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Economic and Socio-Demographic Determinants of Child Nutritional Status in Egypt: A Comprehensive Analysis using Quantile Regression Approach

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Economic and Socio-Demographic Determinants of Child Nutritional Status in Egypt: A Comprehensive Analysis using Quantile Regression Approach

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Abstract

This paper examines the underlying economic and socio-demographic determinants of child nutritional status in Egypt using data from the 2014 Demographic and Health Survey. The Height for Age Z-score (HAZ) is used as a measurement of child growth assessment. We contribute to the extant literature by using a quantile regression model to allow for a heterogeneous effect of each determinant along different percentiles of the conditional distribution of the HAZ score. We use a nationally representative sample of 13,682 children aged 0–4 years, for which we observe their health measures. The multivariate analyses include a set of HAZ determinants that are widely used in the literature. The conditional and unconditional analyses reveal a socioeconomic gradient in child nutritional status, in which children of low income-education families have lower HAZ than children from the high income-education households. We also find significant disparities in child nutritional status by demographic and social characteristics. The quantile regression results show that the association between the economic and socio-demographic factors and the HAZ differ along the conditional HAZ distribution. Intervention measures need to take into account the heterogeneous effect of the determinants of child nutritional status along the different percentiles of the HAZ distribution. There is no one-size-fits-all policy to combat child malnutrition; a multifaceted approach would be required to address this problem effectively.

JEL Classification : I14, J13

Keywords: Child malnutrition; socio-demographic characteristics; quantile regression; Egypt

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1. Introduction

It is widely documented that poor nutrition in childhood has devastating consequences on child growth. Compared to well-nourished children, malnourished children have a weaker immune system, higher risk of mortality and morbidity, reduced physical ability, and inability to reach potential height (United Nations Children's Fund, 2013). Chronic malnutrition in early childhood, including the pregnancy period, impairs brain development and has inescapable effects on child growth, such as having the inadequate height for age (stunting) for the rest of their life. A child's poor nutritional status has been linked to poor school performance which in turn lowers future employment opportunities and income generation, causing intergenerational consequences (United Nations Children's Fund et al., 2012).

Worldwide, under-nutrition, including vitamin and mineral deficiencies, contributes to about one-third of all, under-5-years child deaths, and impairs healthy development and life-long productivity (United Nations Children's Fund, 2013). A key indicator of chronic malnutrition is stunting -when children are too short for their age group, compared to the World Health Organization (WHO) child growth standards. Worldwide, more than 165 million children are stunted, with the highest stunting rates in Africa and Asia. Wasting, a severe form of malnutrition, is responsible for the death of more than 1.5 million children annually, with the highest prevalence among the poor (United Nations Children's Fund et al., 2012).

Egypt has the largest number of stunted children under five years old in the Middle East and North Africa, and the twelfth worldwide. According to 2008 Egypt Demographic and Health Survey (EDHS), child stunting rate reached 29%, with 14% are severely stunted. Statistics reveal significant disparities in health child outcomes by region, economic and socio-demographic characteristics in Egypt (Sharaf and Rashad, 2015).

The objective of this paper is to examine, using data from 2014 Egypt Demographic and Health Survey, the association between economic and socio-demographic factors and child nutritional status in Egypt on which limited research has been conducted. In this paper, we use the Height for Age Z-score (HAZ) as a measurement of child growth assessment. We contribute to the extant literature by using quantile regression. The merit of the quantile regression is that it allows the effect of each determinant to vary along different percentiles of the conditional distribution of the HAZ score. Examining how individual economic and socio-demographic factors affect the child nutritional status at different HAZ levels is particularly important in the nutrition literature where attention is given to the tails of the distribution.

The importance of this study is that by identifying the underlying factors associated with child nutritional status, the findings of this paper would help in designing effective intervention measures aimed at reducing disparities in child health and improving child health outcomes.

The paper is organized as follows: Section 2 presents a brief review of the related literature. Section 3 provides a description of the data and the empirical methodology. Section 4 presents the results which are then discussed in Section 5. Section 6 concludes the paper.

2. A Brief Review of the Literature

A growing literature has emerged to examine the determinants of child nutritional status, in a wide range of countries, and using different econometric methodologies [see for e.g. Bassolé (2007); Bomela (2009); Kabubo-Mariara et al. (2009); Mazumdar (2010); Fenske et al. (2013); Sweeney et al. (2013)]. Previous studies mostly use linear regression methods to examine the correlates of the conditional mean of the HAZ. Standard linear regressions, like Ordinary Least Squares (OLS), estimate the effect of different covariates on the conditional mean of the HAZ. This average effect may over or underestimate the influence of the covariates at different points across the HAZ distribution. Also, this approach may be less informative if the association between the demographic and socio-economic determinants and the HAZ significantly varies across the HAZ distribution.

