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Socioeconomic Characteristics and Overweight Problems in Underdeveloped Economies: Does Income Really Matter?

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ABSTRACT

Available evidence suggests that overweight and obesity prevalence is increasing worldwide at an alarming rate in both developed and developing countries. This study focuses on the determinants of overweight in mothers and children, using a unique data set collected in urban Accra, in Ghana. The findings show that mothers' education, employment status and ethnicity significantly exert influence on the generation of body weight. In particular, those who attained secondary and tertiary education had lower body mass indices and were much less likely to be overweight or obese, lending support to the notion that more educated women normally have better health knowledge and are more likely to consume healthy foods and also engage in physical exercises that help to control weight gain. Mother's education was also found to exert a negative and significant impact on the weight status of children. Furthermore, household expenditure was found to exert a positive and significant impact on the probability of being a mother being overweight or obese, but no significant impact on the probability of a child being overweight.

Key words: Body mass Index (BMI), overweight, obesity, socioeconomic status, bivariate probit

Introduction

The high and rising overweight and obesity rates world-wide is increasingly gaining attention from both researchers and policy-makers (WHO, 2000; Monteiro et al., 2001). In particular, obesity has reached epidemic proportions globally, with more than 1 billion adults overweight and is a major contributor to the global burden of chronic disease and disability. Often coexisting in developing countries with under-nutrition, obesity is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socioeconomic groups (WHO, 2004).

Martorell (2000) argues that obesity is not a problem everywhere in the developing world, but appears to become a problem as income increases, particularly in urban households. Available estimates indicate that over 40 percent of the populations in Colombia and Chile are overweight, while the corresponding figures for Ghana and Togo are 18 and 20 percent, respectively (WHO, 2000). A recent survey of 300 households consisting of 1,243 persons in a township near Cape Town in South Africa revealed that 75 percent of the women in the sample were either overweight or obese (Case and Deaton, 2005). The WHO asserts that childhood obesity is already an epidemic in some areas and is on the rise in others, with about 22 million children under five estimated to be overweight worldwide. This gives cause for concern, given that childhood overweight and obesity are important predictors of adult overweight and obesity. Available evidence indicates that more than 40% of 5 to 7 year old overweight children remain overweight or become obese (Power et al., 1997).

Traditionally, major causes of illness and death in developing countries have been linked to infectious diseases and under-nutrition, and these are still major public health problems in several regions of the world. But recent projections by the World Health Organization (2000) indicate that in 20 years, non-communicable diseases will account for over 60% of the disease burden and mortality in the developing world. Obesity is recognized as an underlying risk factor for many of these chronic conditions. It is a major risk factor for

diabetes, hypertension, cardiovascular disease, stroke, gall bladder disease, respiratory dysfunction, osteoarthritis, and some forms of cancer. Furthermore, a recent large scale study of U.S. cancer deaths concluded that adults being overweight or obese accounted for about 14 percent of all deaths from cancer in men and 20 percent of those in women (Calle et al., 2003). Baum and Ford (2004) also show in their study that obesity has a statistically significant negative effect on the wage of young men and women, but the penalty is larger for women's than men's wage. Hence, human obesity translates with a time lag into future human health problems, including morbidity and mortality, reduced labor productivity, and increased demand for health care. Overweight and obesity in children and adolescents may also have more immediate impacts, particularly on mental health because of social rejection and low self esteem.

Although the genetic explanation for obesity is generally acceptable, the recent trends in overweight and obesity suggest that other factors may be equally significant. Recent research has therefore focused on the role of environmental factors, including socioeconomic status (Popkin et al., 1995; Martorell et al., 1998; Danielzik et al., 2002; Anderson et al., 2003; Cutler et al., 2003; Chou et al., 2004). The studies have generally reported a significant relationship between socioeconomic status and overweight or obesity. Other environmental factors like technological innovation and television watching have also been found to be influencing overweight and obesity. For example, Gortmaker et al. (1996) report a positive correlation between television viewing and being overweight among children in the United States. The United States Center for Disease Control (2000) recently argued that the growing obesity rates are an indication of a growing long term imbalance between an individual's energy intake from food and drink and energy use in basal metabolism, work, and leisure, and seem to have little to do with the gene pool of the population which is fixed. Furthermore, growing obesity rates are widely attributed to poor eating habits and lack of physical activities, which are choices a person makes.

As in developed societies, the risk of obesity in developing countries is also strongly influenced by diet and lifestyle, which are changing dramatically as a result of the economic and nutrition transition. The globalization of food markets has resulted in the introduction of mass-produced, low-cost foods to the domestic food supply of many developing countries. This change, along with advertising campaigns, may have a powerful effect on food choices and dietary patterns of low-income families. For example, the introduction of low-cost vegetable oils from industrialized countries greatly increased the proportion of fat calories in the average diet in countries undergoing the nutrition transition (Caballero, 2005).

