Impact of Macro-Level Economic Improvement on Child Health: Childhood Malnutrition in Ghana, 1988-2003

Jemima A. Frimpong
Health Care Systems Department
The Wharton School
University of Pennsylvania
3641 Locust Walk, Rm G7
Philadelphia, PA 19104
Tel: 215-417-8230
E-mail: frimpong@wharton.upenn.edu

Roland Pongou
Population Studies and Training Center
Brown University
Robinson Hall
64 Waterman Street
Providence, RI 02912
Tel: 402-863-
E-mail: Roland_Pongou@brown.edu

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Abstract

We examine the impact of macro-level economic changes on childhood malnutrition in Ghana during the period 1988-2003, and attempt to identify the intermediate socioeconomic factors that mediated this impact. Ghana experienced economic growth after the mid 1980s, a situation slightly disturbed by a short-term shock in 1997. We use Demographic and Health Surveys (DHS) to examine the health effects of these economic changes. Weight-for-age malnutrition among children aged 2-35 months declined from 30% in 1988 to 25% in 1998 and to 24% in 2003. Height-for-age malnutrition declined from 29% in 1988 to 21% in 1998, but increased to 27% in 2003. Better household economic status, access to primary health care, and parental education were associated with better nutritional status in each year, and improvements in these factors explained the decline in malnutrition during economic upturns. Our analysis also suggests that increase in stunting between 1998 and 2003 may result from declining health care utilization following the Ghana health care reform and the 1997 economic shock.

Introduction

Malnutrition is currently the single leading cause of the global burden of disease (Ezzati et al. 2002) and has been identified as the underlying factor in about 50% of deaths of children under 5 years of age in developing countries (Black et al 2003). Nearly a third of these children are stunted and a quarter are underweight, a situation which is expected to worsen in some parts of the world including sub-Saharan Africa (De Onis et al 2000). Additionally, current patterns in population growth will lead to radical changes in the contribution of Africa and Asia to global prevalence of malnutrition. That is, comparing underweight rates from 1990, where 80 out of 100 underweight children lived in Asia and 16 in Africa, in 2015, the estimated figures show that 60 out of 100 underweight children will come from Africa and only 38 from Asia (De Onis et al. 2004). These figures are indications of a serious public health crisis with long term effects on population health, human capital accumulation and sustainability of developing countries.

The consequences of malnutrition span beyond compromise in physical health, and have been found to be associated with instability in mental health, internalization of behavioral problems, delays in primary school enrollments, and lower educational attainment (Glewwe and Jacoby, 1993; Weinreb et al. 2002; Chang et al. 2002). Using longitudinal data with information at national and subnational levels, Pelletier and Frongillo (2003) found a significant relationship between child mortality and weight-for-age after controlling for socioeconomic factors and changes in policy. Given the implications of malnutrition on social and economic development of nations, one of the Millennium Development Goals is the eradication of "extreme poverty and hunger."

In developing countries, economic crises have been shown to negatively impact child health (see Paxson et al 2004 on Peru, Hill et al 1993 on sub-Sahara Africa and Pongou et al 2005 on Cameroon). However, household and community factors involved in the mechanism linking macro-level economic shocks to micro outcomes (e.g. mortality, malnutrition etc.) have not been identified in most studies. In addition, studies have been mainly concerned with the health effects of economic downturns (Behrman and Rosenzweig, 2004; Haddad et al. 2003), with little attention on the impact of economic upturns. Yet, some developing countries have experienced economic growth in recent years, with likely positive consequences on households' economic status and national health sectors. In sub-Sahara Africa, Ghana is one of these countries that experienced economic growth during the 1990s, setting it apart from the experience of other countries in the sub-region. Our study examines the impact of this macro-level economic improvement on childhood malnutrition during the period 1988-2003 in this country, and attempts to identify the intermediate socioeconomic and environmental factors that mediated this impact. We use the Demographic and Health Surveys (DHS) conducted in the years 1988, 1993, 1998 and 2003 in the country to:

1- Examine trends in the prevalence of underweight, stunting and wasting during the period 1988-2003;
2- Study the determinants of these outcomes, their trends and their distributions during the period of interest;
3- Evaluate the contribution of each determinant to the trends in malnutrition.

While various studies have investigated the relationship between economic crises and health, a contribution of our study is an enhancement of our understanding of the impact of macro-level economic improvement on child health.

Ghana economic upturns

Ghana experienced increase in GDP growth in the early 60's (figure 1); however the economy began to decline in the early 70's. In 1982-1983, the country witnessed its worst drought in 50 years which caused bush fires and in turn destroyed crops. During the same period, the country also experienced weak levels of consumption, and minimum wages and social services (USAID, 1992). The economy stabilized in 1984 and maintained growth with little variance post that period.

Policy improvements and reforms have played a significant role in the growth of GDP. Between 1988 and 1991, the contribution of industry to GDP doubled and represented nearly 16% (World Bank, 1992). GDP grew at an annual rate of 5%, and inflation dropped from 122% before reform to about 10% in 1992. In recent years, the long term importance of agriculture has declined as industry gains momentum. Ghana took advantage of the *Heavily Indebted Poor Country* (HIPC) initiative and reached its decision point in 2002. The improvements in macroeconomics allowed the government to implement its reform agenda for the Ghana Poverty Reduction Strategy (GPRS). GPRS emphasizes wealth creation, improved governance and reductions in income inequalities (World Bank, 2004).

These macro level economic transformations were likely to have an impact at the micro level (household consumptions) and at the community level (health care sector, public infrastructure, access to water and sanitation, garbage removal, distance to electricity grid, etc). Kunbar (2001) posed a very interesting question about the growth in the economy of Ghana and what it means to income and livelihood of the people. In exploring this question, we hypothesize that changes in these household and community effects might have positively impacted childhood nutrition.

Methods

Data

Demographic and Health Surveys (DHS) were conducted in Ghana in 1988, 1993, 1998 and 2003. Designed to be representative at the national, urban-rural and regional level, each survey used a two-stage probabilistic sample technique to select clusters at the first level and households at the second level. In each household, information was collected on household socio-economic characteristics. The survey also included a questionnaire administered to women aged 15 to 49 years, comprising a birth history, information on individual characteristics and health behaviors, and details on their children.