Another group of studies examine the correlates of nutritional status using binary regression models. The shortcoming of these models is that they treat observations that are below or above a particular threshold level equally, and ignore the intensity of the deviations from that threshold level. Consequently, there could be a statistical loss of information that may be relevant for intervention and health promotion measures. For example, individuals may respond differently to the factors causing nutritional deficiencies, depending on their location in the HAZ distribution. Accordingly, this study contributes to the extant literature by using a quantile regression framework to characterize the heterogeneous association across the different percentiles of the HAZ distribution. This is of particular importance to the nutrition literature where attention is given to certain segments of the HAZ distributions. For example, individuals in the lower percentiles of the HAZ distribution, both stunted and severely stunted, are of more interest to policies aimed at reducing malnutrition and improving children health outcomes.

In a related study, Bassolé (2007), used quantile regression and found a heterogeneous impact of access to public infrastructure, i.e. safe water and health facilities, on child nutritional status in Senegal. In particular, the effect of health facilities is more important to the lowest quantile and is decreasing, and safe water improves child nutritional status up to the 10th percentile at the national level. However, in rural areas, only health facilities have a positive and significant effect on child nutritional status. Fenske et al. (2013) analysed, using cross-sectional data, the determinants of child stunting in India, and examined whether the established focus on linear effects of single risks is appropriate. They modelled linear, non-linear, spatial and age-varying effects of the stunting determinants using additive quantile regression for four quantiles of the Z-score of standardized height-for-age, and logistic regression for stunting and severe stunting. They found that differential effects of the child stunting determinants across the height-for-age distribution did not play a major role.

In a cross-country study, Bomela (2009) used cross-sectional data from the DHS, and binary logistic regression analysis, to examine the effect of social, economic, health and environmental characteristics on the nutritional status of children in three Central Asian countries: Uzbekistan, Kyrgyzstan and Kazakhstan. The study found that the household size and wealth, birth weight, age of child, knowledge of oral rehydration therapy, maternal education, and the number of children-under-5 years of age, and source of drinking water were strong predictors of child nutritional status in these countries. Using data from India, and a decomposition analysis, Mazumdar (2010) investigated the linkage between poverty, measured in terms of the wealth index, and inequality in malnutrition. Poverty was found to have a considerable impact on average rates of malnutrition, explaining more than half of the inequality in malnutrition.

Using pooled data from the DHS, Kabubo-Mariara et al. (2009) analysed the determinants of children's nutritional status in Kenya. They found that boys suffer more malnutrition than girls, and children of multiple births are more likely to be malnourished than singletons. They also found that maternal education, the use of public health services and household assets are important determinants of children's nutritional status and that nutrition improves at a decreasing rate with assets. Liu et al.,(2013) examined the degrees of health and nutritional disparities between urban and rural children in China and found that on average urban children have 0.29

higher height-for-age *Z*-scores and 0.19 greater weight-for-age *Z*-scores than rural children. Urban children are 40% less likely to be stunted or underweight during the period 1989–2006. They also found that the urban–rural health and nutritional disparities have been declining significantly over time.

3. Data and Methodology

3.1. Data

This paper uses data from the most recent round of the Demographic and Health Survey (DHS) for Egypt conducted in the year 2014. The DHS is an international survey conducted in 85 countries. The survey has data on a rich set of indicators in the areas of population, health, and nutrition. The DHS has a complex survey design that involves stratification based on the level of urbanization and clustering, where villages are the primary sampling unit for rural and districts/towns are the primary sampling unit for urban areas (Ministry of Health and Population et al., 2015).

In this paper, we focus on a nationally representative sample of 13,682 children aged 0–4 years, for which we observe their health measures. The multivariate analyses include a set of HAZ determinants that are widely used in the literature. These include child characteristics such as child age, sex; and parental and household-level factors along with other socioeconomic determinants related to the affordability of purchasing nutrition-rich food, and living in a healthy environment. In particular, the analyses include child sex, age, size at birth, whether a child is a twin, mother's age, level of education, employment status, BMI, access to regular health care during pregnancy, whether a mother is pregnant; household economic status measured by the wealth index, access to piped water, and parental healthcare visits, health insurance coverage, region of residence. All analyses are population weighted using the sampling weights provided in the DHS survey, and the survey design is taken into account in the analysis.

3.2. Methodology

In this paper, we use the HAZ score as a measurement of child growth assessment, and hence the outcome variable of interest in this study is the HAZ. There are three key anthropometric indexes for child growth assessment: the height-for-age, the weight-for-age and the weight-for-height. The height-for-age measures a child's body height relative to age, which reflects cumulative linear growth. The weight-for-age measures body mass relative to age, while the weight-for-height measures body weight relative to height. A low height-for-age is referred to as stunting, and it reflects inadequate nutrition for an extended period or chronic malnutrition. Unlike height, body weight is sensitive to short-term changes in diet; thus, it reflects the current nutritional status. A low weight-for-height is referred to as wasting, which is a result of starvation, or illness, and a low weight-for-age is referred as underweight (O'Donnell et al., 2008).

