UNIVERSITY OF ALBERTA
FACULTY OF ARTS
Department of Economics

Working Paper No. 2015-16

Does Economic Growth Reduce Child Malnutrition in Egypt? New Evidence from National Demographic and Health Survey

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October 2015

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October 2015

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Abstract

Economic growth has been widely considered an effective instrument to combat poverty, and child malnutrition. Though there is a substantial literature on the relationship between economic growth and child malnutrition in a wide range of countries, empirical evidence on this relationship is sparse in the case of Egypt. Using repeated cross sectional data from the National Demographic and Health Survey, we examine the association between income per-capita growth, at the governorate level, and child malnutrition outcomes; stunting, wasting, and underweight, in Egypt during the period 1992-2008. The association between child malnutrition and economic growth is examined within a multivariate framework using a logistic multilevel modeling approach to account for the multilevel structure of the data, and the clustering of observations. Statistics show that 29% of the children-under-5 years were stunted, 7.2% were wasted, and 6% were underweight in 2008. Results reveal that child, and household-level characteristics are more important than aggregate economic conditions (as proxied by economic growth and Gini index of income inequality) in explaining malnutrition rates in Egypt. In particular, Child age, sex, birth interval of the child, parent's education, and household economic status are particularly important determinants of malnutrition outcomes. Results show a modest reductive effect of economic growth on child underweight and wasting rates, while the effect on stunting rates was not statistically significant. Though economic growth could be a necessary condition for combating child malnutrition, this paper shows that economic growth by itself is not sufficient and has to be complemented by other intervention measures that aim directly at improving child health and nutrition.

JEL Classification: I14, I15

Keywords: Economic growth, Malnutrition, Stunting, Egypt.

1. Introduction

It is widely documented that poor nutrition in childhood has devastating consequences on child growth. Compared to well-nourished children, mal-nourished 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). 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, 2012). The World Bank Group President Jim Yong Kim described the consequences of malnutrition for a country as a "*great loss that hold back a country's potential for a vibrant, productive labor force and its ability to realize the promise of the demographic dividend*". 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, World Health Organization, the World Bank, 2012).

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, 2013). Using data from U.K. and the U.S., Case and Paxson (2006) noticed a positive association between adults' height and earnings. They found that the height-earnings gap is mainly due to good nutrition in early childhood. Workers who received good nutrition during childhood are more intelligent than their malnourished counterparts, which accounts for the labor market height premium (Case and Paxson, 2006).

Economic growth has been widely considered an effective instrument to combat poverty, and hence child malnutrition. Though there is a substantial literature on the relationship between economic growth and child malnutrition in a wide range of countries, empirical evidence on this relationship is sparse in the case of Egypt. In fact, studying the case of Egypt is not only critical for its regional importance in the Middle East, but also this paper serves as an initial attempt to evaluate the impact of economic growth on human deprivation preceding the popular uprising in Egypt which called for social justice and better economic conditions in the 2011 revolution.

The prevalence of under-nutrition is particularly high in Egypt. According to the United Nations Children’s Fund (UNICEF), Egypt has the largest number of stunted children in the Middle East, with about 2.7 million children are experiencing growth failure (United Nations Children's Fund, 2013). The economic and social cost of child malnutrition in Egypt was estimated to be 20.3 billion Egyptian Pounds, which is equivalent to about 2% of the Egyptian GDP (Information and Decision Support Center, 2013).

In Egypt, to date, and to the best of our knowledge, there is no study that empirically examined the association between economic growth and child malnutrition. Two earlier studies, El Laithy *et al*. (2003), and Kheir-El-Din and El-Laithy (2008) assessed the effect of economic growth on poverty alleviation in Egypt. They found evidence that economic growth, which took place between 1990 and 2005, has reduced poverty rates. The current study goes beyond poverty, by examining the effect of economic growth on other measures of human deprivation. In this study, we develop a unique repeated cross sectional dataset to examine the association between income per capita growth, at the governorate level, and childhood malnutrition status in Egypt for the period between 1992 and 2008.

The paper is organized as follows: Section 2 presents a review of the theoretical and empirical literature on the link between economic growth and child malnutrition, in addition to the different methods of measuring malnutrition. Section 3 presents an overview of economic growth, and child feeding practices in Egypt. The data and empirical methodology are described in Section 4. Section 5 presents the empirical results which are then discussed in Section 6. Section 7 concludes the paper.

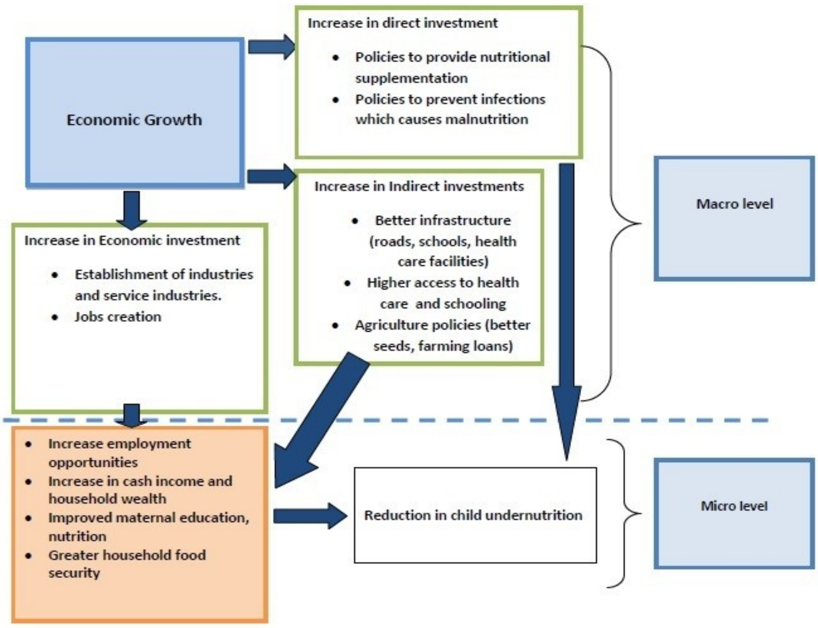
2. Literature Review

2.1. The Economic Growth - Malnutrition Linkage: A Theoretical Framework

Theoretically, the relationship between economic growth and child malnutrition could be bi-directional. While poverty and food insecurity could lead to malnutrition, child’s malnutrition may in turn have intergenerational consequences, which could slow down economic growth. The inadequate dietary intake and diseases are the direct causes of child malnutrition. This could arise as a result of households’ food insecurity, inadequate feeding practices, unhealthy household environment and inadequate health service, all of which are directly related to economic growth.