For children alive at survey (those aged 2-35 months in 1988, 0-35 months in 1993, 0-59 months in 1998, and 0-59 months in 2003), weight and height were measured and used to calculate anthropometric indicators: height-for-age z-scores (HAZ), weight-for-age z-scores (WAZ) and weight-for-height z scores (WHZ) using the United States National Center for Health Statistics/World Health Organization (NCHS/WHO) international reference. For comparability across years, we restrict our study to children aged 2-35 months at each survey.

Variables

Malnutrition is measured using anthropometric indicators. Stunting is defined as height-for-age 2 standard deviations (SDs) below the median of the NCHS/WHO international reference. Underweight and wasting are similarly defined, using weight-for-age and weight-for-height z-scores, respectively. HAZ is a measure of linear growth and reflects cumulated and chronic health insults. WHZ measures the nutritional effects of short-term shocks, while WAZ is though of as a composite index of HAZ and WHZ, and has been used in many epidemiological studies on the impact of child nutrition on mortality (Pelletier et al 2003). While many studies have used these indicators in isolation, we also consider combining them, which has the potential to assess the total burden of malnutrition. In this case, malnutrition is defined as the occurrence of stunting or underweight, or the occurrence of at least one of the three forms of malnutrition just defined.

Control variables include a set of child characteristics (age, sex, breastfeeding status, birth order, preceding birth interval), maternal characteristics (educational attainment, occupation, marital status, age at child birth), and household characteristics (economic status, access to or utilization of health care, household size, number of children under five in the household). Household socio-economic status (SES) is measured using principal component analysis on nine variables indicating the possession of certain household facilities reflecting wealth and environmental conditions (car or truck, motorcycle, refrigerator, electricity, radio, television, finished floor, flush toilet, and piped water in the household). The indicator for access to health is constructed similarly, with indicator variables including prenatal visits, tetanus injection during pregnancy, medical assistance at delivery, knowledge of oral rehydration solutions (ORS) and possession of a health card for the child. These analyses were performed using pooled data from the four years (1988, 1993, 1998 and 2003) to ensure cross-year comparability. Details on the distribution of these variables are presented in table 1. We note that the SES index showed an upward trend during the period 1988-2003, consistent with the positive economic performance of the country during the 1990s. The health access index shows a rising trend until 1998, followed by a decline after this period. Also notable is the shift in maternal occupation, as the proportion of children born to unemployed mothers diminished progressively, in contrast to the proportion of children born to mothers working in agriculture. These trends might have some implications for the trends in the prevalence of malnutrition.

Results

Prevalence of malnutrition in Ghana, 1988-2003

Trends in the prevalence of malnutrition in Ghana are reported in table 2. The proportion of stunted children declined from 30% in 1988 to 27% in 1993 and to 21% in 1998, but increased to 27% in 2003. Underweight fell progressively from 30% in 1988 to 24% in 2003. In contrast, the prevalence of wasting increased during this period, reaching a peak in 1993 (13%). We also note a higher proportion of children with at least one form of malnutrition in each year; 39% of children were stunted or underweight in 1988, but this proportion declined to 33% in 1998, and rose to 37% in 2003. The total burden of malnutrition shows a quite stable trend. The proportion of children presenting at least one form of malnutrition was around 37-40%.

Determinants of malnutrition

To assess the determinants of malnutrition, we estimate specifications of the form:

$$(1) \qquad y_i = \beta_0 + \sum_{t=1993,1998,2003} \beta_t \, year_t + \sum_{t=1988,1993,1998,2003} \left(x_i * year_t \right) \alpha_t + \varepsilon_i$$

where y_i is an outcome (stunting, underweight etc.) for child *i*. The term $x_i * year_t$ is an array of child, maternal and household characteristics (x_i) interacted with a dummy indicator for the year t ($year_t$) (*t=1988, 1993, 1998, 2003*). Note that the year 1988 is omitted in the first summation term while all years are used in interaction terms in the second summation term. This specification allows estimation of the effect of each variable in each year. Cross-year comparison of these effects is also permitted. These effects are measured by the parameters α_t which are reported in tables 3-7. We estimate equation (1) using sub-region random effects[1], also correcting for clustering of observations within sub-regions in the standard errors.

Child characteristics: sex, age, birth interval and breastfeeding status

Child sex was not significantly associated with any form of malnutrition in 1988 (tables 3-5). But in subsequent years, the prevalence of stunting was greater in boys, even after controlling for all other factors. Stunting was 4.8 percentage points (pp) higher in males than females in 1993, but this difference decreased to 2.6 pp in 1998, and increased to reach 6.2 pp in 2003 (table 3, model 3). While underweight was significantly more prevalent in boys than girls in 1993, sex difference in this form of malnutrition was not significant in 1998 and 2003 (table 4). Sex difference in wasting was insignificant in all years, except in 1998 where it was 3.1 pp higher in boys compared to girls (table 5).

As expected, age was positively associated with all forms of malnutrition in all years: exposure to malnutrition increase as children age. This relation was non-linear as the quadratic term for age was significant (tables 3-5). We also note that the strength of the relation varied across forms of malnutrition and across years. After controlling for all other factors, a unit increase in child age (in month) was on average associated with 2.6-4.1 pp increase in stunting, 3.8-4.8 pp increase in underweight, and 0.9-2.4 pp increase in wasting.

Preceding birth interval was negatively associated with all forms of malnutrition in all years; however, the statistical significance of this relationship generally diminished after adjusting for other covariates. This result confirms the positive effect of birth spacing on child health, as it also has positive impact on maternal health.

Breastfeeding also showed significant association with malnutrition, but the direction and the strength of this relation differed across years and across forms of malnutrition. After controlling for all covariates, children who were still breastfeeding by the survey were consistently more stunted than those who had breastfed for 13 months or more (table 3). We note that without controls, the latter were significantly more stunted than the former, but this

[1] We split each region reported in table 1 into urban and rural areas, creating a total of 16 sub-regions.

relation was probably confounded by child age because younger children are less stunted than older ones, and they are also more likely to be kept on breast. This negative effect of prolonged breastfeeding was not observed on underweight (table 4) and on wasting (table 5). After adjusting for all covariates, with respect to stunting and underweight, children who had breastfed for 5-6 months did significantly differ from those of the reference category (those who had breastfed 13+ months), but the prevalence of wasting was consistently lower in the former compared to the latter, except in 1988 and 1998 where this relation was not statistically significant (table 5).