Although the few published literature on this topic tend to suggest a positive relationship between socioeconomic status and overweight in both men and women, (Popkin et al., 1995) that may not be true for all developing countries. For example, an empirical analysis of women of childbearing ages from Latin America and the Caribbean, using national data in the mid-1990s revealed a negative association between education levels and obesity in five of nine studies countries (Martorell et al., 1998). As pointed out by Monteiro et al. (2001), it is reasonable to expect that in any developing society, it is only up to a certain level of economic and technological development that the level of material wealth can remain the basic determinant of how much food an individual may obtain and how much energy he or she will spend along the day. Beyond that level, income differences will determine distinct access to several commodities but not necessarily to food, and energy expenditure during work might tend to converge to low or moderate values in all social classes. Under such circumstances, both rich and poor will be equally exposed to overweight.

Very few studies have empirically examined the determinants of overweight and obesity in developing countries and particularly in sub-Saharan Africa. This is in contrast to the huge literature on the topic in developed economies. Given the increasing significance of this phenomenon in this part of the world, additional work needs to be done to shed more light on

the factors contributing to overweight problems in the society and to provide appropriate recommendations for public policy.

This study focuses on the determinants of overweight in mothers and children, using a unique data set collected in urban Accra, in Ghana. Given that the data set is cross-sectional, we are only able to examine the impact of individual and household characteristics on the probability that a mother is overweight or obese, as well as household and child characteristics on the probability that a child is overweight. The paper may be outlined as follows. Section 2 presents a simple behavioral model of the determinants of overweight, using a health production theoretical framework. Section 3 discusses the data employed and the specification used in the empirical analysis, while section 4 presents the empirical findings and discussion of the results. Concluding remarks are presented in the final section.

Conceptual Framework

The conceptual framework underpinning our empirical analysis of the determinants of overweight and obesity derives from the well-known household model in the tradition of Becker (1981). In this framework, it is assumed that households maximize utility which is dependent on the consumption of commodities and services, C_i, the leisure, L_i, and health status H_i of each household (of which body weight, is one dimension). Without considering the household decision-making process, assume that the household solves the following problem:

$$\max_{C,L,H} U = U(H_i, C_i, L_i; K, Z_i), \quad (1)$$

where K and Z, respectively represent individual and household characteristics, some of which are unobserved. Household allocation choices are made conditional on the budget constraint:

$$PC + P_I I = W(T - L) + Y, \quad (2)$$

where P is a vector of prices; I denotes the current inputs into the production function such as nutrient intake, energy output, health care practices and illness; P_I is the price of I and W is a vector of household members´ wages, T is a vector of the maximum number of hours a household member can work; Y is the sum of all household members´ non-wage income. Time spent at work, or employment status may also be an element of the input vector I.

Individual characteristics, K, such as age, employment or work status of the individual and education, ethnicity as well as household characteristics, Z, such as education of household head or mother, household income and household composition may affect health outcomes through their impact on allocation decisions or directly through the health production function. The health outcome of the households, H_i, is determined by the reduced-form anthropometric production function of the form:

$$H_i = f(I_i, K, Z, \mu_i), \tag{3}$$

where I_i is a vector of health inputs, and μ_i represents the unobservable individual and household characteristics.

Based on the conceptual framework presented above, Eq. (3) can be used for the empirical specification of the determinants of anthropometric outcomes such as overweight and obesity of mothers and children in the household. As indicated earlier, we are interested in examining the factors that influence the probability of a mother being overweight or obese, as well as the child being overweight. Thus, overweight and obesity, the key outcomes under the present analysis, are defined as dichotomous variables. For overweight only, H_i takes the value of one, if the BMI of the mother is greater than 25 but less than 30, and zero otherwise. For obesity, H_i takes the value of one, if the BMI of the mother is greater than 30, and zero otherwise;[1] For ease of exposition, we reformulate Eq. (3) and subsume all the exogenous

[1] Although results using probability of overweight and continuous BMI are similar, we employ the probability of overweight in the present analysis.

variables into a vector *X*. Denoting H_i^{ov} and H_i^{ob} for overweight and obesity outcomes, respectively, the following reduced form probit model can be specified:

$$H_i^{ov} = \gamma_1' X_{1i} + \xi_{1i} \text{ where } H_i = 1 \text{ if } H_i^{ov} > 0 \text{ and 0 otherwise} \quad (4)$$

$$H_i^{ob} = \gamma_2' X_{2i} + \xi_{2i} \text{ where } H_i = 1 \text{ if } H_i^{ob} > 0 \text{ and 0 otherwise} \quad (5)$$

We assume that $E(\xi_{1i}) = E(\xi_{2i}) = 0; \text{var}(\xi_{1i}) = \text{var}(\xi_{2i}) = 1$; and $\text{cov}(\xi_{1i}) = \text{cov}(\xi_{2i}) = \rho$. Given that a mother that is obese is also overweight, although an overweight mother may not be obese, unobservable variables may affect both the propensity to be overweight and obese. Therefore, our empirical strategy for the mother's equation relies on estimating a full information maximum likelihood bivariate probit model instead of two single probit estimations. However, a probit model is employed to examine the probability of a child being overweight.