Figure 1 shows that economic growth could help in reducing child malnutrition through three channels. Firstly, economic growth increases the employment opportunities, income levels, and wealth which offer poor household food security, better nutrition and health care, and improved maternal education. Secondly, economic growth widens the tax base, and increases public revenues, which enable higher public spending on health and social protection, such as spending on food ration cards. Thirdly, economic growth could benefit individuals indirectly through higher public spending on infrastructure, such as roads, schools, and hospitals.

Figure 1: Economic Growth and Children Nutritional Status Linkage



Source: Adopted from Subramanyam *et al*. (2011).

2.2. Measuring Child Malnutrition

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 malnutrition:

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 deviation 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 six countries: Brazil, Oman, Ghana, India, USA, and Norway (De Haen *et al*., 2011).
2. **Percent of median**: is calculated by dividing the value of a 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. In addition, it is a continuous variable, which is fully observed, and could be incorporated directly into regression models. Accordingly, the z-score is the most convenient and widely used measure of child malnutrition in the literature.

2.3. Empirical Literature

A growing number of empirical studies have emerged to examine the effect of economic growth on childhood malnutrition with mixed findings [see for example: Smith and Haddad, 2002; Subramanyam *et al*., 2011; Harttgen *et al*., 2012; Vollmer *et al*., 2014]. Existing empirical studies differed in the used methodology, the sample covered, and the level of analysis, as some have performed cross-country analysis using macro level data, while other studies used data at the household level. Consequently, the results of these studies are not directly comparable.

For example, using panel data on 63 developing countries, over the period 1970-1996, Smith and Haddad (2002) found a strong reductive effect for economic growth on child malnutrition. They hypothesized that the global economic growth which took place between 1970 and 1996 is responsible for half of the reduction in the prevalence of child malnutrition, through promoting investments in women's education and health, environment quality and food affordability. In another cross-country study, Harttgen *et al*., (2012) examined the association between GDP per capita growth, and the reduction of child malnutrition in 15 Sub-Saharan African countries, using both a macro and a micro model. In the macro model, they estimated the overall levels of malnutrition across countries from the Demographic and Health Surveys (DHS) which were regressed on GDP per capita using fixed effect model. The fixed effect macro model failed to detect a significant relationship between income growth and the level of child malnutrition. In the micro model, all the DHS surveys from Sub-Saharan African countries were pooled together into one single large dataset, which allowed testing the effect of macroeconomic growth on child level. The results of the micro model showed that GDP per capita growth has a mild effect on child malnutrition. The authors concluded that economic growth did not trickle down to the poor, and that individual level variables, such as mother's education, socioeconomic status and mother's nutritional status are more critical to children's growth than national development indicators.

Using data from 121 surveys in 36 low-income and middle-income countries, Vollmer *et al*., (2014) utilized logistic regression models to estimate the association between changes in per-capita GDP, and changes in child under-nutrition outcomes. They found evidence that macroeconomic growth has a null, to quantitatively very weak, contribution to the reductions in early childhood stunting, underweight, and wasting. Using country level data from the World Bank's World Development Indictors, Heltberg (2009) analyzed spells of malnutrition over time, and found a significant, but small, negative association between economic growth and chronic child malnutrition, where periods of economic growth are often associated with reduced child malnutrition. The author also found that the association between economic growth and chronic child malnutrition is much lower than the effect of growth on poverty. The elasticity of stunting with respect to growth in per-capita gross national income was about -0.2 in a country with 30% stunting rate, and that halving stunting from a level of 30% through economic growth alone would requires an annual growth of real per capita income by 3.7% for 25 years.

In addition to cross-country studies, several country-specific studies have investigated the effect of economic growth on child malnutrition, in a wide range of countries. For example, Alderman *et al*. (2006) found, using panel data from Tanzania, evidence that a combination of income growth, and nutrition interventions are effective in reducing malnutrition. In another study, Subramanyam *et al*., (2011) focused on India, a country with the largest number of children under 5 years old who are stunted in the world. They used several models at different levels but their unique contribution to the literature is in the use of income growth at the state level instead of economic growth rate at the country level. They pooled three national representative surveys of India for the years 1992, 1998 and 2005, and regressed a binary variable for child malnourishment on individual and state level variables. No or weak association was found between economic growth at the state level and the different types of child malnutrition. They concluded that the strong economic growth that took place in India was not sufficient to reduce child malnutrition.

At the micro level, several studies have examined the relationship between household income and the health status of children (see for example Case *et al*., 2009). The premise is that households with high levels of income are better able to invest in their children's health and education which would lead to better health and nutritional status.