Maternal characteristics: education and occupation

Maternal education has been found to be a significant determinant of child health in many studies (Barrera 1990; Lavy et al. 1996; Handa 1999). Our study shows that children born to mothers with more education were less likely to be malnourished (tables 3-5). However this effect was very weak, and generally lost statistical power when other variables were controlled. The unadjusted coefficient on education ranged from -0.006 in 1988 and 1991 to -0.05 in 1998 for stunting; but it dropped to -0.009 in 2003. The adjusted coefficient on education fell to non-significant in all year, except in 2003 where it was still significant. The adjusted effect of education on underweight increased over time. This effect was not significant in 1988 and 1993, but it gained strength and statistical power in 1998 and 2003. The effect of education on wasting was unexpectedly positive in 1988, but it was negative and statistically non-significant in subsequent years.

Maternal occupation showed stronger association than education with stunting and underweight (tables 3-4). We note that in 1988 and 1991, children born to mothers engaged in the agricultural sector were worst off, but this disadvantage diminished over time. After controlling for all factors, stunting was 11.4 pp lower among children born to unemployed mothers compared to those born to mothers engaged in the agricultural sector in 1988, but this difference decreased to 5.1 pp in 1993 and 0.008 pp in 1998 (table 3). In 2003, this figure reversed, as stunting was 9.1 pp higher in the former group compared to the latter. With respect to underweight, the unadjusted advantage of the former over the latter persisted in all years, with decreasing magnitude, but the adjusted difference between the two groups is smaller and was only significant in 1988 (table 4).

Children born to women employed in the professional, technical or managerial sector were also better off compared to those born to mothers employed in agriculture (table 3). After controlling for all factors, the prevalence of stunting was 17.9 pp lower among the former compared to the latter, but this difference completely disappeared in 1993 and 1998, and even reversed in 2003. The picture was similar for underweight, but it should be noted that this form of malnutrition was 24.9 pp higher in the former group compared to the latter group in 1998, after controlling for all factors (table 4).

Children born to mothers engaged in services or sales also fared better than their counterparts in the reference group (tables 3-4). But as for other groups, these children lost ground over time relatively to children whose mothers were employed in the agricultural sector. After adjusting for all factors, the prevalence of stunting was 20.8 pp lower among children whose mothers were employed in services compared to the reference group, but this difference sharply dropped to 0.3 pp in 2003 (table 3). It should be noted that the difference in the prevalence of underweight between these two groups was insignificant in each year after controls

were included (table 4). Stunting was 10.6 pp higher among children born to mothers engaged in sales, but this difference dropped to 3.5 pp in 1998 and to 0.7 pp in 2003 (table 3). The difference in the prevalence of underweight between these two groups was 9.5 pp in 1988, 5.0 pp in 1993 and around 1.2-1.3 pp in 1998 and 2003.

Children whose mothers were engaged in unskilled or skilled manual work were worse off compared to the groups already surveyed, but were better off compared to the reference group. Stunting was 7.6 pp lower in the former group compared to the latter group in 1988 after controls were included, but this advantage diminished to non-significant in subsequent years (table 3). A similar picture was observed for underweight (table 4). Our results suggest that occupational differentials in the prevalence of stunting and underweight diminished over the years, and that decline in malnutrition during the 1990s occurred mostly among children of lower occupational classes.

Household characteristics: economic status and access to health care

Household economic status was negatively associated with stunting and underweight in all years (tables 3-4). A unit increase in the household economic status (HES) index was associated with a 3.0 pp and 3.7 pp decline in stunting in 1988 and 1993, respectively (table 3). The strength of this relation slightly diminished in 1998 and 2003 as a unit increase in the HES index resulted in a 2.6 pp and 2.8 pp decline in stunting respectively. After controlling for other covariates, the effect of HES diminished, but was still significant in all years, except in 1988. The effect of this variable on underweight was lower. A unit increase in the HES index resulted in 1.9 and 3.0 pp decrease in the prevalence of underweight in 1988 and 1993, respectively, but as for stunting, this effect diminished in subsequent years (table 4). The adjusted effect diminished, but remained consistently significant in all years, except in 1988. As for wasting, the effect of HES was much lower, and was significant only in 1998 (table 5, model 3).

Household access to health care also showed negative association with malnutrition: malnutrition is more prevalent among children with lower access to health facilities. A unit increase in the health access index resulted in decline in stunting ranging from 1.5 pp in 1988 to 4.4 pp in 2003 (table 3, model 3). Note that this effect was not significant in 1998. Decline in underweight corresponding to a unit increase in health access index was 1.6 pp in 1988, 3.4 pp in 1993, 0.7 pp in 1998 (non-significant) and 2.9 pp in 2003 (table 4, model 3). We also note in 1993 and 2003, children with lower access to care were significantly more wasted than those with higher access (table 5, model 3).

We note in general that child demographic and biological factors, maternal socioeconomic status and household characteristics were significantly associated with childhood malnutrition in Ghana during the period 1988-2003. Other factors not reported in the tables such as marital status, maternal age at a child birth, household size, number of children less than five years of age in the household, and child birth order were also controlled in the study. Marital status had little effect on malnutrition in general. While the number of children under five in the household was positively associated with stunting and underweight in some years, household size had a negative effect on these outcomes.

Explaining change in the prevalence of malnutrition

Malnutrition in Ghana during the 1990s was determined by the socioeconomic factors previously highlighted, some of which had varying effects over time and across outcomes. It can therefore be hypothesized that change in the prevalence of malnutrition during this period partly occurred as a result of change in the distribution of these explanatory factors, affected by macro-level economic change experienced by the country during this period. We test this assumption using the following model:

$$(2) \qquad y_i = \beta_0 + \sum_{t=1988,1993,2003} \beta_t \, year_t + X\alpha + \varepsilon_i$$

where y_i is an outcome (stunting, underweight or wasting) of child *i*, *X* a vector of child, maternal and household variables. As for the first specification, we estimate random sub-region effects. We report only the parameters β_t, estimating the difference in the prevalence of malnutrition between year *t* and the year 1998 after controlling for the variables *X*. These parameters therefore also measure the part of this difference that is mediated by the controlled variables. Results are presented in table 6.