Data Source and Specification

The empirical work in this paper is based on a survey conducted by the International Food Policy Research Institute (IFPRI) between January and April 1997. The survey team adopted a two-stage sampling strategy to select 559 households distributed among 16 enumeration areas within the Accra, Ga, and Tema districts. The survey team made use of the primary sampling units that had been mapped out by the Ghana Statistical Service for the Greater Accra area. This sampling frame included 879 urban and 33 peri-urban enumeration areas. Cluster sampling was then employed to select 36 households in the 16 enumeration areas, for a total of 576 households. The basic sampling units for the survey were households with children under the age of three. The sample, therefore, did not include urban residents who do not live in households—that is, street children or homeless population. The survey is cross-sectional, resulting from a single round of data collection.

Five of the 25 enumerators that were used in the survey were selected for specialized training in anthropometric measurement. The height and weight of children and mothers were directly measured by the trained enumerators. This is an advantage of the survey, compared to data on self-reported anthropometric measures. It is well known that self-reported anthropometric variables contain measurement error with heavier persons more likely to underreport their weight. Detailed information on the sampling design and data collection is available in Maxwell et al. (2000).

The survey gathered information on demographic indicators such as household headship, age structure and dependency ratio, available labor in the household, education, and ethnicity. Livelihood indicators collected include reported total per capita household expenditure (used as proxy measure of income at household level), the primary income-generating activity of the head of household, and maternal employment status and place of work, marital status, as well as other household variables such as the availability of a television set and piped water.

The key outcome variable, an indicator for whether the individual is overweight, is based on the body mass index (BMI). BMI is defined as weight in kilograms divided by height in meters square (kg/m^2) and is a commonly used measure to define overweight and obesity in individuals. Optimal BMI levels are generally believed to lie between 20 and 25. BMI below 20 is considered thin, BMI between 25 and 30 is overweight, and BMI above 30 is obese. Available medical evidence indicates increasingly high rates of disease and death as BMI increases above 25 (WHO, 2000).

Given that the survey include only height and weight measures for children and mothers, we use the height and weight measures for the children and mothers to calculate the BMI of these groups. There has not been a level of agreement over the classification of overweight and obesity in children as in adults. In particular, there has been some confusion both in terms of a globally applicable reference population and of the selection of appropriate cut-off points

for designating a child as overweight or obese. Most authors therefore use percentile distributions as cut-off points. For example, Dietz and Bellizzi (1999) conclude from their study that a BMI above the 85th percentile for a child's age and sex group is likely to accord with the adult definition of overweight, and above the 95th percentile with the adult definition of obese. Following Langnaese et al. (2002), we classify those children with a BMI above the 90th percentile (17.7 kg/m^2) of this distribution (for their sex-age group) as "overweight". About 15 percent of the children in the sample fall in this category. The weight and BMI for mothers are skewed to the right, indicating that overweight and obesity is present in the sample (see Figure 1). About 37 percent of women had a BMI greater than 25, while 13 percent showed a BMI greater than or equal to 30, lending support to the growing concern that obesity is an emerging problem among adults in many large urban areas in developing countries, including Africa (WHO, 2000).

The data also show a direct relationship between age and BMI. Overweight and obesity is quite prominent in the age group of 24 to 40 years. The mean age of overweight women was observed to be 32.8 years whereas that of the non-overweight was 28 years. Overweight households were also larger and had higher per capita expenditures than the non-overweight category. While the mean monthly household expenditure of overweight households was 599,359 Cedis, that of the non-overweight group was 488,120 Cedis. Definitions, means and standard deviations of all variables employed in the regressions are contained in Table 1. The per capita household expenditure is used as a proxy for income or wealth. It is also clear from the Table that about 11 percent of the respondents had no form of schooling, while 26 percent went beyond primary school. The predominant ethnic group is the Ga/Adangbe tribe, who traditionally, are home in Accra and its surroundings.

The theory predicts several possible relationships between income and weight, which are positive, negative or inverted U-shaped. Demand for food, that raises weight, could increase with income increases. Continued growth in weight, however, would depend on

whether income growth encourages weight control or not. Weight could decline if rising income leads to reduced demand for food and food consumption. Philipson and Posner (1999) argue that in technologically less developed economies, in which the share of income spent on food is large because food is expensive to produce, a positive relation between income and weight will be expected because richer individuals care more about their health. For the same reason, in technologically advanced economies, in which income is high relative to the price of food, income and weight will exhibit a negative relation.