There are three main approaches for assessing child nutritional status:

1. **Z-score**: is calculated by dividing the difference between the value of a child's height or weight and the median value of the reference population, at the corresponding age and sex, by the standard deviation of the reference population. A child with a z-score less than negative two standard deviations is considered to be malnourished. The Egyptian Demographic and Health Survey uses the World Health Organization (WHO)'s reference as the reference population. This reference is based on the anthropometric measures of children of 6 countries (Brazil, Oman, Ghana, India, USA, and Norway) (De Haen et al., 2011).
2. **Percent of Median**: is calculated by dividing the value of child's height or weight by the median value of the reference population at the corresponding age and sex.
3. **Percentile**: gives the rank of a child with respect to the reference population. The percentile is expressed in terms of what percentage of the reference population a child's height or weight falls or exceeds.

Unlike the percentiles, the Z-score could be used to generate means and standard deviations. Furthermore, it is a continuous variable, which is fully observable, and could be incorporated directly into regression models. Accordingly, the z-score is the most convenient and widely adopted measure of child malnutrition in the literature.

In this paper, we use the HAZ score as a measurement of child growth assessment. The HAZ score is constructed as in Equation (1).

$$HAZ_i = \frac{h_{ij} - \bar{h}_j}{\sigma_i} \quad (1)$$

Where h_{ij} is the observed height of child i in the group j with the corresponding age and sex, $\bar{h}_j$ and σ_i is the median and standard deviation of the height in the reference group j. The DHS uses the World Health Organization (WHO)'s reference as the reference population.

To examine the disparities in child nutritional status by economic and socio-demographic factors at different points of the conditional HAZ distribution, we estimate the following quantile regression in Equation (2).

$$Q_{HAZ}(\mu|SES_{ij}, X_{ij}) = \alpha(\mu) + SES_{ij}\,\beta(\mu) + X_{ij}\,\gamma(\mu) \quad (2)$$

$Q_{HAZ}(\mu|SES_{ij}, X_{ij})$ is the μ^{th} conditional HAZ quantile function. The subscript i and j denote individual and country. μ represents a quantile. SES denote parental and household-level socio-economic status including mother's age, employment status, level of education, pregnancy status, nutritional status of the mother, whether the mother had adequate birth interval, household economic status measured by the wealth index, X is a vector of other covariates which includes: child characteristics such as child age, sex, size at birth; whether the child is a twin, access to piped water, delivery in a health facility, and parental healthcare visits, region of residence, access to health care insurance, whether there are other children under the age of 5.

4. Results

Insert Table 1 here

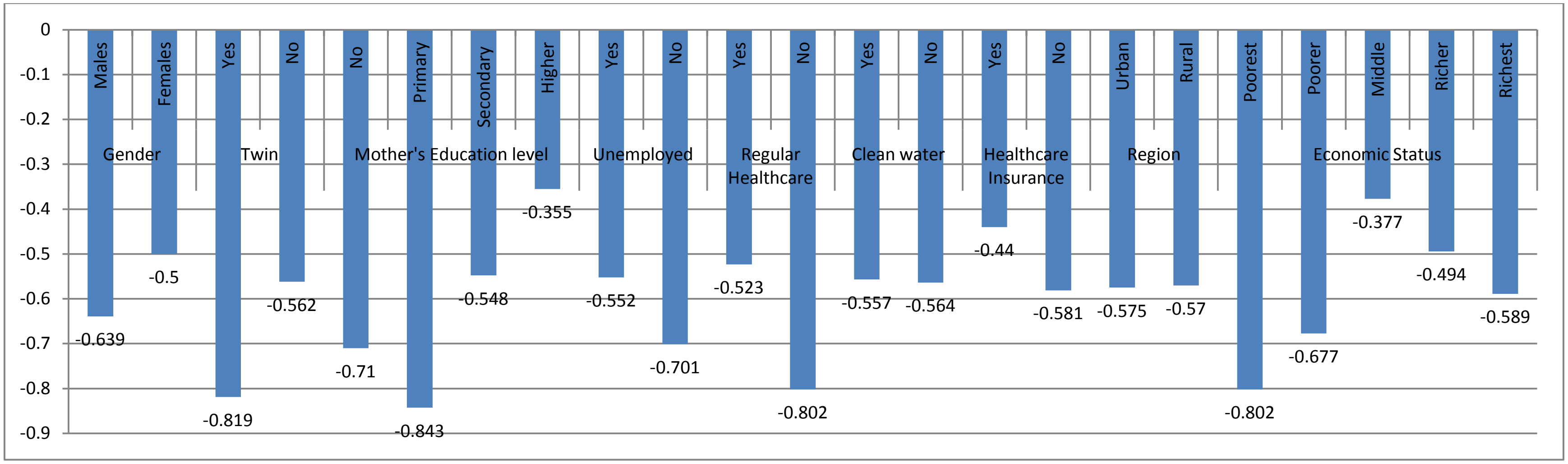
Table 1 presents a summary statistics of the variables used in the analyses. The mean HAZ score is -0.57, which indicates that, on average, Egyptian children are more than a half standard deviation shorter than the WHO's reference population (children of 6 countries: Brazil, Oman, Ghana, India, USA, and Norway). 54.5% of the children in our sample are boys, 41.47% are aged one year or less, 3.7% are twins, and 15.75 % have size at birth less than average. As for the mothers' characteristics, about 25% of the mothers are below the age of 24, 36% are aged between 25-29 years, and only 4% are aged between 40-49 years. About 88% of the mothers are unemployed, 9.25% were pregnant at the time of the interview, 0.31% are malnourished, about 18% did not receive regular health care during pregnancy, and 87% did not have an adequate birth interval. For mothers' educational level completed, 18% of the mothers are illiterate, 8.71% have primary education, 57.5% have completed secondary education, and 16% have more than secondary education. As for the household socio-economic status and living environment, about 14% of the households have more than one child under the age of 5, about 6% of the households have no access to clean water, 69.2% live in rural regions, 93.2% have no health insurance coverage, and the average wealth index is -17186.56.