For each panel of table 6, model 1 estimates the unadjusted effect of the year of survey on the outcome of interest. The coefficient on year *t* therefore measures the crude difference in the prevalence of malnutrition between year *t* and the year 1998. We note that stunting was 10.3 pp and 6.0 pp lower in 1998 compared 1988 and 1993 respectively. This form of malnutrition increased by 6.3 pp between 1998 and 2003 (panel A). After controlling for child characteristics (sex, age, birth order and breastfeeding status) (model 2), we note that the 1988 and 1993 level of stunting remained unchanged relatively to 1998, suggesting that none of these factors mediated trends in stunting during the 1990s, but the 2003 level dropped by 1.5 pp relatively to the reference year; this was particularly attributable to the negative role played by prolonged breastfeeding, as the proportion of children who was still breastfeeding during the survey increased from 64.0% to 66% between 1998 and 2003 (table 1). Further Control for health access index and maternal occupation shows that improvement in these factors mediated part of the decline in stunting between 1988 and 1998, and worsening in these factors explained about 1.8 pp increases in this form of malnutrition between 1998 and 2003. This explanation is particularly consistent with the evolution of the index for access to health care which sharply increased from -0.01 point in 1988 to 0.27 point in 1993 and to 0.53 point in 1998, but significantly dropped to 0.26 point in 2003 (table 1).

We also note that children born to mothers engaged in the agricultural sector increased over time. Estimating the effect of maternal occupation separately, we found that if the distribution of this variable in other years were similar to the 1998 distribution, the elevated prevalence of stunting would have been greater in 1988 and lower in 1993 and 2003. This is consistent with the evolution of children born to mothers engaged in the agricultural sector as this group was consistently worst off in all years (at least in the unadjusted model, table 3), and it clearly establishes that increase in stunting after 1998 was partially mediated by increase in the proportion of this class of children. Also following the argument just stated, occupation doesn't explain decline in stunting between 1988 and 1998. Controlling for household economic status and maternal education diminishes by 1.7 pp the elevated prevalence of stunting in 1988 compared to 1998 (model 4); this shows that improvements in these factors mediated part of the

decline in stunting between 1988 and 1998, and these factors played no role in the 1998-2003 increase.

After controlling for preceding birth interval (model 5), we note that increase in average birth interval from 30.8 months in 1988 to 33.9 in 1998 is also an explanatory factor of decline in stunting during this period. We note that almost 39% of decline in stunting between 1988 and 1998 is explained by change in the distribution of socioeconomic variables previously surveyed, and more than 50% in the increase of this form of malnutrition between 1998 and 2003 was explained three key factors including prolonged breastfeeding, decline in household access to health care, and increase in the proportion of children born to mothers engaged in the agricultural sector.

Results also show that decline in underweight between 1988 and 1998 was mainly explained by increase in access to health care (panel B, model 3) and improved household economic status (panel B, model 4). Results also suggest that if the distribution of certain variables (including breastfeeding status, access to health care and maternal occupation) in 2003 were similar to the 1998 distribution, the prevalence of underweight would have decreased by 4.8 percentage points (pp) between the two years. Overall, we note that about 64.2% of decline in underweight between 1988 and 1998 was explained by the socioeconomic variables included in our analysis, in particular increased utilization of health care and improved household economic status.

The prevalence of wasting was respectively 4.9 pp, 0.9 pp and 2.9 pp lower in 1988, 1993 and 2003 lower compared to 1998 (panel C, model 1). Controlling for other variables show no mediating effect of these variables in wasting trends during the period of our study, but results show that if the distribution of variables in those years were similar to the 1998 distribution, the relatively lower level of wasting associated with these years would been more pronounced.

Discussion

This study examines the impact of macro-level economic improvements on childhood malnutrition in Ghana during the period 1988-2003. Our analysis indicates an upward trend in the household socioeconomic status index, mirroring the economic growth in Ghana during this period. However, trends in two of the three anthropometric measures of malnutrition (stunting and wasting) did not entirely move in the same direction. Stunting declines from 1988 to 1998, but increased sharply aftwards; and wasting increased, reaching a peak in 1998. Contrary to the expectation that countries in West Africa will continue to experience increase in underweight (De Onis 2004), this form of malnutrition declined in Ghana during the period of our study. Prior studies have also indicated declines in malnutrition only based on one of the three anthropometric indicators (Monteiro 1992; Haddad 2003). But we note that the proportion of children presenting at least one form of malnutrition stabilized at 37% - 40%.

Considering the relation to macro economic growth and increase in GNP, the result for stunting is inconsistent with other studies (Frongillo and Hanson, 1995; Frongillo et al. 1997; Smith and Haddad, 1999; Haddad et al. 2003). It is however important to note that inequalities in income distribution cancel out the significant effect of per capita GNP (ACC/SCN Report 2000).

While household socioeconomic status improved during economic upturns, our analysis also shows that utilization of health care declined after 1998, following an increase in the early

period. The collapse in health care utilization is shown to mediate part of increase in stunting after 1998, while it didn't affect underweight and wasting during this period. These findings unavoidably raise the question of the mechanisms linking macro-level economic changes to different indicators of child health.

System Level Factors (Access to Health Care)

Health care reform in Ghana may have impacted health care utilization and may explain increase in stunting after 1998 as previously argued. The landscape of the health care delivery system in Ghana has changed significantly in recent years. Health care reform in the country took place in the context of the IMF/World Bank structural adjustment program (SAP), which was adopted in 1983. Two of the key objectives of the reform in the health sector were to improve access to services and quality of health services. As part of health sector reform, the government introduced cost sharing and fee-for-service in 1985.

Even though household income increased in Ghana during the period 1988 – 2003, user fees and competing demands for services (i.e. education, water, food) might have mitigated the need to seek care for children, especially after the 1996 decentralization of the health care sector and the 1997 short-term shock. User fees and decentralization of health care systems have been shown to influence utilization patterns and to impose considerable hardships on the poor in developing countries (Mbugua et al. 1995; Blas and Limbambala, 2001; Palmer et al. 2004; Manzi et al, 2005). We speculate that the implementation of user fees coupled with the decentralization of the health sector in 1996 caused declines in health care utilization in Ghana, which contributed to the worsening of health indicators such as stunting. Households with scare resources and multiple needs to satisfy will be less likely to access services that require a fee or payment. We note that exemptions are included in the reform to ease the burden of cost to the poor, however inefficiencies in these programs prevents individuals who need exemptions from accessing essential health services (Nyonator and Kutzin, 1999).