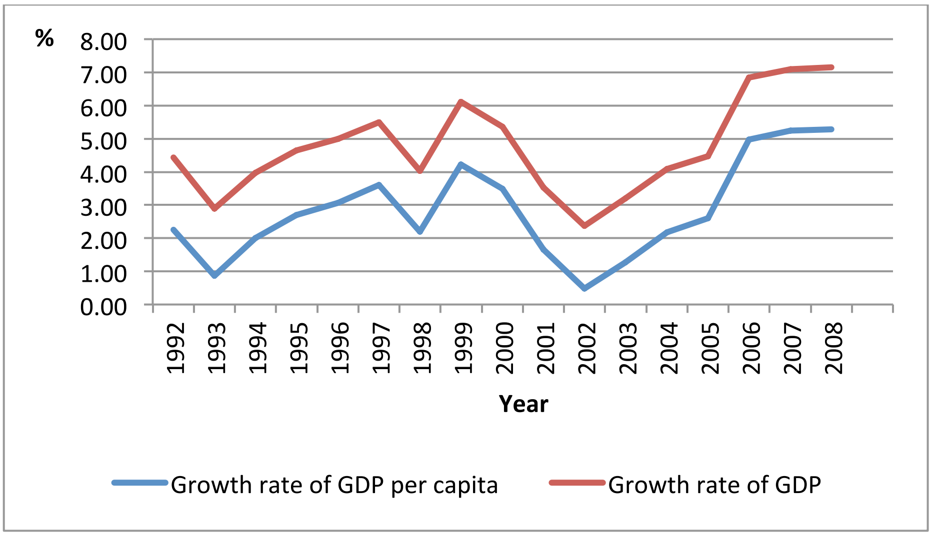
3. Economic Growth, and Child Feeding Practices in Egypt

3.1. Economic Growth in Egypt

In the last three decades, statistics show that the Egyptian economy has been in general growing, except for a couple of negative spikes. Real GDP per capita has grown from \$895 in 1992 to \$1456 in 2008. In 1999, the Egyptian economy slipped into recession. The fall in direct investments, and the sluggish improvement in labor productivity, along with other internal and external factors, dampened the growth of income per-capita to less than 2% between 2001 and 2003. In 2004, the Egyptian government launched an economic reform program to stimulate economic growth by simplifying bureaucracy, custom rules and red tape. In addition, the program has implemented a tax reform that lowered the tax rates. It also provided easy access to foreign currency, in addition to privatization of half of the public banks. The reform policies have encouraged domestic and foreign direct investments significantly. Furthermore, the oil boom in the region has led to increased remittance inflows, coupled with an increase in the tourism, and capital inflow from the Gulf region. Consequently, the growth rates in real GDP has jumped to 7.1% and 7.2% in the years 2007 and 2008 respectively (World Bank, 2007)

In spite of the relatively high rates of economic growth, Egypt has the largest number of stunted children in the Middle East, and a high prevalence of under-nutrition, especially in Upper Egypt, compared to other countries in the region.

Figure 2: Economic Growth in Egypt: 1992 to 2008



Source: World Development Indicators, World Bank (2014).

3.2. Child Feeding Practices in Egypt

Feeding practice is a key determinant of a child nutritional status, and inadequate dietary intake is a risk factor for illness and early child mortality. Exclusive breastfeeding, during the first six months, has been consistently recommended by the WHO and the UNICEF, as mother's milk contains all the essential nutritional ingredients. In addition, breastfeeding for two years is also a guidance from religion, which may form another motivate for mothers to continue breastfeeding in many countries including Egypt.

Early complementary feeding is not recommended, as it reduces breast milk output, and increases the risk of diarrheal disease and hence, malnutrition. However, by the age of six months, complementary feeding becomes necessary, as breast milk is no longer enough to provide appropriate nutrition. Healthy complementary feeding includes daily consumption of vitamin-A rich fruits and vegetable, and the consumption of meat, poultry, fish and eggs. In addition, fatty food is also recommended in babies' diet, as it provides acids that facilitate absorption, while tea and coffee are discouraged for children, as they contain ingredients that hinder iron absorption.

As for actual feeding practices in Egypt, statistics from the 2008 Egypt Demographic and Health survey (EDHS) show that 70% of infants received supplementary feeding in the first six months, and that the median duration of exclusive breastfeeding is only 2.6 months.

It has been reported that appropriate infant and young children feeding practices involve the introduction of food by the age of six month, with the gradual increase in the amount and frequency of food, while keeping frequent breastfeeding up to the age of two. Data from the 2008 EDHS shows that only 41% of the children have met the minimum requirement for appropriate infant and child feeding. In addition, one third of babies between age 6 to 8 months are not offered any solid or semi-solid food beside breast milk, and the majority of children did not eat any vitamin-A rich food in the last 24-hour prior to the interview, and tea drinking was also common. Statistics from the EDHS also reveals that the percentage of children with appropriate feeding practices does not vary systemically by the level of mother's education, or income levels, which suggests that child malnutrition is not a problem of food access but inadequate feeding practices. This last point was supported by the finding of several empirical studies such as Kalve *et al*., (2014) who found educating mothers about appropriate feeding practices an effective approach to improve children health.

4. Data and Methods

4.1. Data

This paper uses data on children's nutritional status for a nationally representative sample of 45,600 households from five rounds (1992, 2000, 2003, 2005, and 2008) of the Egyptian Demographic and Health Survey (EDHS). The DHS is an international survey, which is conducted in 85 developing countries, and is sponsored by the U.S. Agency for International Development. It is the main source of information on child health in developing countries. EDHS interviews women between age 15 and 49 (reproductive age), and collects information on infant and child mortality, and is implemented every five years.

The EDHS has a complex design. The design involves stratification based on the level of urbanization, and region. It involves clustering, where the selected villages are the clusters for rural areas, and the selected districts/towns are the clusters for urban areas. The complex survey design has been taken into account in all stages of the analyses in this study. The EDHS collects information on all born children. However, children who are dead by the time of the interview, and children with missing data on height or age, have been excluded from the analyses.

There are 26 governorates in Egypt, four are urban governorates, and the rest are a mixture of urban and rural regions. Data on GDP per capita and Gini index, at the governorate level, were developed by the Egyptian Institute of National Planning, and collected from the Egyptian Human Development Reports (Handoussa, 2010). In this study, all analyses and statistics are population weighted using the sampling weights in the EDHS survey.

4.2. Econometric Methodology

The association between child malnutrition and economic growth is examined within a multivariate framework, after controlling for other covariates that are widely used in the literature such as, child's age, sex, birth order of child, father's and mother's education, age of mother, mother's occupation, household economic status, whether the mother received regular health care during pregnancy, governorate fixed effect, and year fixed effect.

