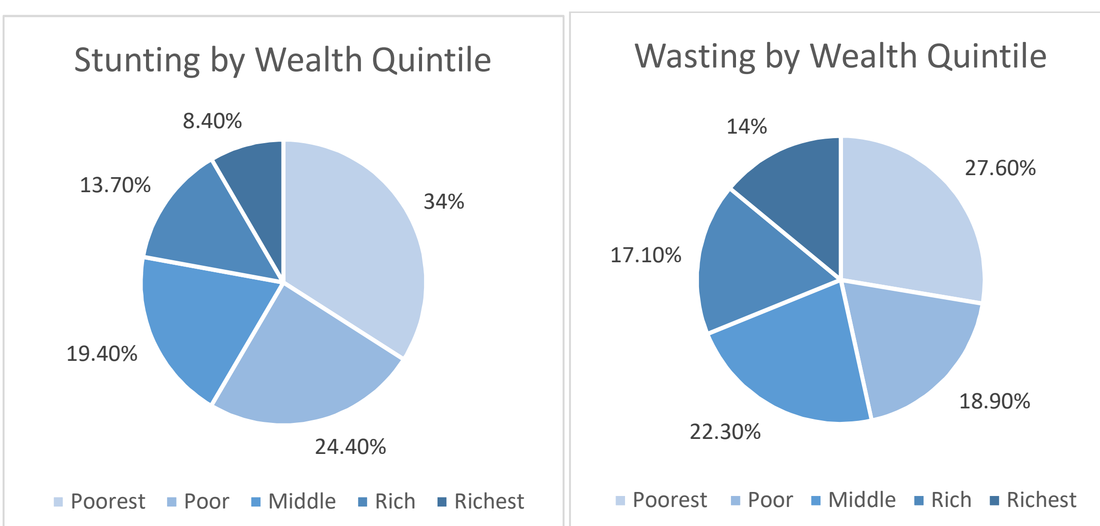
As suggested in the literature (Shively et al, 2011), undernutrition has great regional disparities. As shown in Figure 2, stunting is a much greater issue for children living in the mountains where more than half of the children in our sample are stunted. Rates of stunting in Nepal are significant, with no less than 30 percent of children from any given ecological zone in this sample found to be stunted (Figure 2) Additionally, rates of wasting in the terai region are found to be far greater than in any other ecological zone.

Figure 2:



Children in the bottom two wealth quintiles, those who are from the poorest and the poor families, have significantly higher rates of stunting than children from the top three wealth quintiles (Figure 3). Wasting appears to be distributed more evenly among wealth quintiles than rates of stunting, however, children from the top two wealth quintiles have a smaller rate of wasting than the lower three quintiles.

Figure 3:



4.2 OLS and Quantile Regression Results

Table 2 shows the impact of a variety of determinants on the nutritional outcomes of children along the distribution. Living in a mountainous region was found to have a significant negative impact on height for age across the distribution, and more significantly so for those in the lowest quantile. Holding all else constant, a child living in the mountainous regions in the lowest quantile of nutritional status will have a height-for-age 0.354 standard deviations lower than children in the hills. This means that those who are worst off in terms of their nutritional status are increasingly affected by residing in mountainous regions than their counterparts from the hill or terai regions. This confirms that holding all other factors constant, the mountainous regions suffer from the largest nutritional problems. Alternatively, the impact of living in the terai region was significant and negative for the weight-for-height of children in Nepal across the distribution and insignificant for their height-for-age. All else equal, a child’s weight-for-height will see a negative effect of no less than 0.414 and no more than 0.474 standard deviations when living in the terai region. These findings coincide with the literature that the terai region is characterized by high instances of illness and disease, a common source of wasting in children (Shively et al, 2011).

A child’s age was found to be negatively significant across all models for height-for-age z-scores and for the weight-for-height z-scores of children in the lowest (q=0.25) and highest (q=0.75) quantiles. This is not surprising in terms of height-for-age due to its cumulative nature. Considering height-for-age is a measure of long-term nutritional deficiencies, the older a child is, the more stunted they will become when nutritional deficiencies are sustained over long periods of time.