Household Level Factors (Maternal characteristics)

Household factors also mediated changes in the prevalence of malnutrition during the 1990s in Ghana. We find that maternal occupation had a stronger association with malnutrition (underweight and stunting) than education. Improvement in macro level economic indicators had a positive household effect by creating employment opportunities for women. However, increase in activities that generated income may have replaced other traditional maternal duties (i.e. caring for children and their needs) and could have played a role in stunting after 1998. This argument is supported by other studies that examined the impact of maternal factors on child health (McKinlay, 1972; Christiaensen and Alderman, 2004; GDHS, 2003). Additionally, our finding of maternal education had a weak effect on malnutrition shows that mothers who are formally educated are not necessarily knowledgeable about proper nutrition. This finding is important because it questions prior findings that have linked mother's education to malnutrition. It further indicates that a more appropriate measure would be knowledge about nutrition or appropriateness of mother's information about nutrition in addressing childhood malnutrition. Although access to formal education may serve as a path through which information about proper nutrition could be obtained, it is not the only path or a good measure for assessing the

effect of knowledge on malnutrition (Glewwe, 1999). As shown by our analysis, occupational differentials in malnutrition diminished over time. The impact of decision-making and occupational status on child health has been examined (Pokhrel and Sauerborn, 2004; Basu, 1990). Based on our findings and prior studies, we argue that mothers employed in the formal sector are likely to be head of household or have some decision making power. Therefore, they will have to make tradeoffs between their roles in and outside of the home, which may negatively impact child health. Reduction in workload is therefore essential to removing the negative effect of occupational status on childhood malnutrition. These modifications will lead to effective and efficient decision making that will lead to better health seeking behavior for children and a possible decline in malnutrition rates (Radebe et al., 1996)

Conclusion

Although household income responded positively to macro level economic upturns in Ghana during the 1990s, we show that possible explanations for the mixed results in the three measures of malnutrition could be associated with health care system and maternal factors. It is important that we address both individual and system level characteristics that are barriers to health services and proper nutrition. It is also important to note that macro-level economic growth that may lead to improvements in household economics may not necessarily translate into improvement in child health and nutrition. The findings from the study are significant to policy development as well as intervention approaches. It reiterates the importance of interventions that address characteristics associated with specific populations within communities. Policy and interventions should emphasis individual, community and governmental level approaches. Empowering parents with necessary tools and information concerning the importance of proper nutrition could potentially overcome differences in occupation, employment status, and mechanisms of decision-making that negatively impacts child malnutrition. Further research into this topic would be instrumental to effectively addressing the malnutrition crisis in Ghana.

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Table 1: Distribution of selected variables. Standard errors are in parentheses.

Variables	1988	1993	1998	2003
N	1836	1751	1602	1856
Child characteristics				
Sex				
Male	0.50 (0.01)	0.50 (0.01)	0.50 (0.01)	0.49 (0.01)
Female	0.50 (0.01)	0.50 (0.01)	0.50 (0.01)	0.51 (0.01)
Age (months)	18.1 (0.21)	17.8 (0.23)	17.7 (0.23)	18.0 (0.21)
Breastfeeding duration				
Never breastfed	0.01 (0.00)	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)
Breastfed 0-4 months	0.01 (0.00)	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)
Breastfed 5-6 months	0.00 (0.00)	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)
Breastfed 7-12 months	0.10 (0.00)	0.07 (0.01)	0.06 (0.01)	0.05 (0.00)
Breastfed 13+ months (R)	0.27 (0.10)	0.28 (0.01)	0.28 (0.01)	0.28 (0.01)
Still breastfeeding	0.61 (0.01)	0.65 (0.01)	0.64 (0.01)	0.66 (0.01)
Preceding birth interval	30.8 (0.53)	34.6 (0.64)	33.9 (0.70)	36.1 (0.73)
Maternal characteristics				
Educational attainment (years)	4.62 (0.10)	4.72 (0.10)	4.89 (0.11)	4.54 (0.10)
Occupation				
None	0.45 (0.01)	0.20 (0.01)	0.14 (0.01)	0.12 (0.01)
Professional	0.02 (0.00)	0.02 (0.00)	0.01 (0.00)	0.02 (0.00)
Services	0.02 (0.00)	0.03 (0.00)	0.05 (0.00)	0.05 (0.04)
Sales	0.29 (0.01)	0.41 (0.01)	0.34 (0.01)	0.24 (0.01)
Agriculture	0.11 (0.01)	0.21 (0.01)	0.33 (0.01)	0.43 (0.01)
Manual	0.10 (0.01)	0.13 (0.01)	0.13 (0.01)	0.13 (0.01)
Marital status				
Married	0.85 (0.01)	0.77 (0.01)	0.72 (0.01)	0.81 (0.01)
Maternal age at child birth (yrs)	27.1 (0.16)	27.2 (0.15)	27.3 (0.18)	28.0 (0.16)
Household characteristics				
Selected indicators for economic status				
Car	0.04 (0.00)	0.03 (0.00)	0.03 (0.00)	0.05 (0.00)
Refrigerator	0.06 (0.00)	0.08 (0.01)	0.11 (0.01)	0.15 (0.01)
Pipe water in household	0.09 (0.01)	0.10 (0.01)	0.11 (0.01)	0.10 (0.01)
Flush toilet	0.03 (0.00)	0.05 (0.00)	0.04 (0.00)	0.07 (0.01)
Selected indicators for access to health				
Prenatal visits	0.88 (0.01)	0.87 (0.01)	0.90 (0.01)	0.84 (0.01)
Tetanus injection during pregnancy	0.73 (0.01)	0.79 (0.01)	0.82 (0.01)	0.76 (0.01)
Medical assistance at delivery	0.69 (0.01)	0.60 (0.01)	0.70 (0.01)	0.46 (0.01)
Economic status index	-0.30 (.04)	-0.05 (0.04)	0.14 (0.05)	0.47 (0.05)
Health access index	-0.01 (0.03)	0.27 (0.03)	0.53 (0.03)	0.26 (0.03)
Household size	7.21 (0.08)	5.58 (0.07)	5.54 (0.07)	5.90 (0.06)
Number of children under 5	2.18 (0.03)	1.86 (0.02)	1.77 (0.02)	1.80 (0.02)
Place of residence				
Urban	0.28 (0.01)	0.28 (0.01)	0.26 (0.01)	0.34 (0.01)
Rural	0.72 (0.01)	0.72 (0.01)	0.74 (0.01)	0.66 (0.01)
Region of residence				
Greater Accra	0.11 (0.01)	0.09 (0.01)	0.11 (0.01)	0.10 (0.01)
Western	0.10 (0.01)	0.09 (0.01)	0.12 (0.01)	0.11 (0.01)
Central	0.10 (0.01)	0.10 (0.01)	0.12 (0.01)	0.09 (0.01)
Eastern	(0.16 (0.01)	0.11 (0.07)	0.14 (0.01)	0.11 (0.01)
Volta	0.13 (0.01)	0.11 (0.01)	0.11 (0.01)	0.08 (0.01)
Ashanti	0.14 (0.01)	0.18 (0.01)	0.17 (0.01)	0.19 (0.01)
Brong Ahafo	0.15 (0.01)	0.10 (0.01)	0.08 (0.01)	0.11 (0.01)
Northern, Upper East, Upper West	0.11 (0.01)	0.21 (0.01)	0.15 (0.01)	0.21 (0.01)