Figure 1 depicts the disparities in the HAZ score by selected demographic and socio-economic characteristics. According to this unconditional analysis, boys have a greater standard deviation disadvantage in terms of height over that of girls. Figure 1 also reveals the standard socioeconomic status gradient in child health, where children from households with higher socioeconomic status have a lower height disadvantage when compared to children from households with lower SES. For example, the height disadvantage decreases with the mothers' level of education: higher education (-0.355) versus secondary education (-0.548), and primary education (-0.843). The relationship between households' income level and HAZ is taking a U-shape pattern with the biggest height disadvantage for children from the poorest households and the lowest standard deviation disadvantage for children from middle-income class. Figure 1 also shows no significant differences in the HAZ scores between urban and rural children. The height disadvantage, relative to the reference population, is lower for children with access to clean water, health insurance coverage, and those whose mothers received regular healthcare during pregnancy, and those whose mothers are unemployed.

Insert Table 2 here

Table 2 presents results of the Ordinary Least Squares (OLS) model as a baseline, as well as quantile regression estimates at five selected percentile levels (15%, 30%, 50%, 70%, and 90%). Results of the baseline OLS model show that on average boys have a 0.14 standard deviation disadvantage, in terms of height, over that of girls. Results also show a statistically significant negative association between HAZ and age. As the age of a child increase by one extra year, the HAZ decreases by 0.13 standard deviations. Older children have lower HAZ, which could be because the height disadvantage of Egyptian children relative to the international standard increases over time. Twin Childs have a 0.23 standard deviation disadvantage in terms of height over non-twin children. Child size at birth was also significantly associated with the HAZ, where small-sized children are 0.12 standard deviations shorter than big sized children.

Figure 1. Disparities in the HAZ score by Selected Demographic and Socio-economic Characteristics



Having a health insurance also has a statistically significant positive association with the HAZ, where children from households with health insurance coverage are 0.15 standard deviations taller compared to households with no health insurance.

Though children whose mothers are pregnant or malnourished have lower HAZ, compared to those whose mothers are not malnourished or pregnant, the coefficients are not statistically significant. Mother’s age has a statistically significant positive relationship with HAZ; Childs whose mothers are older (25 to 29, 30 to 34, and 35 to 49 years old) have higher HAZ than younger mothers (15 to 24 years old). In particular, compared with mothers who are between 15 and 24 years old, women in the age range (25 to 29) and (30 to 34) years old have children who are taller 0.12 and 0.18 standard deviations respectively. Results of the OLS show that on average, mother’s nutritional status, and pregnancy status, have a negative association, though not statistically significant, with HAZ, while adequate birth interval has a weak negative association with HAZ at 10% significance level. This is, in general, similar to the results of the quantile regression. However, the coefficient of mother’s nutritional status has a positive sign at lower percentiles (15% and 30%), which changes sign at higher percentiles. This means that at lower percentiles, children whose mothers are malnourished have higher HAZ than those whose mothers are not malnourished. Consistent with the results of OLS, quantile regressions estimates show a positive association between health insurance and HAZ. However, this positive association is statistically significant only at lower percentiles. As per mother`s level of education, compared to an illiterate woman, a woman with a higher education has children who are 0.25 standard deviations taller. Unemployed women have children who are 0.28 standard deviations taller than employed women. Receiving a regular healthcare during pregnancy is positively and significantly associated with the HAZ. Women who received regular health care during pregnancy have children who are 0.20 standard deviations taller than those who did not receive regular healthcare.