Table 1: Descriptive Statistics

VARIABLES	Obs.	Mean	Std. Dev.	Min	Max
Height-for-Age	2,315	-1.539	1.321	-5.85	4.99
Weight-for-Height	2,319	-0.646	1.109	-4.88	4.76
Age of Child (in months)	2,319	29.105	17.088	0	59
Mountain	2,319	.084	.277	0	1
Terai	2,319	.509	.500	0	1
Mother's Education (in years)	2,319	5.08	4.337	0	11
Upper Caste	2,319	.351	.477	0	1
Indigenous	2,319	.283	.450	0	1
Lower Caste	2,319	.210	.407	0	1
Hindu	2,319	.866	.339	0	1
Poorest	2,319	.248	.432	0	1
Poor	2,319	.225	.418	0	1
Middle	2,319	.213	.410	0	1
Rich	2,319	.177	.381	0	1
Richest	2,319	.134	.341	0	1
Mother's Age at Birth (in years)	2,319	24.194	5.372	14.25	46.67
Female	2,319	.475	.499	0	1
Rural	2,319	.651	.476	0	1
Father's Education (in years)	2,319	6.712	3.766	0	11
Toilet	2,319	.812	.390	0	1
Birth Order	2,319	2.247	1.528	1	11
Elder Sister	2,319	.319	.466	0	1
Safe Water	2,319	.943	.231	0	1
Observations					2319

Wealth is shown in table 2 to have a very strong link to the height-for-age of children along the distribution of nutritional outcomes. Children in the poorest wealth quintile suffer significant, negative effects to their height-for-age in the OLS regression as well as all three quantile regressions. Moving from the "poorest" wealth quintile to "poor" has a significant effect on a child's height-for-age, indicating that wealth is important, particularly for children who are the worst off. A child in the 25th percentile and lowest wealth quintile, holding all else constant will see a reduction in their height-for-age z-score of 0.460 standard deviations. An upward movement toward other wealth quintiles does not have this same effect until you reach the "richest" quintile, which has a significant positive effect on children's height- for-age in the OLS