Given that a major motivation of the study is to examine the relationship between socioeconomic factors and overweight, it is essential that household resource availability is adequately measured. As argued by Thomas et al. (1996), non-wage income is normally very difficult to measure, and is not likely to reflect long-run resources. Besides, if households smooth consumption over income shocks, then expenditure is likely to be a better indicator of long-run resources.[2]

The mother's work status, which tends to affect her physical activity, will be expected to influence her weight. Lakdawalla and Philipson (2002) and Cutler et al. (2003) stress the significance of energy spent on the job and in commuting to work in explaining the increase in obesity over time. The amount of time that one works and the character of the work affects weight in two respects: the first is through increasing earned income, which as explained above, has an effect on weight. The second is through affecting the amount of calories expended on the job.[3]

The number of children in the family may also influence the mother's work status, since a mother may continue to work outside home with only one child, and choose to stay home

[2] While the reported mean total expenditure per capita per year of the households used in this study was 1,028,000 Cedis, the reported mean total income per capita per year was 536,300 Cedis, revealing that on average, households consumed more than they earned, most probably as a result of transfers from other family members and friends, or under-reporting of earned income.

[3] It is interesting to note that some authors suggest that increased numbers of women at work have increased the demand for eating outside and for eating less healthy food. However, Cutler et al. (2003) reject this theory of obesity and rather propose a theory of obesity based on reductions in the time cost of food, which in turn has allowed more frequent food consumption of greater variety and, thus resulted in higher weight gains.

when there are several children. For biological reasons, age could have an effect on the probability of being overweight. Specifically, people may gain weight as they approach middle age, but then begin to lose weight as they enter old age, resulting in an inverted U-shape relation between weight and age.

Education and ability may affect both the individual's employment patterns and health. Schooling, which is connected with health knowledge, may affect overweight and obesity in a number of ways. It potentially increases the efficiency of health production by expanding knowledge concerning what constitutes a healthy diet. The health capital theory also argues that education is likely to influence overweight and obesity by contributing to household income. Komlos et al. (2004) suggest that education may also influence an individual's BMI by altering time preference. An individual's consumption level has been shown to depend on the rate at which future health benefits are discounted in the individual's consumption decisions, with individual fitness being negatively associated with a high rate of time preference (or impatience). Thus, if individuals are less willing to trade current benefit (utility) for potential future health benefits, then they will most likely consume more calorie dense foods and engage in more sedentary leisure pursuits despite the future adverse consequences. Smith et al. (2005) hypothesize that an increase in the marginal rate of time preference has contributed to increasing obesity. In contrast, Cutler et al. (2005), argue that little of the differences in health behaviors, including obesity, can be explained by variations in time preference and are instead largely due to variations in genetics and situational influences.

With regard to children, individual as well as the maternal and household characteristics described above may affect the likelihood of a child being overweight. Mother's weight status may reflect either the impact of genetics on the child's likelihood of being overweight or the effects of common home environment on the family's weight status. Moreover, popular opinion consistently draws a direct link between mothers working and poor health outcomes

for children. There are a number of ways through which children's eating habits and level of physical activity may be affected by having parents who work outside the home. Parents who work outside home may serve more high-calorie prepared or fast foods, and unsupervised children may make poor nutritional choices when preparing their own after-school meals or snacks. Unsupervised children may also spend a great deal of time indoors, watching television or playing video games rather than engaging in more active outdoor pursuits (Anderson et al., 2003). Alternatively, there may not be any adverse effects of parents working on childhood weight problems. Parents' participation in the labor market may even have a negative impact on children's probability of being overweight if households where mothers work earn enough money to purchase more healthy meals. Children from such households may also be more likely to participate in after-school sports, thereby increasing their activity levels.

In addition to the socioeconomic factors discussed above, the socio-cultural environment may also influence an individual's weight status. Given that overweight and obesity are household-produced goods, an individual's self-image and social interactions are likely to play a role in determining his or her weight. Several studies report that blacks and Hispanics in the United States tolerate, and may even encourage, larger body size than do whites (Becker et al., 1999). Anderson et al. (2003) show in their study that black children are significantly more likely to be overweight than other groups, while Lakdawalla and Philipson (2002) report that black women tend to be much heavier than white and Hispanic women. Some authors also discuss the role of matching markets (marriage and dating markets) in determining weight. For example, Philipson and Posner (1999) argue that if weight affects one's ability to match, unmarried people today would be expected, as consumers in the marriage market, to be thinner than married people. Marital status may also affect the time available for household chores and active leisure in a variety of ways.

Empirical Results

The reduced form bivariate probit estimates of the probability of a mother being overweight or obese are presented in Table 2, while the single equation probit estimates of the probability of child being overweight are also presented in Table 3. The results in Table 2 show that the estimate of ρ (correlation between the errors) that maximized the bivariate probit likelihood function was 2.81 and was significantly greater than zero at the 1% level. This suggests a positive correlation between the unobservables that determine overweight and obesity status. This result also provides a justification for using a bivariate probit model in estimating the equation for overweight and obesity.[4] The marginal effects of the regressors on the probability of being overweight or obese, which are calculated by multiplying the coefficient estimates $\hat{\gamma}$ by $\phi(\hat{\gamma}' X)$ at the mean values of *X*, are also reported with the coefficient estimates.