In the current study, we examine the association between economic growth, at the governorate level, and six outcomes of malnutrition: stunting, sever stunting, wasting, sever wasting, underweight, and sever underweight. This association is examined using a logistic multilevel modeling approach to account for the multilevel structure of the data and the clustering of observations (children nested within households within clusters nested in governorates). We model the odds of malnutrition for child i in household j, nested in governorate k at the survey year t, using the multilevel logistic model in Equation (1).

$$\mathrm{M_{ijkt}} = \alpha + \varphi \mathrm{Y_{kt}} + \beta \mathrm{X_{ijkt}} + \tau\, \mathrm{H_{ijkt}} + \gamma \mathrm{G_{kt}} + \delta \mathrm{S_t} + \varepsilon_{\mathrm{ijkt}} \quad (1)$$

In Equation (1), $\mathrm{M_{ijkt}}$ is the probability of malnutrition (stunting, wasting, under nutrition), which is a dichotomous variable, of child i in household j, nested in governorate k at the survey period t. $\mathrm{Y_{kt}}$ is the log real GDP per capita of governorate k for the survey year t. $\mathrm{X_{ijkt}}$ is a vector of child characteristics such as child age, sex, birth order of the child. H_{ijkt} is a vector of parental and household-level factors. G_{kt} is the governorate fixed effects, S_t is the year fixed-effects, and ε_{ijkt} is the standard $i.i.d$ error term.

The key predictor of interest is the log GDP per capita at the governorate level. In addition, the multivariate analyses control for other explanatory variables that represent the characteristics of the household, the mother, and the child. Household-level covariates include household wealth index, number of living children, father's education, whether the household has an independent toilet, and access to sanitation and clean water. As for the child characteristics, we control for the child sex, age, whether the child had a risk birth interval, and whether the child is a twin.

We also control for the mother's characteristics to account for possible socioeconomic factors that are not captured by the other control variables, and which may affect the child nutritional status. In particular, we include mother's age, Body Mass Index (BMI), occupation, whether the mother received regular health care during pregnancy, and the mother's current pregnancy status. Similar to several previous studies, we include the mother's BMI to control for the mother's nutritional status which may affect child nutrition via a genetic linkage or via a socioeconomic indication. In addition, we also control for the current pregnancy status of the mother and the number of living children in the household, to account for possible constraints on the mother's ability to care for her children.

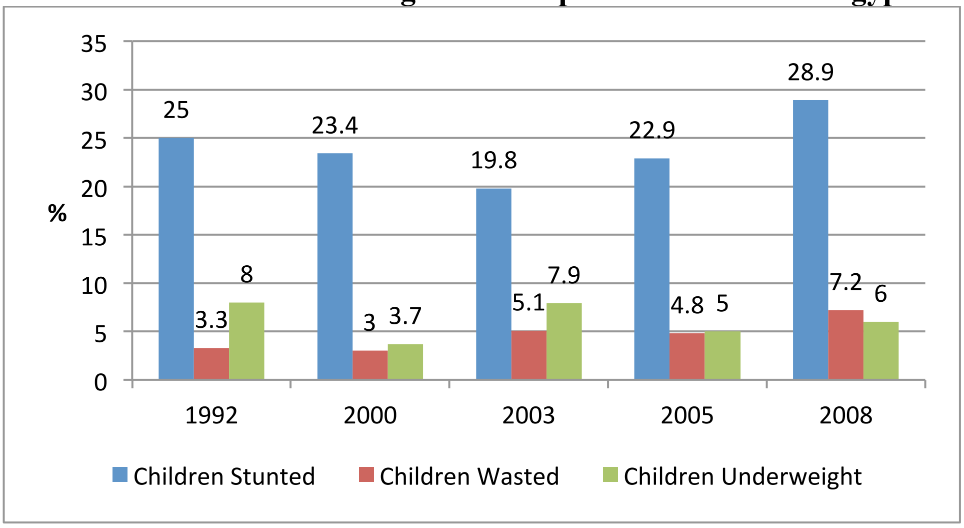
Governorates in Egypt differ in their geographical location, climate, natural resources, income inequality, and the degree of economic problems. Accordingly, we also included governorate fixed-effects, which account for governorate-specific factors affecting malnutrition that are constant over time. To control for income inequality, we use the Gini coefficient, which measures the fairness of income distribution within a governorate, where a high Gini coefficient indicates high level of income inequality. The multilevel logistic model also controls for survey year fixed-effects to capture general developments that affect all governorates.

5. Results

Figure 3 depicts the level of stunting, wasting and underweight in Egypt based on data from EDHS, during the period 1992 to 2008. The WHO classifies the degree of child malnutrition within a country into three levels: low, medium, high and very high. Based on the WHO's classification, the overall prevalence of stunting in Egypt is classified as high, while the degree of underweight and wasting is low.

As shown in Figure 3, in 2008, 29% of the children under-5-years were stunted, 7.2% were wasted, and 6% were underweight. Though the prevalence of stunting dropped in the beginning of the new millennium to 19.8% in 2003, compared to 25% in 1992, the declining trend for stunting prevalence was reversed and started to increase once again reaching 29% in 2008.

Figure 3: Percentage of Children under Five years classified as malnourished according to Anthropometric Indices in Egypt



Source: Authors' calculations based on data from several rounds of the EDHS.

Table 1 presents the results of the multilevel logistic regression models for the different forms of malnutrition (stunting, wasting, and underweight). The results show that although economic growth has a negative association with child malnutrition, as the odds ratios are all less than one, this association was not statistically significant for stunting (OR=0.617; 95% CI=0.332 - 1.148), and weakly significant at 10% significance level, for wasting (OR=0.544; 95% CI=0.282 - 1.047), while it was statistically significant for the underweight at 5% significance level (OR=0.550; 95% CI=0.342 - 0.885). Malnutrition in Egypt is mainly portrayed as a stunting problem as depicted in Figure 3. According to the UNICEF *et al.*(2013), Egypt has the largest number of stunted children in the Middle East, with about 2.7 million children are experiencing growth failure. Since the results showed that economic growth has no statistically significant negative association with stunting and weakly associated with wasting, then we could conclude that the economic growth that took place in Egypt during the last 2 decades failed to reduce child malnutrition in Egypt. This was also revealed by the unconditional analysis, which shows an increase in stunting and wasting rates in 2005 and 2008 compared to the years 2000 and 2003.