Table 2: Determinants of Nutritional Outcomes

	OLS Regression		25th Percentile		50th Percentile		75th Percentile	
VARIABLES	HAZ	WHZ	HAZ	WHZ	HAZ	WHZ	HAZ	WHZ
Age of Child	-0.019***	5.58e-05	-0.0116***	0.0033*	-0.0185***	-0.0015	-0.020***	-0.0042**
	(0.0015)	(0.0014)	(0.0024)	(0.0017)	(0.0019)	(0.0017)	(0.0018)	(0.0016)
Mountain	-0.247**	-0.0894	-0.354***	-0.0417	-0.224*	-0.0378	-0.279**	-0.115
	(0.111)	(0.0897)	(0.134)	(0.0969)	(0.121)	(0.109)	(0.126)	(0.119)
Terai	-0.0009	-0.424***	0.0157	-0.417***	0.0044	-0.414***	0.0503	-0.474***
	(0.0702)	(0.0614)	(0.0882)	(0.0768)	(0.0792)	(0.0708)	(0.0826)	(0.0718)
Mother Educ	-0.0017	0.0105	-0.0393	0.0557*	-0.0036	-0.0014	-0.0061	-0.0007
	(0.0282)	(0.0233)	(0.0338)	(0.0294)	(0.0342)	(0.0289)	(0.0330)	(0.0274)
Mother Educ^2	0.0017	0.0001	0.0046	-0.0047*	0.0016	-4.36e-06	0.0023	0.0014
	(0.0026)	(0.0021)	(0.0032)	(0.0027)	(0.0032)	(0.0025)	(0.0030)	(0.0025)
Upper Caste	0.0639	0.102	0.107	0.0506	-0.0077	0.173	0.0487	0.134
	(0.111)	(0.0868)	(0.141)	(0.122)	(0.135)	(0.114)	(0.145)	(0.105)
Indigenous	0.319***	0.160*	0.370***	0.167	0.141	0.217**	0.223	0.112
	(0.109)	(0.0833)	(0.137)	(0.109)	(0.140)	(0.108)	(0.141)	(0.0970)
Lower Caste	0.166	-0.0536	0.213	-0.161	0.0867	0.0622	0.0992	0.0836
	(0.109)	(0.0863)	(0.146)	(0.114)	(0.132)	(0.123)	(0.139)	(0.109)
Hindu	0.0585	-0.254***	-0.0480	-0.136	-0.0279	-0.258**	0.0519	-0.371***
	(0.0912)	(0.0795)	(0.116)	(0.102)	(0.100)	(0.107)	(0.105)	(0.0859)
Poorest	-0.364***	-0.0974	-0.460***	-0.151	-0.382***	-0.152	-0.268**	-0.101
	(0.0934)	(0.0805)	(0.117)	(0.108)	(0.111)	(0.0980)	(0.129)	(0.104)
Poor	-0.121	-0.0486	-0.106	0.00334	-0.132	-0.101	-0.160	-0.170*
	(0.0803)	(0.0690)	(0.108)	(0.0938)	(0.0984)	(0.0910)	(0.103)	(0.0913)
Rich	0.105	0.0737	0.157	-0.00407	0.105	0.0227	0.199*	0.0548
	(0.0857)	(0.0759)	(0.107)	(0.0972)	(0.103)	(0.0943)	(0.107)	(0.0970)
Richest	0.383***	0.0513	0.311**	0.135	0.313***	0.00356	0.360**	0.00917
	(0.0996)	(0.0828)	(0.128)	(0.107)	(0.119)	(0.105)	(0.156)	(0.0999)
Mother Age	0.0392	-0.0195	0.0357	-0.0322	0.0567	-0.0347	-0.0204	-0.0176
	(0.0384)	(0.0301)	(0.0599)	(0.0473)	(0.0459)	(0.0424)	(0.0629)	(0.0305)
Mother Age^2	-0.0005	0.0004	-0.0003	0.0007	-0.0006	0.0006	0.0008	0.0003
	(0.0007)	(0.0005)	(0.0011)	(0.0009)	(0.0008)	(0.0007)	(0.0012)	(0.0005)
Female	0.0566	0.0191	0.0412	0.0255	0.0140	0.0105	0.0592	-0.0146
	(0.0532)	(0.0482)	(0.0713)	(0.0609)	(0.0663)	(0.0585)	(0.0752)	(0.0615)
Rural	0.0215	-0.0411	-0.00318	-0.0371	0.0968	-0.0316	0.0187	-0.0701
	(0.0599)	(0.0502)	(0.0704)	(0.0627)	(0.0744)	(0.0620)	(0.0750)	(0.0606)
Father Educ	0.0282	0.00845	0.0321	-0.0480	0.0210	0.0134	-0.00576	0.0603**
	(0.0301)	(0.0236)	(0.0403)	(0.0312)	(0.0361)	(0.0300)	(0.0371)	(0.0263)
Father Educ^2	-0.002	-0.0011	-0.0015	0.0037	-0.0014	-0.0013	-0.0002	-0.0058**
	(0.0025)	(0.002)	(0.0034)	(0.0026)	(0.003)	(0.0025)	(0.0031)	(0.0024)
Toilet	0.230***	0.0410	0.252**	0.0585	0.377***	0.0953	0.252**	-0.0715
	(0.0869)	(0.0702)	(0.122)	(0.0849)	(0.110)	(0.0993)	(0.113)	(0.0849)
Birth Order	-0.0770**	-0.0314	-0.125**	-0.0203	-0.120***	-0.0468	-0.0942**	-0.0364
	(0.0306)	(0.0256)	(0.0530)	(0.0339)	(0.0387)	(0.0369)	(0.0401)	(0.0302)
Elder Sister	-0.0351	-0.0805	-0.0590	-0.130	0.0529	0.0140	-0.0401	-0.0708
	(0.0776)	(0.0659)	(0.107)	(0.0821)	(0.0983)	(0.0826)	(0.0975)	(0.0880)
Safe Water	0.138	-0.0879	0.346*	-0.0927	0.161	-0.105	0.113	-0.0300
	(0.147)	(0.109)	(0.208)	(0.117)	(0.186)	(0.195)	(0.170)	(0.0934)
Constant	-2.047***	0.0382	-3.089***	-0.590	-2.291***	0.334	-0.505	1.027**
	(0.546)	(0.442)	(0.753)	(0.648)	(0.660)	(0.633)	(0.891)	(0.460)
Observations	2,322	2,319	2,322	2,319	2,322	2,319	2,322	2,319
R-squared	0.149	0.064	0.132	0.052	0.144	0.059	0.141	0.051

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

regression and across the whole distribution. Weight-for-height is not significantly affected by wealth and is not easily predicted as given by r-squared (Table 2).

Birth order is negatively significant for height-for-age in the two lowest quantiles. This means that children with a higher birth order, that is, the later-born children, are more likely to have a lower height-for-age than first-born children for all regressions. A child in the bottom two nutritional quantiles will see a loss in their HAZ of no less than 0.120 and no more than 0.125 holding all else constant. Greater negative values for lower quantiles (q=0.25, q=0.50) further support the idea that children who are the worst off are more greatly affected by limited resources than children higher up in the distribution.