The log-likelihood ratio statistic was significant at the 1% level, suggesting that the independent variables taken together influence weight status. The McFadden R^2, an indication of goodness of fit and the log-likelihood statistics (indicator of the significance of all covariates) are also presented in each Table. The results show that household expenditure exerts a positive and significant impact on both the probability of being overweight and obese, with non-linear effects. That is, the probability of being overweight or obese first increases with increasing expenditure and later declines with additional per capita household expenditures, a result that contradicts with some findings based on U.S. data (e.g., Stunkard, 1996). However, this finding is consistent with the point made by Philipson and Posner (1999) that in less developed economies, in which the share of income spent on food is large, income will tend to exert a positive impact on weight. The results also indicate that at younger ages an increase in age increases the risk of overweight and obese with the maximum effect

[4] We also estimated comparable models using BMI as a continuous measure as dependent variable and obtained qualitatively similar results.

occurring at thirty-nine and half years for overweight and thirty-nine years for obesity. At older ages, the risk of overweight and obesity decreases as age increases.

Education generally has little effect on weight of women with primary or middle education, but with women who have secondary and tertiary education, schooling tends to reduce the likelihood of being overweight or obese. The marginal effects of secondary and tertiary education for overweight are 0.09 and 0.11, respectively. The corresponding figures for obese are 0.10 and 0.15, respectively. These later findings are consistent with results reported by Cutler et al. (2003), who show that obesity for U.S. women is negatively associated with education. As argued earlier, more educated women generally have more health knowledge and as such are more likely to consume healthy foods and also engage in physical exercises that help to control weight gains. A test of the null hypothesis that the coefficients of the four education variables are jointly equal to zero is rejected for both overweight and obese. The sample value of the Wald statistics distributed as χ_4^2, are 16.59 and 17.56, with a critical value of 13.3.[5]

Work status appears to be associated with the risk of overweight and obesity. All the variables representing type of work are negative and statistically significant, implying that relative to their unemployed counterparts, women engaged in the labor market are less likely to be overweight or obese. The marginal effects suggest that relative to their counterparts in other employments, women working on farms or gardens (marginal effect of -0.09 and -0.13) are least likely to be overweight and obese. The negative and highly significant coefficients of the variables representing work on farm or garden suggests that women engaged in these activities expend large amounts of energy and are therefore less likely to be overweight and obese. The same applies to the variables for working in the market or street. Compared to women who are not engaged in the labor market, this group of women spend some time commuting to work and also engage in some work exercises. Although women at home might

[5] Note that obtaining tertiary education involves going through primary, middle and secondary schools.

spend some time cooking, they are not likely to expend as much energy as those who commute to work and engage in physical activities on the job, that require substantial amounts of calories. A test of the null hypothesis that the coefficients of the three work status variables are jointly equal to zero is rejected for both overweight and obesity. The sample value of the Wald statistics distributed as χ_3^2, are 13.97 and 14.29 for overweight and obesity, respectively, with a critical value of 11.30.

The effects of ethnicity are also quite significant for overweight and obesity, with the Ga/Adangbe and Akan/Fanti/Ashante more likely to be overweight and obese than the other ethnic groups, with substantial marginal effects. In particular, Ga/Adangbes have significantly higher measures of outcomes. This finding is not surprising, given the fact that members of this ethnic group is generally known to be heavier than other ethnic groups in the country. Compared to other ethnic groups, Ewes do not seem to be significantly more likely to be overweight or obese.

The results reveal no significant effect of marriage on the probability of being overweight or obese, suggesting that social interactions do not exert significant influence on the generation of body weight. Although we do not focus on their coefficients, we also control for other variables such as household composition and household consumption of calories derived from fruits. While the negative, *albeit* insignificant coefficients of the variable for calories from fruits might indicate that greater quantities of fruits consumed tend to reduce the likelihood of overweight and obese, there is a question as to how the coefficients of the household composition variables may be interpreted. For example, the negative and significant (at the 10% level) coefficients of the variable for children under the age of five may either be linked to maternal employment patterns or household resources.[6]

[6] As argued earlier, if the presence of younger children in the household compels the mother to stay more at home, her presence may ensure that children eat more healthy foods that would reduce the likelihood of the child being overweight or obese. Particularly in a poor developing country, larger household size may be associated with budget limitations, resulting in reduced intake of calories.

Table 3 reports the results on the influence of individual and household effects on the probability of a child being overweight. A striking result is the impact of mother's weight on the child's weight status. To capture the differential impact of overweight and obese status of the mother, we include variables for obese and overweight mothers. Both variables exert positive and significant impacts on the probability of a child being overweight, although the impact is greater for obese mothers. Given that obese mothers (BMI of at least 30) are also overweight (BMI of at least 25) in the present study, the marginal effect of a mother being obese is 0.17, which is the sum of the two marginal probabilities. This finding is in line with the notion that body mass index has large genetic components, although it might also reflect the effects of the common home environment. If mothers for some reasons rely on calorie-rich prepared and fast foods, then one would expect everyone in the family to be more likely to be overweight.