Results also show no statistically significant association between income inequality, as measured by the Gini Index, and any of the outcomes of child malnutrition, as none of the odd ratios was statistically significant.

Insert Table 1 here

As for the other covariates, a child's sex was significantly associated with malnutrition. Compared to a male child, a female child is less likely to be stunted (OR=0.842; 95% CI=0.802 - 0.883), wasted (OR=0.824; 95% CI=0.725 - 0.937), and underweight (OR=0.721; 95% CI=0.632 - 0.822). Malnutrition has a statistically significant negative association with the child's age, where older Childs have lower risk of being wasted, and underweight. In particular, when compared with an infant child, a child who is one year old has lower odds of being underweight (OR=0.551; 95% CI=0.470 - 0.645), and wasted (OR=0.467; 95% CI=0.371 - 0.589). Similarly, a four years old child is less likely to be underweight (OR=0.424; 95% CI=0.331 - 0.542), and wasted (OR=0.371; 95% CI=0.289 - 0.476) when compared to an infant child. On the contrary, results show higher odds of stunting among a one year old child (OR=1.529; 95% CI=1.372 - 1.704), a two years old child (OR=1.548; 95% CI=1.404 - 1.708), and a three years old child (OR=1.186; 95% CI=1.036 - 1.358), when compared to an infant child, while a four years old child has a lower risk of being stunted (OR=0.822; 95% CI=0.730 - 0.925),

Being a twin increase the risk of being stunted (OR=1.320; 95% CI=1.096 - 1.591), and underweight (OR=1.668; 95% CI=1.254 - 2.218). A child with a risky birth interval has higher odds of being stunted (OR=1.196; 95% CI=1.156 - 1.238), and underweight (OR=1.292; 95% CI=1.179 - 1.417) when compared to a child with no risk birth interval. Receiving a regular health care during pregnancy only reduce the risk of being underweight (OR=0.887; 95% CI=0.814 - 0.967). Having a private toilet, as one of the indicators of a household's economic status, is significantly associated with lower odds of malnutrition: stunting (OR=0.874; 95% CI=0.757 - 1.008); wasting (OR=0.694; 95% CI=0.526 - 0.917); and underweight (OR=0.793; 95% CI=0.638 - 0.985). Mother's occupation is in general not significantly associated with child malnutrition, but for agriculture in which there is a statistically significant higher odd of stunting (OR=1.247; 95% CI=1.097 - 1.416) when compared with children whose mother is not employed. Mother's age is not associated with the child's underweight, and wasting, as none of the odds ratios is statistically significant. However, mother's age was associated with lower odds of stunting, with mothers in the middle ages have in general lower odds of stunted children (mother's age (25-29): OR=0.870; 95% CI=0.767 - 0.987; mother's age (30-34): OR=0.849; 95% CI=0.755 - 0.956; mother's age (40-44): OR=0.800; 95% CI=0.655 - 0.976); mother's age (45-49): OR=0.781; 95% CI=0.608 - 1.003) when compared to younger mothers. Current pregnancy status of the mother was not associated with any of the outcomes of malnutrition. Mothers' education was in general not significantly associated with child`s malnutrition, but for secondary education which has a lower odds, at 10% significance level, for stunting (OR=0.925; 95% CI=0.845 - 1.013) and underweight (OR=0.887; 95% CI=0.777 - 1.012) when compared to no education. However, higher father's education reduced the risk of stunting, wasting and underweight. Access to clean water was not associated with wasting, stunting, and underweight, as none of the odd ratios was statistically significant. Number of children has a positive significant association with stunting (OR=1.022; 95% CI=1.000 - 1.043).

Insert Table 2 here

A mother's BMI has no statistically significant association with stunting, wasting, but positively associated with underweight (OR=1.135; 95% CI=0.871 - 1.479) at the 10 % significance level. Household economic status, as measured by the wealth index, has no significant association with wasting. Children from the richest wealth group have lower odds of being stunted (OR=0.831; 95% CI=0.694 - 0.995), and underweight (OR=0.808; 95% CI=0.668 - 0.977) compared to children from the poorest household.

Mothers working at the agricultural sector have higher odds of having stunted children (OR=1.247; 95% CI=1.097 - 1.416). The composition of the GDP and the sources of economic growth could help in explaining the persistence of chronic malnutrition among children of agricultural sector workers. The service sector in Egypt accounts for more than half of the economy and it has been the main driver of the recent economic growth between 2003 and 2008, more specifically the tourism industry, the telecommunication sector, and the transportation sector. On the other hand, the agricultural sector, on which one-fourth of the working population, and the majority of the Upper Egypt residents are depending, showed a weak economic performance. If economic growth benefits mostly the service sector workers and by-passes the agricultural sector workers, it is to be expected that income growth will likely has modest or no effect on poverty reduction and child malnutrition.

Table 2 presents results of the multilevel logistic regression models for the extreme malnutrition (extreme stunting, extreme wasting, and extreme underweight). The results were in general similar to that presented in Table 1. In particular, the results show that though economic growth has a negative association with child malnutrition, as the odds ratios are all less than one, none of the odd ratios for extreme underweight (OR=0.747; 95% CI=0.417 - 1.336) and extreme wasting (OR=0.534; 95% CI=0.216 - 1.318) were statistically significant, while the negative association of economic growth and extreme stunting was weakly significant at 10% significance level (OR=0.472; 95% CI=0.205 - 1.087).