Table2: Trends in prevalence of malnutrition in Ghana, 1988-2003

	1988	1993	1998	2003
% HAZ < -2 SD	30.0 (1.1)	26.8 (1.1)	20.6 (1.0)	27.4 (1.0)
% WAZ < -2 SD	30.3 (1.1)	28.2 (1.1)	25.7 (1.1)	24.1 (1.0)
% WHZ < -2 SD	7.7 (0.6)	12.0 (0.8)	13.2 (0.8)	9.7 (0.7)
% HAZ < -2 SD or WAZ < -2 SD	39.1 (1.1)	37.3 (1.2)	33.0 (1.2)	36.6 (1.1)
% HAZ < -2 SD, WAZ < -2 SD or WHZ < -2 SD	40.5 (1.2)	39.5 (1.2)	36.9 (1.2)	39.5 (1.1)

Table 3: GLS sub-region random estimates of height-for-age malnutrition

	1988			1991			1998			2003		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Variables												
N	7045	7045	7045	7045	7045	7045	7045	7045	7045	7045	7045	7045
Sex												
Male	0.001	0.007	0.008	0.046***	0.044***	0.048***	0.023	0.023*	0.026*	0.055*	0.061**	0.062**
Female (R)												
Age (months)	0.033***	0.035***	0.034***	0.024***	0.025***	0.025***	0.026***	0.027***	0.027***	0.038***	0.040***	0.041***
Age*age	-0.000***	-0.000***	-0.000***	-0.000*	-0.000	-0.000	-0.000**	-0.000	-0.000	-0.001***	-0.001***	-0.001***
Breastfeeding duration												
Never breastfed	-0.034	-0.007	0.009	0.005	0.346	0.390	-0.316***	0.141	0.137	0.172***	-0.305***	-0.292***
Breastfed 0-4 months	-0.019	0.034	0.065	-0.161	0.105	0.109	0.262	0.303*	0.293*	-0.150	-0.193**	-0.180**
Breastfed 5-6 months	0.152	0.192	0.191	0.005	-0.006	0.009	-0.138	-0.048	-0.043	-0.174	-0.199*	-0.205
Breastfed 7-12 months	-0.144***	-0.107***	-0.111***	-0.006	0.043	0.044	0.003	0.024	0.024	0.114	0.104	0.101
Breastfed 13+ months (R)												
Still breastfeeding	-0.172***	0.120***	0.116***	-0.092*	0.204***	0.207***	-0.027	0.201***	0.208***	-0.055*	0.057	0.059
Preceding birth interval	-0.001*	-0.001	-0.001	-0.002***	-0.001**	-0.001	-0.001***	-0.001***	-0.000	-0.001***	-0.001**	-0.001**
Years of education	-0.006*	-0.003	-0.003	-0.006**	0.001	0.001	-0.05**	-0.003	-0.002	-0.009**	-0.007*	-0.007*
Maternal occupation												
None	-0.140**	-0.113***	-0.114***	-0.118***	-0.043**	-0.051**	-0.048*	-0.005	-0.008	-0.004	0.097***	0.091***
Professional	-0.269***	-0.186***	-0.179***	-0.123*	0.001	0.022	0.024	0.198	0.201	-0.065	0.133*	0.143*
Services	-0.356***	-0.214***	-0.208***	-0.126*	-0.605	-0.040	-0.238	0.065	0.053	-0.124**	-0.003	-0.003
Sales	-0.135**	-0.0106**	-0.106**	-0.145***	-0.085***	-0.087***	-0.083***	-0.031	-0.035*	-0.098***	-0.004	-0.007
Agriculture (R)												
Manual	-0.049	-0.071*	-0.076**	-0.112**	-0.540	-0.050	-0.060**	-0.012	-0.006	-0.046	0.019	0.018
Economic status index	-0.030***	-0.016	-0.015	-0.037***	-0.019***	-0.016***	-0.026***	-0.021**	-0.018**	-0.028**	-0.015**	-0.015*
Health access index	-0.014*	-0.014***	-0.015***	-0.024***	-0.030***	-0.027***	-0.008	-0.001	0.001	-0.054***	-0.048***	-0.044***
Overall R-squared		0.143	0.151		0.143	0.151		0.143	0.151		0.143	0.151

Model 1 is the unadjusted model including only the variable of interest interacted with the dummy indicators for the years 1988, 1993, 1998 and 2003 (age and age*age are included together); the interaction terms are included together with the indicators for 1993, 1998 and 2003. Model 2 controls for all the variables presented in the table in addition to child birth order and its quadratic term. Model 3 includes all the variables in Model 2 and further controls for maternal age at child birth, its quadratic term, marital status, household size, and the number of children under five in the household. Note that because each variable is interacted with each year dummy, the results presented in the table are comparable across years for each model.