Mother's education also appears to influence the probability of a child being overweight. The variables representing secondary and tertiary education are both negative and significant, implying that children with mothers that have attained secondary and tertiary education are less likely to be overweight.[7] A test of the null hypothesis that the coefficients of mother's education variables are jointly equal to zero is rejected, with a sample value of a Wald statistic of $\chi^2_4 = 18.95$ against a critical value of 13.30. This last finding would seem to confirm evidence provided by Langnäse et al. (2002) on the role of education in contributing to the epidemic of child obesity in Germany. It is, however, interesting to note that interpretation of such a finding poses a question as to whether maternal education actually has an impact on children's weight, or mothers with more education have other attributes that are different and tend to reduce the likelihood that their children will be

[7] As pointed out by Glewwe (1998), father's schooling, apart from its income effect, is less likely to be important for maintaining children's health.

overweight. As argued earlier, the better health information knowledge of more educated women is probably responsible for the negative impact of mother's education on overweight.

Although the maternal work status variables are all positive, only the variable for the category shop/factory/office category is marginally significant, suggesting that the mother merely working does not necessarily have an impact on the child's weight status. The positive and significant impact of the shop/factory/office variable may be reflecting income effects on weight status, since this category of workers generally earn higher wages than their counterparts working on farms and gardens. Anderson et al., (2003) attribute the positive and significant impact of maternal work status on the probability that a child is overweight to constraints on mother's time.

Several of the other coefficients are also worth noting. As in the estimates for mothers, ethnicity also appears to influence the weight status of children. Relative to other ethnic groups, Ga/Adangbe children are significantly more likely to be overweight. Children from larger families are less likely to be overweight, compared to those from smaller families. Similarly, children from households with greater number of children under five years old are less likely to be overweight.

Interesting enough, per capita expenditure does not seem to have any significant impact on the likelihood of a child being overweight. This is probably because the socioeconomic status of the mother is well controlled for by education, ethnicity, weight, and work status. In particular, expanding labor market opportunities for women normally result in significant increases in families' command of real resources and higher living standards. In order to verify if the socioeconomic variables were responsible for the insignificance of the expenditure variable, we run a regression without the variables, but with per capita expenditure. Not surprisingly, there is a positive and significant impact of per capita expenditure, confirming that the inclusion of the socioeconomic status of the mother renders the expenditure term insignificant.

Another interesting observation is the positive, *albeit* insignificant relationship between the presence of television in a household and weight of the child. The insignificance of the variable is probably due to the fact that it is a dummy that captures the presence or absence of a TV set in the household, and not the extent of TV viewing, as in other studies. Particularly in Accra and several towns in Ghana, people from households without TV sets normally move from their homes to watch television in other homes, implying that TV viewing is a better variable to capture the impact. Since the data employed in the present study does not contain information on TV viewing, using the presence of TV in the household provides information on TV viewing.

Summary and Conclusions

Researchers and policy makers are presently concerned about the sharp increase in the number of overweight children and adults in recent decades. Although it is quite apparent that weight gain arises from taking in more energy than one expends, the reasons for the sharp divergence between energy intake and expenditure in the last few decades remain unclear. While the genetic explanation for being overweight or obese may be compelling, the recent rapid increase in overweight suggests that other factors may be important as well. In particular, socioeconomic status and technological innovations are among the factors that have been considered as important contributors to overweight problems.

This paper employs a unique data set to examine the influence of individual and household characteristics on the overweight and obesity among women and children in urban Accra, in Ghana. The data reveals that around 36 percent of women had a BMI greater than 25, while 13 percent showed a BMI greater than or equal to 30, lending support to the growing concern that obesity is an emerging problem among adults in many large urban areas in developing countries, including Africa. Examination of the determinants of overweight

using the data suggests a significant role for public policy in influencing the weight problems of urban Ghanaians.

Consistent with previous research, we find that mother's work status significantly affects her body mass index and probability of being overweight. In particular, women engaged in farm or garden work and market or street work were found to be much less likely to be overweight relative to those who were unemployed and stayed at home. This finding suggests that women working on farms or gardens, or even market and street work must normally commute to work and probably engage in work-related exercise, and as such are less likely to be overweight or obese. Commuting to work and engaging in work-related exercise require larger amounts of energy, which contributes to a reduction in weight gains.

Our results further reveal that mothers who attained secondary and tertiary education had lower body mass indices and were much less likely to be overweight, lending support to the notion that education is negatively related to the probability of being overweight or obese. More educated women normally have better health information knowledge and are more likely to consume healthy foods and also engage in physical exercises that help to control weight gains. Mother's education was also found to exert a negative and significant impact on the weight status of children. Thus, children with mothers who had secondary and tertiary education were far less likely to be overweight than those with only primary education or no schooling. The marginal effects of a mother having secondary or tertiary education on the probability of a child being overweight were -0.14 and -0.19, respectively.