For the other covariates, no statistically significant association between income inequality, as measured by the Gini Index, and any of the outcomes of child malnutrition was found, as none of the of the odd ratios was statistically significant. Household economic status, as measured by the wealth index, has a significant negative association with extreme stunting and underweight, where children from the middle and the richer wealth group have lower odds of being extremely stunted and underweight compared to children from the poorest household.

A child's sex was significantly associated with extreme malnutrition. Compared to a male child, a female child is less likely to be extremely stunted, wasted and underweight. Being a twin is not a risk factor for extreme malnutrition. Higher odds of extreme stunting and underweight exist among children with risky birth intervals. Extreme malnutrition has a statistically significant negative association with the child's age, where older Childs have a lower risk of being extremely stunted, wasted, and underweight when compared to an infant child. Though children, whose mothers are malnourished or currently pregnant, have higher odds of being extremely stunted, wasted and underweight, none of the odd ratios were statistically significant. Number of children was also not significantly associated with extreme malnutrition. A child`s father's education has a significant negative association with extreme stunting, while the mother's education and occupation were in general not significantly associated with any of the extreme malnutrition outcomes.

6. Discussion

This paper failed to find a significant, in statistical sense, robust association between economic growth and child malnutrition in Egypt. Despite the growth in real income per capita from 8,369 Egyptian Pounds (LE) in 1992 to 12,807 LE in 2008, which is equivalent to a 3.31% growth rate per year, the proportion of stunted children has remained high in the years 1992 and 2008. However, economic growth has a statistically significant negative association with underweight and weak negative association with wasting.

Based on the WHO's classification, the overall prevalence of stunting in Egypt is classified as high, while the degree of underweight and wasting is low. The low levels of underweight and wasting versus the high level of stunting could be explained by the global shift toward junk food with high level of starch, fats and sugar (De Haen *et al*., 2011). The malnutrition indicators that involve weight measurements are sensitive to this type of food, while height is far less sensitive to this global switch in diet. As a result, the low level of underweight may under-estimate the malnutrition problem in Egypt. In addition, there is a controversy over the use of a single standard growth reference, as genetic difference in height across different regions of the world are not controlled for (Harttgen *et al*., 2012).

The role of economic growth in reducing child malnutrition rests on the pre-assumption that as households become richer, they purchase more food and feed their children more. But this assumption may not necessarily hold. People may choose to spend the additional income gained from economic growth on non-food items, or on food with little nutritional value. Another possible explanation for the non-significant effect, in statistical sense, of economic growth on child malnutrition is the widespread of poor feeding practices in Egypt. Children in Egypt eat little to no animal-source foods, while junk food is a major complementary food (Kavle et at., 2014). The junk food consumption is supported by parents and some healthcare providers, and it often replaces other nutritive foods. Statistics from the EDHS show excessive consumption of black tea and juices by children in Egypt which is not in line with the healthy feeding practices suggested by the WHO. An additional factor that intensifies the malnutrition problem is that parents do not relate inadequate feeding practices to low height for age. They commonly viewed stunting as hereditary.

The findings of this paper are in line with several previous studies. For example, in spite of India's rapid growth performance, Subramanyan *et al*., (2011) found weak to no association between economic growth, at the state level, and different types of child malnutrition. They concluded that the strong economic growth that took place in India was not sufficient to reduce child malnutrition. Similarly, Harttgen *et al*., (2012) failed to find a statistically significant association between economic growth and child malnutrition in Sub-Saharan Africa.

The literature documents other factors that are more critical to child nutritional status than macroeconomic development. For instance, Jayachandran and Pande (2013) explained the fact that Indian children are shorter than Sub-Saharan African children by the parental preferences regarding higher birth order children which is driven by culture norms of the eldest son preference. In Sub-Saharan African countries, Harttgen *et al*., (2012) suggested factors such as women's education and low fertility as more important to child health than economic growth.

There is considerable evidence that child's malnutrition in Egypt is not only a problem of deprivation, food insecurity and hunger. Firstly, based on EDHS statistics, the level of child malnutrition was mainly concentrated among the poorest wealth quintile. The prevalence of child malnutrition is also quite high among wealthier groups. For example, in the years 2005 and 2008, the proportions of wasted children, wasting indicates starvation, are higher at the richest wealth quintile compared to the poorest quintile. In 2008, the level of extreme stunting is higher among the richest quintile compared to the poorest quintile. This suggests that beside income level, there is a common driver of childhood undernutrition among different socio-economic groups. Secondly, Egypt is a middle income country with a very low level of extreme poverty. The proportion of population below $1 (PPP) a day is equal to 3.5% in 2005. Thirdly, the problem of underweight among adults is a very minor problem. For example, the percentage of underweight among adult women does not exceed 1% in the period between 2000 and 2008. On the contrary, Egypt is experiencing a very high rate of obesity and overweight exceeding 70% among adults (Ng *et al*., 2014). This implies that some of malnourished children and obese parents coexist under one roof. Fourthly, Egypt has one of the largest food subsidy programs. In 2008, the

Government of Egypt spent about $4 billion in food subsidies (2% of the GDP). Finally it has been argued that high rate of childhood undernutrition is not a good indicator of development and food insecurity (Dehaen *et al*., 2011). For example, although countries like India and Egypt outperforms Sub-Saharan African countries on several development indicators, such as infant and maternal mortality, life expectancy, poverty incidence and educational attainment, they are enduring higher rates of child malnutrition than Sub-Saharan African countries.

7. Conclusion

Results reveal that several child and household-level characteristics are more important than aggregate economic conditions (as proxied by economic growth and Gini measure of income inequality) in explaining malnutrition rates in Egypt. Child age, sex, birth interval of child, and whether the child is a twin, father`s education, and household economic status are particularly important determinants of malnutrition outcomes. Results also show that a household economic status (as proxied by the wealth index) appears to be more important than average prosperity of a country. Higher income has not led to a better nutritional status of children in Egypt, and further research is needed to examine the impact of cultural norms on under-nutrition in Egypt.