Studies have shown that household income is an important determinant of child health. Wealthier households can afford better medical care and more nutritious food, and can provide a healthy living environment. Consistent with this earlier evidence, both the OLS and quantile regression results show a positive association between household economic status and HAZ. Children from middle-income and richer households have higher HAZ when compared to the poorest households. In particular, children from middle income and richer households have a

0.34 and 0.18 standard deviation advantage in terms of height, over children from the poorest households. We found no statistically significant difference in the HAZ between rural and urban children though the coefficient on the rural dummy is negative. To capture the effect of healthy environment, we included a dummy for whether the household has access to clean water. Results show that children with access to clean water are on average 0.26 standard deviations taller than children with no access to clean water.

Figure 2. OLS and quantile regression estimates for HAZ determinants

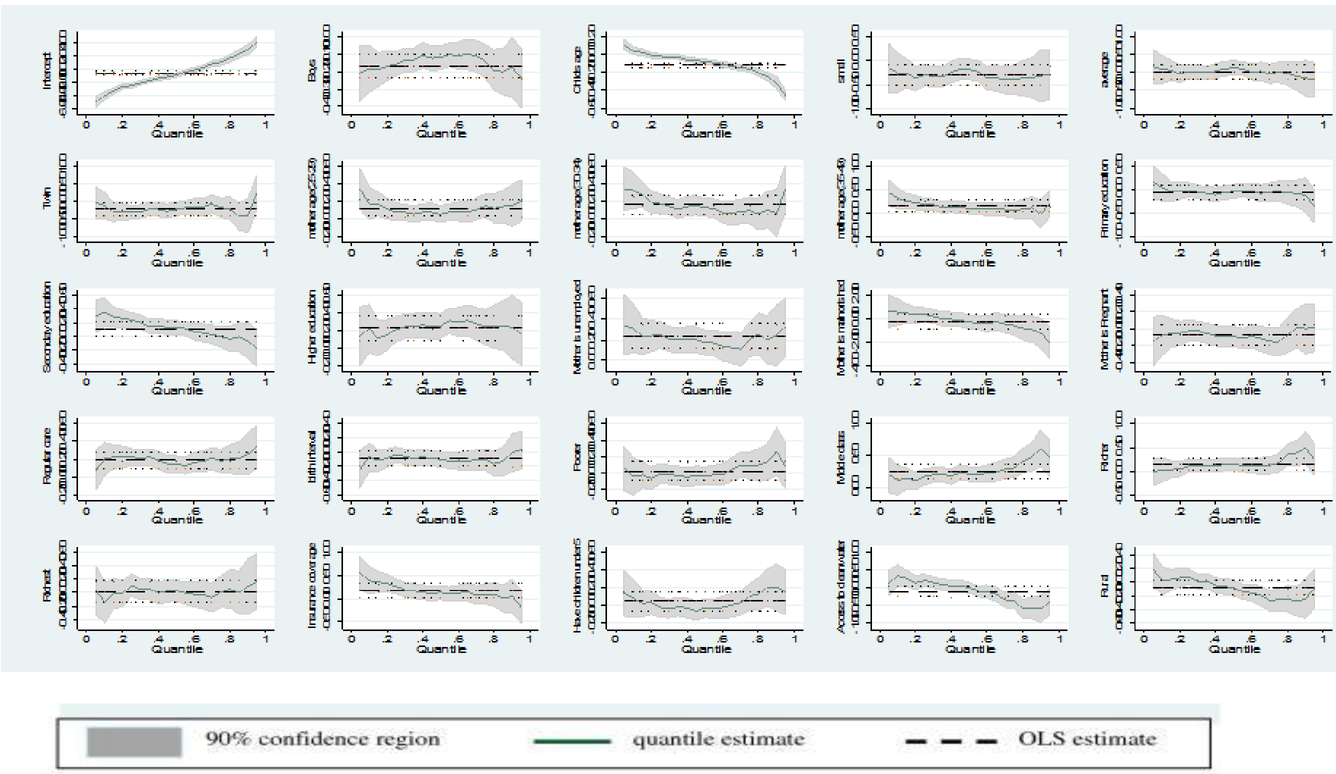


Figure 2 displays the OLS and quantile regression estimates for the HAZ determinants across the entire HAZ distribution. The quantile regression reveals the heterogeneous responses of a child's HAZ to the various socio-economic and demographic characteristics at different tails of the HAZ distribution. Figure 2 shows that the OLS model understates (overstates) the effect of access to clean water, the region of residence, mother's nutritional status, and access to health insurance on the HAZ at the lower (higher) quantiles of the conditional HAZ distribution.