Our results also indicate that household expenditure exerts a positive and significant impact on the probability of a mother being overweight or obese, but at a decreasing rate, suggesting the importance of the relationship between income and weight control. In contrasts to findings from studies with U.S. data which report a negative relationship between income and weight, this observation indicates that at lower income levels, weight increases with increasing income, but tends to decline after a certain level of income. However, we find no

evidence that household resources expressed through household expenditure affects the likelihood of a child being overweight.

Children whose mothers are obese are also more likely to be overweight, as the coefficients for overweight and obese both turned out to be positive and significant, with marginal effects of 0.04 and 0.13, respectively. Ethnicity also appears to be an important determinant of overweight and obesity, with Ga/Adangbe women and children being more likely to be overweight, compared to other ethnic groups. Although a much higher percentage of the Ga/Adangbe women than the other ethnic groups are overweight, it is generally known that particularly among the less educated groups in urban areas, thinness continues to be a signal of possible poverty and poor health, malnutrition, or even bad habits such as alcoholism and AIDS. It is therefore not altogether surprising that in spite of the increasing trend towards slenderness, some women still view increasing weight as a sign of attractiveness.

It is worth mentioning that in developing economies, overweight and obesity problems are emerging at a time when under-nutrition remains a significant problem. The nutrition transition appears to be facilitating rapid gains in body weight in low income and undernourished populations. Hence, strategies that consider both undernourishment and overweight problems will need to be considered. As pointed out by Cabarello (2001), unless there is a concurrent reduction in childhood stunting and an improvement in adult stature, normalizing BMIs might not confer the same reduction in mortality risk as that in developed countries populations. Continuing gains in BMI beyond the normal range will increase the potential risk associated with low stature. While reducing the health risk associated with obesity in developed countries requires a focus on controlling excess body weight, the task in developing countries also demands an effort to combat childhood malnutrition that would increase the stature of future generations of adults.

With regard to overweight and obesity in developing economies, public interventions such as education programs with a focus on healthy food choices, incorporation of physical activity and a decrease in sedentary behaviour will all be important. Moreover, promoting healthy behaviors to encourage, motivate and enable individuals lose weight by eating more fruits and vegetables, as well as nuts and grains would be quite significant in reducing the incidence of overweight and obesity. Future research in this area will still need to consider a broader understanding of other contributors to weight problems. It would be particularly interesting to know more about adult's and children's opportunities for vigorous exercises and access to recreational facilities.

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Figure 1: Body Mass Index Distribution of Mothers, 1997