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Appendix

Table 1. Multiple Logistics Regression Analyses of the Association between Economic Growth and Malnutrition

Explanatory Variables	**Stunting**	**Underweight**	**Wasting**
LOGGDP	0.617	0.550**	0.544*
	(0.332 - 1.148)	(0.342 - 0.885)	(0.282 - 1.047)
Gini Index	1.002	0.998	0.989
	(0.990 - 1.015)	(0.985 - 1.012)	(0.960 - 1.018)
Wealth Index			
Poorest	1	1	1
Poorer	0.944	0.945	0.955
	(0.818 - 1.089)	(0.820 - 1.088)	(0.820 - 1.112)
Middle	0.907*	0.913	1.018
	(0.811 - 1.014)	(0.782 - 1.066)	(0.854 - 1.213)
Richer	0.867*	0.883	1.039
	(0.741 - 1.013)	(0.731 - 1.067)	(0.900 - 1.199)
Richest	0.831**	0.808**	1.017
	(0.694 - 0.995)	(0.668 - 0.977)	(0.830 - 1.246)
Child is twin			
No	1	1	1
Yes	1.320***	1.668***	0.989
	(1.096 - 1.591)	(1.254 - 2.218)	(0.780 - 1.254)
Mother's is malnourished			
No	1	1	1
Yes	1.135	1.472*	1.413
	(0.871 - 1.479)	(0.939 - 2.305)	(0.935 - 2.135)
Mother is currently pregnant			
No	1	1	1
Yes	1.043	1.142	1.071
	(0.964 - 1.128)	(0.946 - 1.379)	(0.936 - 1.226)
Number of living children	1.022**	0.994	1.018
	(1.000 - 1.043)	(0.948 - 1.041)	(0.986 - 1.052)
Access to clean water			
No			
Yes	0.970	1.152	1.112
	(0.808 - 1.165)	(0.862 - 1.540)	(0.815 - 1.519)
Sex of child			
Male	1	1	1
Female	0.842***	0.721***	0.824***
	(0.802 - 0.883)	(0.632 - 0.822)	(0.725 - 0.937)
Current age of child			
Less than one year	1	1	1
One year	1.529***	0.551***	0.467***
	(1.372 - 1.704)	(0.470 - 0.645)	(0.371 - 0.589)
Two years	1.548***	0.551***	0.453***
	(1.404 - 1.708)	(0.439 - 0.691)	(0.345 - 0.596)

Three years	1.186**	0.422***	0.398***
	(1.036 - 1.358)	(0.337 - 0.530)	(0.310 - 0.510)
Four years	0.822***	0.424***	0.371***
	(0.730 - 0.925)	(0.331 - 0.542)	(0.289 - 0.476)
Father's education level			
No education	1	1	1
Primary	0.977	0.872*	0.841**
	(0.911 - 1.049)	(0.754 - 1.009)	(0.724 - 0.979)
Secondary	0.890***	0.820**	0.828**
	(0.826 - 0.960)	(0.682 - 0.985)	(0.689 - 0.995)
Higher	0.802***	0.848	0.882
	(0.737 - 0.872)	(0.670 - 1.074)	(0.704 - 1.106)
Mother's education			
No education	1	1	1
Primary	0.995	1.069	0.968
	(0.933 - 1.062)	(0.928 - 1.231)	(0.839 - 1.116)
Secondary	0.925*	0.887*	1.040
	(0.845 - 1.013)	(0.777 - 1.012)	(0.870 - 1.242)
Higher	1.041	1.002	1.088
	(0.885 - 1.225)	(0.750 - 1.338)	(0.800 - 1.481)
Regular health care during pregnancy			
No	1	1	1
Yes	0.974	0.887***	0.958
	(0.923 - 1.028)	(0.814 - 0.967)	(0.862 - 1.064)
Mother's occupation			
Not working	1	1	1
Professional, technical, managerial, clerical	0.964	0.915	0.943
	(0.849 - 1.093)	(0.724 - 1.158)	(0.743 - 1.198)
Sales services	1.062	0.829	0.922
	(0.862 - 1.308)	(0.500 - 1.376)	(0.626 - 1.357)
Agriculture	1.247***	1.057	0.910
	(1.097 - 1.416)	(0.873 - 1.279)	(0.712 - 1.162)
Manual	1.021	1.042	0.837
	(0.828 - 1.258)	(0.678 - 1.604)	(0.542 - 1.291)
Having a toilet			
No	1	1	1
Yes	0.874*	0.793**	0.694**
	(0.757 - 1.008)	(0.638 - 0.985)	(0.526 - 0.917)
Risky birth interval			
No	1	1	1
Yes	1.196***	1.292***	1.116
	(1.156 - 1.238)	(1.179 - 1.417)	(0.977 - 1.275)
Mother's age			
15-19	1	1	1
20-24	0.946	1.002	1.193
	(0.839 - 1.067)	(0.720 - 1.395)	(0.850 - 1.674)
25-29	0.870**	0.964	1.261
	(0.767 - 0.987)	(0.680 - 1.365)	(0.905 - 1.758)

30-34	0.849***	0.993	1.239
	(0.755 - 0.956)	(0.696 - 1.417)	(0.928 - 1.655)
35-39	0.842**	0.969	1.141
	(0.717 - 0.989)	(0.666 - 1.411)	(0.857 - 1.520)
40-44	0.800**	1.034	1.329
	(0.655 - 0.976)	(0.648 - 1.652)	(0.926 - 1.907)
45-49	0.781*	0.854	0.657
	(0.608 - 1.003)	(0.513 - 1.421)	(0.289 - 1.496)
Governorate Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Constant	21.12	36.75*	41.13
	(0.130 - 3,424)	(0.628 - 2,150)	(0.171 - 9,875)
Observations	40,765	40,817	40,837

Note: The provided coefficients are the adjusted odds ratios. Robust 95% confidence intervals are in parentheses. *** P <0 .01; ** P < 0.05, * p<0.1. All estimations are weighted using the DHS sampling weights.