Although the results show that child age has a statistically significant negative association with the HAZ score, the extent of this association varies across quantiles of the conditional HAZ distribution. In particular, the age coefficient increases in absolute value for children at higher points of the conditional HAZ distribution. For example, the age coefficient at the 90th quantile is almost seven times the estimate at the 30th quantile. Also, though results of both the OLS and quantile regression show that access to clean water and health insurance coverage are positively associated with the HAZ score, the extent of this association also varies across quantiles of the conditional HAZ distribution. The health insurance coefficient decreases in magnitude for children at higher points of the conditional HAZ distribution. The insurance coefficient is statistically significant only at the lower points of the conditional HAZ distribution. Similarly, the coefficient of the access to clean water variable decreases in magnitude as we move to higher points of the conditional HAZ distribution. This suggests that an adequate health insurance coverage and access to clean water could be an effective policy instrument to combat stunting and malnutrition among children in Egypt. As for the regional effects, results of the OLS model show no statistically significant difference in the HAZ score between urban and rural children. However, the quantile regression shows significant regional differences in the HAZ score, especially at higher points of the conditional HAZ distribution. Figure 2 reveals that the rural coefficient reversed it sign, where at lower quantiles, children in rural region have higher HAZ score than urban children, however, this pattern is reversed at higher quantilies of the HAZ distribution indicating that the urban advantage in is more profound among children at higher percentiles of the conditional HAZ distribution.

Socioeconomic status (SES), usually measured by income and education level, has been consistently linked to nutritional status. The level of income affects the amount of financial resources available for healthy and nutritious food. Educational attainment affects nutritional knowledge and awareness about the benefits of physical activity. In line with the unconditional analysis, results from both the OLS and quantile regressions reveal the existence of a socioeconomic status (SES) gradient in HAZ, where children from high-income families and those whose mothers have a higher level of education, have higher HAZ score compared to those from lower SES. The extent of this SES gradient varies across the conditional quantiles of the HAZ distribution. As for the association between income status and the HAZ score, results were mixed. Consistent with the results of the OLS model, the quantile regression shows no statistically significant difference in HAZ score between children from the poorer and richest households compared to children from the poorest families. However, children from middle income and richer households have higher HAZ score compared to children from the poorest households. This is consistent with earlier evidence that income level matters, to a certain degree, in health disparities. The quantile regression shows that children from richer families have a statistically significant HAZ advantage over poorest children only at lower percentiles of the conditional HAZ distribution while this advantage becomes not statistically significant at higher points of the HAZ distribution.

5. Discussion and Policy Implications

There is a substantial literature examining the determinants of child nutritional status in a wide set of countries, and using different econometric methods. However, previous related studies mostly used standard multiple linear or logistic regressions. The findings from these estimation methods may lead to wrong policy intervention measures if the association between child nutritional status and the different economic and socio-demographic determinants is heterogeneous at the different percentiles of the HAZ distribution. To overcome the limitations of earlier studies, we used a quantile regression model for investigating the disparities in child nutritional status by economic and socio-demographic factors in Egypt at different points of the conditional HAZ distribution. Results of the conditional and unconditional analyses show the existence of a socioeconomic gradient in child nutritional status, in which children of low income-education families have lower HAZ than children from the high income-education households. We also find significant disparities in child nutritional status by demographic and social characteristics. The quantile regression results show that the association between the economic and socio-demographic and the HAZ differ along the conditional HAZ distribution.

Several reasons have been presented in the literature to explain the disparities in child nutritional status by economic and socio-demographic characteristics [see for e.g. Kabubo-Mariara et al. (2009); Chen and Li (2009)]. For example, it has been suggested that educational attainment affects nutritional knowledge and awareness about the risks associated with inadequate nutrition. Previous studies found that educated mothers could feed their children better, as they are more skilled and could benefit more effectively from healthcare providers and healthcare information, and they are more aware of nutrition rich food and the importance of the hygienic living environment. In an earlier study, Chen and Li (2009), using data on a large sample of adopted children from China, found that mother’s education is an important determinant and has a causal nurturing effect on the health of adopted children as measured by the height-for-age Z-score.

The wealth status, a key socioeconomic determinant, has been consistently linked to health outcome such as malnutrition, as it directly related to the affordability of purchasing nutrition rich food, living in the healthy environment, and to access healthcare services. Consistent with this earlier evidence, both the OLS and quantile regression results show a positive association between household economic status and HAZ. Children from middle-income and richer households have higher HAZ when compared to the poorest households. The lack of satisfactory sanitation and safe water supply expose children to the risk of diseases and infections. To capture the effect of healthy environment, we included a dummy for whether the household has access to clean water. Results show that children with access to clean water have higher HAZ score than children with no access to clean water.

In a recent study, Rashad and Sharaf (2015a) found that child and household-level characteristics, including child age, sex, birth interval of the child, parent's education, and household economic status are more important than aggregate economic conditions (as proxied by economic growth and Gini index of income inequality) in explaining malnutrition rates in Egypt.

We found that receiving a regular healthcare during pregnancy is positively and significantly associated with the HAZ. Studies have shown that antenatal care is negatively associated with child malnutrition, as it could treat and protect mothers and babies from iron deficiency, anemia, and other diseases. In addition, it helps to identify whether the mother needs special care during delivery. Delivery at a health facility helps prevent harmful health consequences, like infections and pregnancy complications. Also, it provides the necessary information for adequate food intake for the baby and the mother.