-Statistical significance: *: P<0.10; **: p<0.05; ***: p<0.001

Table 4: GLS sub-region random estimates of weight-for-age malnutrition

	1988			1991			1998			2003		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Variables												
N	7045	7045	7045	7045	7045	7045	7045	7045	7045	7045	7045	7045
Sex												
Male	-0.010	-0.004	-0.002	0.035**	0.032*	0.035*	-0.007	-0.003	-0.004	0.025	0.026	0.024
Female (R)												
Age (months)	0.045***	0.048***	0.048***	0.035***	0.038***	0.038***	0.047***	0.047***	0.047***	0.038***	0.038***	0.038***
Age*age	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
Breastfeeding duration												
Never breastfed	0.054	0.047	0.048	0.055	0.386	0.402	0.214**	0.286**	0.286**	-0.234***	-0.243***	-0.232***
Breastfed 0-4 months	0.136**	0.180**	0.180*	-0.278***	-0.079	-0.072	0.160	0.174	0.172	-0.067	-0.104	-0.098
Breastfed 5-6 months	0.098	0.155	0.150	0.055	0.010	0.015**	-0.040	0.021	0.023	-0.091	-0.116	-0.110
Breastfed 7-12 months	-0.111**	-0.097**	-0.094**	-0.000	0.034	0.033	-0.023	-0.014	-0.016	0.019	0.008	0.008
Breastfed 13+ months (R)												
Still breastfeeding	-0.030	0.162***	0.165***	0.006	0.231***	0.233***	0.047	0.225***	0.226***	0.027	0.098***	0.097***
Preceding birth interval	-0.001	-0.000	-0.000	-0.001**	-0.000	0.000	-0.001**	-0.001**	-0.001**	-0.000	-0.000*	-0.000*
Years of education	-0.001	0.003	0.002	-0.011**	-0.004	-0.003	-0.006***	-0.005**	-0.005***	-0.006**	-0.006*	-0.006*
Maternal occupation												
None	-0.101**	-0.065**	-0.066*	-0.109***	-0.004	-0.007	-0.049**	-0.001	-0.001	-0.022	0.047*	0.040
Professional	-0.254***	-0.209***	-0.193**	-0.197**	-0.051	-0.046	0.039	0.233**	0.249**	-0.071	0.087	0.082
Services	-0.180**	-0.047	-0.037	-0.157**	-0.035	-0.023	-0.048	0.056	0.060	-0.065	0.029	0.034
Sales	-0.134***	-0.097**	-0.095**	-0.131***	-0.051**	-0.050**	-0.076**	-0.012	-0.013	-0.085***	-0.011	-0.012
Agriculture (R)												
Manual	-0.083	-0.092*	-0.089*	-0.106**	-0.043	-0.040	-0.098**	-0.044	-0.043	-0.018	0.028	0.028
Economic status index	-0.019***	-0.014	-0.013	-0.030***	-0.012**	-0.012**	-0.020***	-0.019**	-0.017**	-0.016**	-0.014**	-0.014**
Health access index	-0.010*	-0.016**	-0.016**	-0.032***	-0.036***	-0.034***	-0.008	-0.006	-0.007	-0.027***	-0.030***	-0.029***
Overall R-squared		0.110	0.114		0.110	0.114		0.110	0.114		0.110	0.114

Model 1 is the unadjusted model including only the variable of interest interacted with the dummy indicators for the years 1988, 1993, 1998 and 2003 (age and age*age are included together); the interaction terms are included together with the indicators for 1993, 1998 and 2003. Model 2 controls for all the variables presented in the table in addition to child birth order and its quadratic term. Model 3 includes all the variables in Model 2 and further controls for maternal age at child birth, its quadratic term, marital status, household size, and the number of children under five in the household. Note that because each variable is interacted with each year dummy, the results presented in the table are comparable across years for each model.

-Statistical significance: *: P<0.10; **: p<0.05; ***: p<0.001

Table 5: GLS sub-region random estimates of weight-for-height malnutrition

	1988			1991			1998			2003		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Variables												
N	7299	7299	7299	7299	7299	7299	7299	7299	7299	7299	7299	7299
Sex												
Male	0.019	0.019	0.020	0.007	0.004	0.005	0.030*	0.033*	0.031*	0.005	0.005	0.004
Female (R)												
Age (months)	0.016***	0.017***	0.017***	0.018***	0.020***	0.020***	0.024***	0.024***	0.024***	0.009**	0.009**	0.009**
Age*age	-0.000***	-0.000***	-0.000***	-0.000***	-0.000**	-0.000***	-0.001***	-0.001***	-0.001***	-0.000**	-0.000**	-0.000***
Breastfeeding duration												
Never breastfed	-0.036***	-0.048**	-0.060**	-0.081***	0.001	0.000	0.185*	0.199**	0.205**	-0.053***	-0.060**	-0.068*
Breastfed 0-4 months	0.089	0.091	0.102	-0.081***	-0.046	-0.048	0.003	-0.008	-0.006	-0.052***	-0.082***	-0.086***
Breastfed 5-6 months	-0.036***	-0.028	-0.024	-0.081***	-0.097***	-0.103***	0.012	-0.003	-0.009	-0.053***	-0.067**	-0.064**
Breastfed 7-12 months	0.030	0.022	0.018	-0.021	-0.022	-0.022	0.031	0.016	0.013	0.023	0.011	0.010
Breastfed 13+ months (R)												
Still breastfeeding	0.061***	0.055***	0.052**	0.064***	0.087**	0.089**	0.061***	0.022	0.022	0.072***	0.049***	0.047***
Preceding birth interval	-0.000	0.000	0.000	-0.000	-0.000	0.000	-0.000*	-0.000	-0.001*	-0.000	-0.000	-0.000
Years of education	0.002	0.002*	0.002*	-0.006**	-0.003	-0.003	-0.002*	-0.000	-0.001	-0.001	-0.002	-0.001
Maternal occupation												
None	-0.009	0.004	0.001	-0.042*	0.002	0.003	-0.018	-0.003	-0.003	0.012	0.020	0.019
Professional	-0.039	-0.046	-0.046	-0.080*	-0.025	-0.036	0.062	0.125	0.122	-0.018	0.024	0.036
Services	-0.050	-0.034	-0.031	-0.063	0.001	-0.000	-0.072*	-0.035	-0.032	-0.018	-0.001	0.005
Sales	0.009	0.017	0.015	-0.036	-0.002	0.001	-0.029*	-0.007	-0.007	-0.005	0.014	0.018
Agriculture (R)												
Manual	-0.014	-0.008	-0.012	-0.018	0.004	0.007	-0.046**	-0.031	-0.034	0.015	0.024	0.027
Economic status index	0.003	-0.001	-0.001	-0.006	0.001	0.001	-0.009**	-0.011***	-0.011**	0.001	0.001	0.000
Health access index	0.007	0.004	0.004	-0.014*	-0.013*	-0.012*	-0.012	-0.012	-0.013	-0.001	-0.009**	-0.008**
Overall R-squared		0.043	0.048		0.043	0.048		0.043	0.048		0.043	0.048