Table 2. Multiple Logistics Regression Analyses of the Association between Economic Growth and Extreme Malnutrition

Explanatory Variables	Extreme Stunting	Extreme Underweight	Extreme Wasting
Log GDP	0.472*	0.747	0.534
	(0.205 - 1.087)	(0.417 - 1.336)	(0.216 - 1.318)
Gini coefficient	1.010	1.008	0.999
	(0.995 - 1.024)	(0.987 - 1.030)	(0.960 - 1.039)
Wealth Index			
Poorest	1	1	1
Poorer	0.881	0.865	0.822**
	(0.757 - 1.026)	(0.681 - 1.099)	(0.683 - 0.990)
Middle	0.835**	0.929	0.895
	(0.728 - 0.959)	(0.745 - 1.159)	(0.686 - 1.169)
Richer	0.783***	0.750*	0.887
	(0.653 - 0.938)	(0.545 - 1.031)	(0.688 - 1.144)
Richest	0.825	0.712*	0.907
	(0.654 - 1.040)	(0.490 - 1.034)	(0.701 - 1.173)
Child is a twin			
No	1	1	1
Yes	1.233	1.178	1.099
	(0.949 - 1.601)	(0.748 - 1.856)	(0.579 - 2.088)
Mother's is malnourished			
No	1	1	1
Yes	1.072	1.459	1.293
	(0.811 - 1.417)	(0.886 - 2.401)	(0.830 - 2.015)
Mother is currently pregnant			
No	1	1	1
Yes	1.085*	1.155	1.105
	(0.994 - 1.186)	(0.858 - 1.554)	(0.885 - 1.380)
Number of living children	1.020	1.020	1.051
	(0.993 - 1.048)	(0.945 - 1.101)	(0.984 - 1.124)
Access to clean water			
No	1	1	1
Yes	1.300**	1.412	1.043
	(1.056 - 1.601)	(0.783 - 2.547)	(0.627 - 1.737)
Sex of child			
Male	1	1	1
Female	0.802***	0.696***	0.840*
	(0.755 - 0.852)	(0.571 - 0.847)	(0.694 - 1.016)
Current age of child			
Less than one year	1	1	1
One year	1.558***	0.464***	0.394***
	(1.398 - 1.737)	(0.370 - 0.581)	(0.272 - 0.571)
Two years	1.384***	0.448***	0.465***
	(1.202 - 1.594)	(0.358 - 0.559)	(0.318 - 0.682)
Three years old	0.997	0.325***	0.357***
	(0.832 - 1.195)	(0.259 - 0.408)	(0.261 - 0.488)

Four years old	0.609***	0.205***	0.281***
	(0.506 - 0.733)	(0.145 - 0.289)	(0.193 - 0.408)
Father’s education level			
No education	1	1	1
Primary	0.879***	0.747***	1.004
	(0.800 - 0.966)	(0.618 - 0.904)	(0.810 - 1.244)
Secondary	0.883**	0.823	0.936
	(0.784 - 0.994)	(0.620 - 1.093)	(0.733 - 1.195)
Higher	0.838**	1.253	0.974
	(0.718 - 0.979)	(0.777 - 2.020)	(0.720 - 1.319)
Mother's education level			
No education	1	1	1
Primary	0.968	1.002	0.994
	(0.878 - 1.068)	(0.763 - 1.316)	(0.808 - 1.223)
Secondary	0.963	0.797**	1.081
	(0.865 - 1.073)	(0.667 - 0.953)	(0.807 - 1.447)
Higher	1.160	0.891	1.393
	(0.971 - 1.385)	(0.551 - 1.439)	(0.903 - 2.150)
Regular health care during			
No	1	1	1
Yes	0.943	0.920	0.842*
	(0.828 - 1.074)	(0.756 - 1.119)	(0.700 - 1.011)
Mother's occupation			
Not working	1	1	1
Professional, technical, managerial,	0.959	0.867	0.966
	(0.825 - 1.115)	(0.594 - 1.267)	(0.701 - 1.332)
Sales services	1.074	1.340	0.989
	(0.769 - 1.500)	(0.680 - 2.641)	(0.408 - 2.396)
Agriculture	1.234**	1.165	0.794
	(1.035 - 1.472)	(0.867 - 1.565)	(0.526 - 1.200)
Manual	1.035	0.843	1.030
	(0.746 - 1.435)	(0.404 - 1.761)	(0.517 - 2.051)
Having a toilet			
No	1	1	1
Yes	0.766**	0.690**	0.820
	(0.620 - 0.946)	(0.483 - 0.985)	(0.582 - 1.157)
Risky birth interval			
No	1	1	1
Yes	1.326***	1.491***	1.091
	(1.252 - 1.405)	(1.233 - 1.804)	(0.884 - 1.346)
Mother's age			
15-19	1	1	1
20-24	1.076	0.897	0.855
	(0.908 - 1.275)	(0.635 - 1.266)	(0.550 - 1.328)
25-29	0.947	0.892	0.891
	(0.781 - 1.146)	(0.632 - 1.260)	(0.611 - 1.300)
30-34	0.920	0.991	0.833
	(0.758 - 1.116)	(0.638 - 1.540)	(0.573 - 1.210)

35-39	0.982	0.836	0.640**
	(0.777 - 1.242)	(0.528 - 1.325)	(0.428 - 0.957)
40-44	0.859	0.805	0.860
	(0.666 - 1.108)	(0.392 - 1.652)	(0.511 - 1.446)
45-49	1.036	0.616	0.204**
	(0.701 - 1.530)	(0.211 - 1.800)	(0.0537 - 0.775)
Governorate Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Constant	41.01	0.728	18.10
	(0.0314 - 53,619)	(0.00510 - 103.9)	(0.0109 - 30,038)
Observations	40,801	40,847	40,847

Note: The provided coefficients are the adjusted odds ratios. Robust 95% confidence intervals are in parentheses. *** P <0 .01; ** P < 0.05, * p<0.1. All estimations are weighted using the DHS sampling weights.

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