Access to health insurance has been linked to better health outcomes. In line with this evidence, our results show that health insurance is positively associated with HAZ. The lack of efficient universal health insurance coverage exposes a substantial fraction of the Egyptian population to financial risks in the case of illness. According to the Seventh round of the Egyptian Family Observatory Survey, 80% of the households have at least one member covered by public health insurance. Nonetheless, only 25% of households are benefiting from it, due to the low quality of services and excessive red tape. Households with no adequate healthcare insurance rely on out-of-pocket health payments (OOP) to finance healthcare spending which could expose them to financial catastrophe if these payments are excessive and for prolonged periods (Rashad and Sharaf, 2015b; Rashad and Sharaf, 2015c). Statistics show that OOP accounts for 60% of the health spending in Egypt. In a recent study, Rashad and Sharaf (2015b) found that OOP exacerbates households' living severely in Egypt, pushing more than 20% of the population into a financial catastrophe and a significant proportion of the population into extreme poverty.

Both the unconditional and conditional analyses show that boys have a greater standard deviation disadvantage in terms of height over that of girls. This is consistent with the findings of several previous studies. In a meta-analysis of 16 demographic and health surveys, Wamani et al., (2007) examined whether there are systematic sex differences in stunting rates in children under-five years of age, in sub-Saharan Africa, where male children under five years of age are more likely to become stunted than females. The pooled estimates for mean Z-scores were -1.59 for boys and -1.46 for girls with the difference statistically significant. They also found that the sex differences in stunting were more pronounced in the lowest SES groups.

Results of both the OLS and quantile regression show that child-specific characteristics are important and significant determinants of nutritional status. In particular, we found boys, older Childs, and children whose size at birth is small have a nutritional disadvantage in terms of height than their counterparts. The results also show that being a twin is inversely related to children's nutritional status, suggesting competition for food among siblings. Also, we found that Children's nutritional status improves with the age of the mother, highlighting the importance of reducing teenage births. Mother's nutritional status is also associated, though not statistically significant, with children's nutrition, indicating the importance of genetics and phenotype in influencing the stature of children. Household economic status, measured by the wealth index, portrays a statistically significant inverted U-shaped relationship with children's nutritional status, implying that nutrition improves at a decreasing rate with assets. The findings of the current study are in line with the findings of several previous studies [see for e.g. Wamani et al., (2007); Bassolé (2007); Kabubo-Mariara et al.,(2009); Bomela (2009)].

One limitation of the current study is the cross-sectional design of the DHS dataset. This limits our ability to infer causality and does not allow us to control for unobserved factors that may affect a child`s nutritional status. This calls for further research using longitudinal data.

6. Conclusion

Understanding the underlying economic and socio-demographic determinants of child nutritional status helps to identify the targeted groups for nutrition promotion policies aimed at combating child malnutrition. Intervention measures need to take into account the heterogeneous effect of the determinants of child nutritional status along the different percentiles of the HAZ distribution. There is no one-size-fits-all policy to combat child malnutrition; a multifaceted approach would be required to address this problem effectively. For example, increasing families' awareness about appropriate feeding practices, through the media and other community-organized nutrition programs, as well as subsidizing the cost of nutrition rich food, and implementing a universal healthcare coverage, could be helpful in combating child malnutrition, especially among households in low socioeconomic strata.

Author Contributions

Both Authors contributed equally to the conceptualization, design and composition of the paper. Both authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Apendix

Table 1. Descriptive Statistics

Variable		**Variable**	
Child sex		Mother's employment status	
Males	54.45	Employed	13.25
Females	48.55	Unemployed	87.75
Child age		Mother is pregnant	
0	20.30	Yes	9.25
1	21.17	No	90.75
2	20.68	Mother is malnourished	
3	20.69	Yes	0.31
4	17.16	no	99.69
Twin		Access to clean water	
Yes	3.69	Yes	94.46
No	96.31	no	5.54
Size at birth		Regular healthcare	
Above average	2.90	Yes	82.43
Average	81.11	no	17.57
Below average	15.75	Children under 5	
Mother's age		Yes	13.40
15-19	2.43	no	86.60
20-24	22.30	Adequate birth interval	
25-29	36	Yes	13.11
30-34	23.76	No	86.89
35-39	11.36	Wealth index	-17186.56
40-44	3.57	Region of residence	
45-49	0.58	urban	30.78
Mother's level of education		rural	69.22
No education	17.94	Health insurance	
Primary	8.71	yes	6.80
Secondary	57.48	no	93.20
Higher	15.87		

All statistics are population weighted using the sampling weights in the DHS.