Model 1 is the unadjusted model including only the variable of interest interacted with the dummy indicators for the years 1988, 1993, 1998 and 2003 (age and age*age are included together); the interaction terms are included together with the indicators for 1993, 1998 and 2003. Model 2 controls for all the variables presented in the table in addition to child birth order and its quadratic term. Model 3 includes all the variables in Model 2 and further controls for maternal age at child birth, its quadratic term, marital status, household size, and the number of children under five in the household. Note that because each variable is interacted with each year dummy, the results presented in the table are comparable across years for each model.

-Statistical significance: *: P<0.10; **: p<0.05; ***: p<0.001

Table 6: Explaining changes in prevalence of malnutrition

	Panel A: Dependent variable: Stunting				
Variables	Model 1	Model 2	Model 3	Model 4	Model 5
N	7045	7045	7045	7045	7045
Year					
1988	0.103***	0.101***	0.080***	0.067***	0.063***
1993	0.060***	0.060***	0.040**	0.043***	0.044***
1998					
2003	0.063***	0.048***	**0.030*****	**0.039*****	0.040**
Overall R-squared	0.004	0.099	0.115	0.122	0.125
	Panel B: Dependent variable: Underweight				
Variables					
N	7045	7045	7045	7045	7045
Year					
1988	0.053***	0.049**	0.030	0.021	0.019
1993	0.021*	0.023*	0.007	0.011	0.011
1998					
2003	-0.021	-0.034***	-0.048***	-0.040**	-0.039**
Overall R-squared	0.002	0.080	0.093	0.097	0.098
	Panel C: Dependent variable: Wasting				
Variables					
N	7299	7045	7045	7045	7045
Year					
1988	-0.049***	-0.054***	-0.056***	-0.060***	-0.060***
1993	-0.009	-0.008	-0.010	-0.009	-0.009
1998					
2003	-0.029**	-0.031***	-0.033***	-0.033***	-0.033***
Overall R-squared	0.004	0.030	0.032	0.028	0.033

Model 1 includes only the dummy indicators for the years 1988, 1993 and 2003, the year 1998 being the reference category. Model 2 additionally adjusts for child age, sex, birth order, and breastfeeding status. Model 3 includes all the variables in Model 2 and further adjusts for the health access index and maternal occupation. Model 4 additionally controls for maternal education, household economic status and household size. Model 5 further controls for preceding birth interval.

Figure 1: Real GDP per Capita in Ghana, 1965 - 2000

Source: Penn World Table Version 6.1 (Heston et al.)

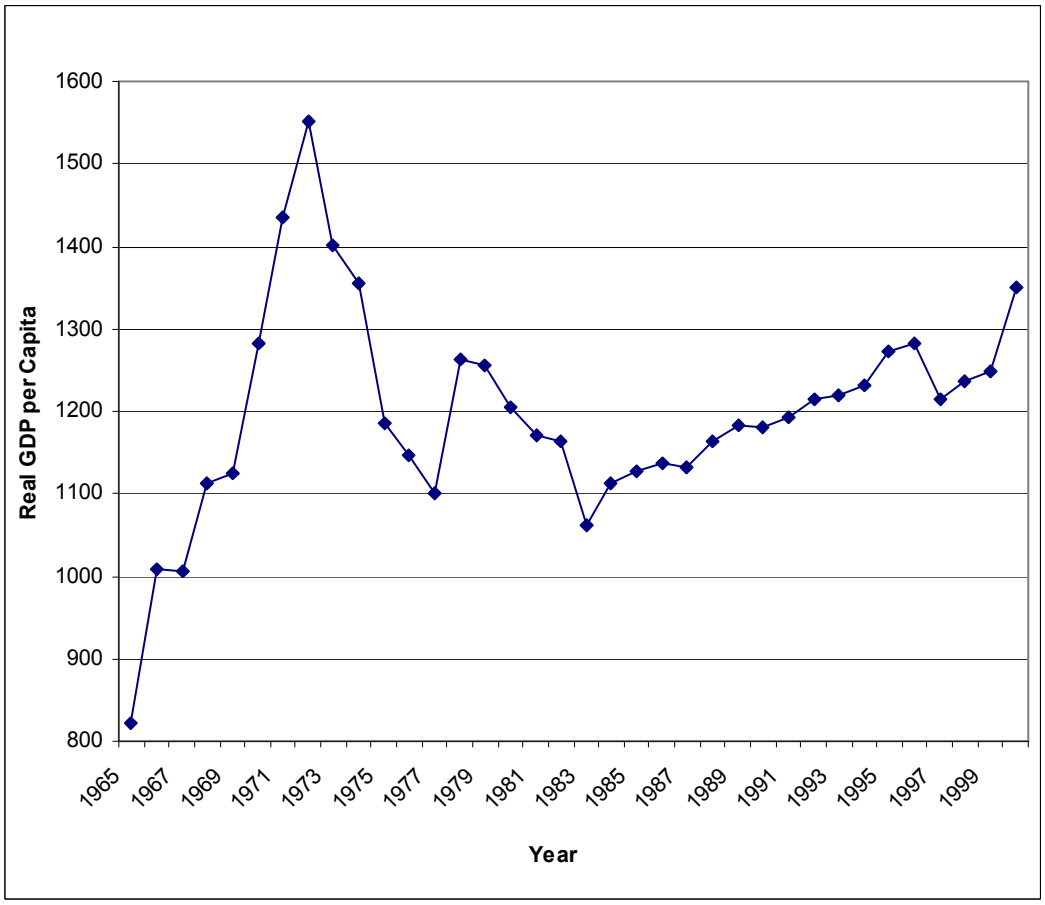

Figure 2: Trends in malnutrition in Ghana, 1988-2003