A mother's education level is positively significant at a 10 percent level for a child's weight-for-height z-score in the lowest quantile (q=0.25), however, has decreasing returns to scale and is not significant for any regressions on height-for-age z-scores. Holding all else constant, a mother with a single year of schooling will increase their child's weight-for-height by 0.0557, but this effect will decrease by 0.0047 with every additional year of education. This may indicate that a mother's education, although insignificant for long-term nutritional status (height-for-age), it is important for increasing the weight-for-height of children who are at the lowest end of the distribution. Furthermore, a father's education level was found to be positively significant at a 5 percent level in the 75^{th} percentile of weight-for-height z-scores. Obtaining a single year of education will increase his child's weight-for-height by 0.06 standard deviations and this effect will decrease by 0.005 with every additional year of schooling, other things being equal. This supports the argument by Vollmer et al (2016) that a father's education ought to be included in studies on nutritional status in children. Education for both mothers at the q=0.25 and fathers for q=0.75 have decreasing returns to scale, meaning that with each additional year of schooling a parent obtains, the positive effect on their child's weight-for-height will have a slightly smaller effect than the previous year.

Sanitation can have crucial health implications to prevent the spread of bacteria and viruses. Access to an improved toilet facility had a significant positive effect on the height-for-age of children in the OLS regression and for all quantiles. All else being equal, children in the 25th and 75th percentiles will have an increase to their height-for-age of 0.252, while children in the 50th percentile will see an increase to their height-for-age of 0.377 standard deviations (Table 2). Likewise, having access to a safe source of drinking water had a significant effect on height-for-age in children who are the worst off (q=0.25). All else constant, a child in the 25th percentile for their height-for-age will have an increase of 0.346 standard deviations at a 10 percent level of significance. As per Table 1, 94.3 percent of households had access to a source of safe drinking water which could explain why it appears to be insignificant for children whom are better off. Additionally, this could be due to multicollinearity with the wealth index which uses household asset indicators in its calculation.

OLS regressions are important contributions in many fields, however, in this context an OLS regression ignores the variation in determinant effects at the differing levels of nutritional outcomes. The OLS regression fails to acknowledge the significantly positive effects that a safe source of drinking water has on children who are the worst off in terms of their height-for-age. It also fails to see the positive contribution parental education has on a child's weight-for-height in the highest quantile (Table 2). This infers that government and aid workers must target different indicators to increase nutritional outcomes for those who are the worst off as opposed to the average child.

In the OLS regression, having access to a safe source of drinking water was insignificant for the weight-for-height and height-for-age of children. The insignificance of these results mirror those found by Tiwari et al (2017) on weight-for-height of children in Nepal. Huijbers et al (1996) found that children in lower castes in the highlands of Nepal had a positive effect on their height-for-age and higher castes had a negative effect. The results from this study found that higher and lower castes were insignificant for a child's nutritional status and thus are not consistent with those found by Huijbers et al (1996). In the future, pooling DHS surveys will give researchers an increased sample size, allowing them to conduct region specific regressions which may present results similar to those found in previous studies.

4. Conclusion and Policy Implications

The health of people as a whole, and the nutritional status of children in particular, is important in its own right as an end in itself. As a part of the United Nations Sustainable Development Goals, reducing child nutrition is recognized worldwide as an important step to building a better world for all (United Nations, n.d.). Although it need not contain any additional value, policy-makers will find that good nutritional outcomes can serve as a means to an ends in addition to its value as an end in itself. Great value can be found in the advancement of child nutritional outcomes as a representation of the country's development and a huge contributor to the quality of human capital entering the work force and upholding their economy. The World Health Organization (2014) declared stunting as a major impediment to human development, however, it is not only individuals that it affects. Undernutrition, in addition to being an impediment to human development, is an impediment to the entire country's development (World Bank, 2012).

Children in the lowest wealth quintile in the mountains are at a particularly high risk of stunting. There is evidence that suggests stunting for these children is a result of access to resources. Programs should be implemented to help farmers in mountainous regions increase their crop yields and target the poorest family units for subsidized food supplies. By ensuring all children are receiving the minimum acceptable amount of nutrients, the high rate of stunting observed in the mountains will likely decrease. Additionally, vaccine and disease prevention programs such as the distribution of mosquito nets should be targeted to the terai region to help curb their emergent levels of wasting. Nutrition policies targeting specific populations will improve the health of children at varying positions on the distribution and will benefit the entire country by improving the lives of the people and increasing their ability to contribute to the economy.

Future research on this topic could pool DHS surveys done in Nepal over recent years so as to increase sample size and obtain results that are more representative. This may solve the issue of having a number of insignificant variables at the 10 percent level. A low weight-for-height is often caused by illness and disease and, as such, there could be seasonal effects which are unaccounted for. Future research could incorporate the month in which the survey is administered, and match DHS surveys to rainfall data so as to control for this seasonal variability. Additionally, matching the DHS data with data that measures the presence of or distance to health facilities in the child's community will improve the study.

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