Table 2. OLS and Quantile regression results for the Demographic and Socio-economic determinants of child nutritional status (Dependant variable: HAZ) at selected quantiles in Egypt

	OLS	Quantile regression estimates				
VARIABLES		(15)	(30)	(50)	(70)	(90)
Male	-0.144***	-0.210***	-0.118***	-0.0844*	-0.138***	-0.155
	(0.0351)	(0.0623)	(0.0397)	(0.0447)	(0.0490)	(0.105)
Age	-0.138***	1.69e-08	-0.0551***	-0.107***	-0.169***	-0.368***
	(0.0131)	(0.0227)	(0.0147)	(0.0167)	(0.0185)	(0.0395)
Small	-0.214**	-0.320	-0.350***	-0.164	-0.312**	0.292
	(0.108)	(0.200)	(0.125)	(0.141)	(0.156)	(0.330)
Average	0.0517	0.0700	-0.0418	0.136	0.0451	0.360
	(0.100)	(0.185)	(0.116)	(0.130)	(0.144)	(0.304)
Twin	-0.238**	-0.280	-0.272**	-0.223*	-0.0687	-0.545*
	(0.0962)	(0.170)	(0.109)	(0.123)	(0.135)	(0.290)
a25_29	0.122***	0.150*	0.0917*	0.0770	0.0909	0.243*
	(0.0472)	(0.0840)	(0.0535)	(0.0605)	(0.0666)	(0.142)
a30_34	0.183***	0.230**	0.160***	0.133**	0.0826	0.283*
	(0.0528)	(0.0939)	(0.0595)	(0.0674)	(0.0743)	(0.158)
a35_49	0.167***	0.190*	0.195***	0.133*	0.0622	0.248
	(0.0602)	(0.106)	(0.0676)	(0.0763)	(0.0838)	(0.181)
Primary	-0.176**	-0.130	-0.209**	-0.119	-0.152	-0.263
	(0.0721)	(0.129)	(0.0812)	(0.0916)	(0.101)	(0.215)
Secondary	0.0739	0.160*	0.0979*	0.0654	-0.000667	-0.0550
	(0.0506)	(0.0882)	(0.0562)	(0.0641)	(0.0712)	(0.155)
Higher	0.254***	0.140	0.172**	0.224**	0.350***	0.312
	(0.0707)	(0.123)	(0.0791)	(0.0905)	(0.0997)	(0.212)
Unemployed	0.287***	0.330***	0.261***	0.208***	0.121	0.480***
	(0.0601)	(0.109)	(0.0696)	(0.0777)	(0.0839)	(0.180)
BMI	-0.132	0.730	0.0863	-0.417	-0.419	-0.998
	(0.324)	(0.445)	(0.349)	(0.380)	(0.413)	(0.941)
Pregnant	-0.0931	-0.230**	-0.00824	-0.0711	-0.134	0.0725
	(0.0618)	(0.110)	(0.0687)	(0.0772)	(0.0845)	(0.181)
Regular care	0.202***	0.250***	0.217***	0.157***	0.237***	0.290**
	(0.0476)	(0.0834)	(0.0531)	(0.0601)	(0.0661)	(0.143)
Birth interval	-0.103*	-0.0200	-0.0672	-0.104	-0.0558	-0.117
	(0.0534)	(0.0942)	(0.0600)	(0.0671)	(0.0738)	(0.159)
Poorer	0.0755	0.0200	0.0338	0.0528	0.109	0.177
	(0.0578)	(0.100)	(0.0637)	(0.0719)	(0.0793)	(0.172)
Middle	0.341***	0.300***	0.304***	0.353***	0.337***	0.545***
	(0.0564)	(0.102)	(0.0642)	(0.0724)	(0.0798)	(0.172)
richer	0.184***	0.180	0.246***	0.268***	0.110	0.240
	(0.0677)	(0.123)	(0.0770)	(0.0873)	(0.0954)	(0.199)
Richest	-0.0181	-0.140	0.0999	0.102	-0.143	-0.152
	(0.0914)	(0.158)	(0.0994)	(0.113)	(0.123)	(0.261)

Insurance	0.158*	0.290**	0.225**	0.127	0.0653	0.162
	(0.0825)	(0.143)	(0.0929)	(0.105)	(0.113)	(0.243)
children5	0.0175	0.0400	0.00230	-0.0301	-0.0425	0.145
	(0.0547)	(0.0945)	(0.0606)	(0.0682)	(0.0745)	(0.158)
Clean water	0.264***	0.490***	0.403***	0.339***	0.344***	0.0175
	(0.0769)	(0.154)	(0.0966)	(0.107)	(0.114)	(0.237)
Rural	-0.00765	0.150	0.212***	0.0465	-0.185**	-0.430**
	(0.0622)	(0.108)	(0.0675)	(0.0770)	(0.0837)	(0.176)
Constant	-1.196***	-3.760***	-2.535***	-1.467***	-0.0573	1.740***
	(0.167)	(0.316)	(0.196)	(0.217)	(0.232)	(0.489)
Observations	13,002	13,002	13,002	13,002	13,002	13,002

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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