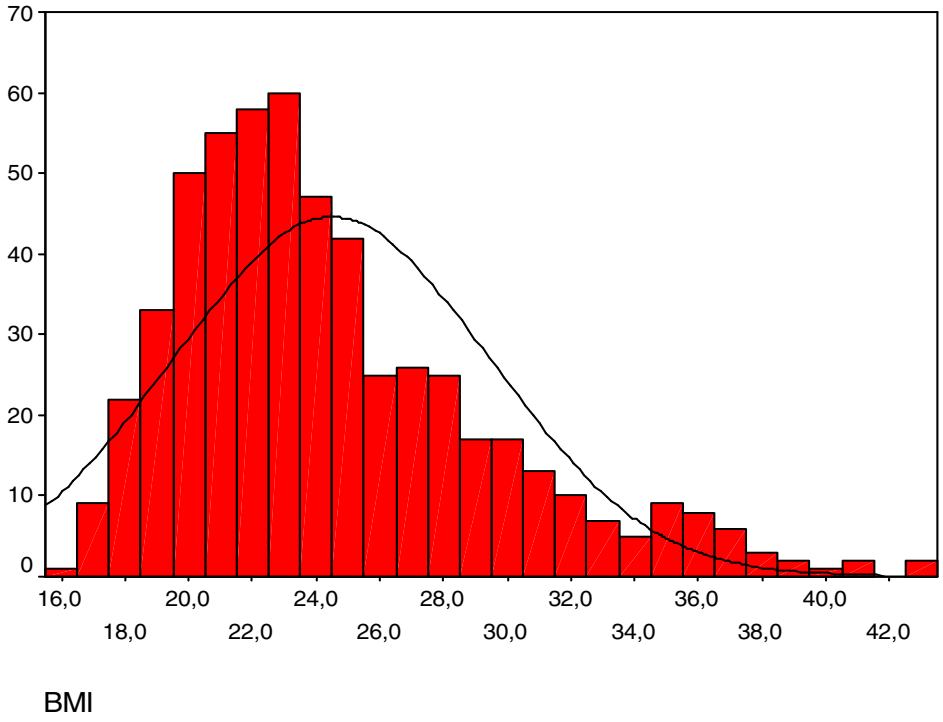

Table 1: Definitions, Means and Standard Deviations of Variables

Variable	Variable Description	Sample Mean	Standard Deviation
	Dependent Variables		
Mother overweight	1 if body mass index is equal to or greater than 25 but less than 30, 0 otherwise	0.24	—
Mother obese	1 if body mass index is equal to or greater than 30, 0 otherwise	0.13	—
Child overweight	1 if weight of child falls outside the 90th percentile of the sampled children, 0 otherwise	0.16	—
	Independent Variables		
Household size	Total number of people in household	5.1	2.3
Mother's age	Age of mother in completed years	29.76	7.69
Mother married	1 if mother is married, 0 otherwise	0.75	—
Child's age	Age of children between 0 and 6 years in months	17.55	9.91
No school	If primary care giver has no school education	0.11	—
Primary school	If primary care giver has primary school education	0.23	—
Middle/Islamic	If respondent has middle or Islamic school education	0.40	—
Secondary school	If primary care giver has some secondary or Islamic school education	0.16	—
Tertiary	If primary care giver has tertiary school education	0.10	—
Ga/Adangbe	If primary care giver is GA or Adangbe	0.37	—
Ewe	If primary care giver is Ewe	0.28	—
Akan	If primary care giver is Akan/Ashanti/Fanti	0.22	—
Other	If primary care giver is a different tribe	0.13	—
Age at 0 – 4	Household members between 0 – 4 years	0.26	0.11
Age at 5 – 14	Household members between 5 – 14 years	0.23	0.13
Age at 15 – 39	Household members between 15 – 39 years	0.39	0.21
Age at 40 and older	Household members of age 40 years and older	0.31	0.29
Farm or garden	1 if mother works on a farm or garden, 0 otherwise	0.69	—
Shop/factory/office	1 if mother works in a shop, factory or office, 0 otherwise	0.59	—
Street or market	1 if mother sells items on the street or in the market, 0 otherwise	1.15	—
FRUITCAL	Daily per head calorie consumption of fruit calories	50.42	127.8
TV	If TV present in household, 0 otherwise	0.50	—
Household expenditure	Log of per capita household monthly expenditure	8.73	0.50

Table 2: Bivariate Estimates of whether Mother is Overweight or Obese

Variable	Overweight		Obese	
	Coefficient	Marginal Probability	Coefficient	Marginal Probability
Intercept	-1.9851 (-4.7007)		-1.4851 (-4.1014)	
Mother's education				
Primary school	0.0985 (0.8686)	0.0291	0.0941 (0.8743)	0.0324
Middle/Islamic school	0.0674 (1.6180)	0.0198	0.1334 (1.2916)	0.0459
Secondary school	-0.2937 (-2.1713)	-0.0865	-0.3078 (-2.3827)	-0.1061
Tertiary education	-0.3761 (-2.3268)	-0.1108	-0.4382 (-2.8609)	-0.1510
Ethnicity				
Ga/Adangbe	0.4019 (2.4697)	0.1184	0.3515 (2.8044)	0.1211
Akan/Ashanti/Fanti	0.2528 (2.0035)	0.0745	0.2671 (2.12361)	0.0920
Ewe	0.0356 (1.3159)	0.0104	0.1752 (1.1443)	0.0604
Household characteristics				
Per capita household expenditure	0.0443 (2.2477)	0.0131	0.0768 (2.4336)	0.0265
Per capita household expenditure squared	-0.0055 (-1.9730)	—	-0.0163 (-1.8772)	—
Calories from fruits	-0.0278 (-1.2141)	-0.0082	-0.0958 (-1.37391)	-0.0329
Household members between 0 – 4 years	-0.1954 (-1.8763)	0.0576	-0.0514 (-1.7391)	-0.0177
Household members between 5 – 14 years	-0.1103 (-1.3547)	0.0325	-0.0117 (-1.1414)	-0.0040
Household members between 15 – 39 years	0.1965 (0.3448)	0.0571	0.0148 (1.2208)	0.0051
Household members of age 40 years and older	0.0091 (0.7144)	0.0027	0.0599 (0.9595)	0.0206
Married	0.0884 (1.2049)	0.0260	0.0145 (1.0651)	0.0049
Mother's age in years	0.0015 (-2.6340)	0.0005	0.0014 (2.5214)	0.0005
Mother's age squared	-0.0019 (2.1053)	—	-0.00180 (-2.0658)	—
Mother's work				
Farm or garden	-0.3184 (-2.7691)	-0.0938	-0.3672 (-2.4950)	-0.1265
Shop or factory or office	-0.2087 (-1.9276)	-0.0615	-0.2265 (-1. 3717)	-0.0781
Street or market	-0.1493 (-1.6884)	-0.0439	-0.1384 (-1. 7892)	0.0477
Rho (1, 2)	0.281 (2.57)			
McFadden R^2	0.396			
Log-likelihood ratio	176.72			
Observations	555			

Table 3: Probit estimates of whether child is overweight

Variable	Coefficient	t - Value	Marginal Probability
Intercept	-4.8825	-2.6530	—
Child' age	02293	1.5622	0.0893
Mother's education			
Primary school	-0.0294	-1.1028	-0.0114
Middle/Islamic school	-0.0952	-1.4063	-0.0371
Secondary school	-0.3544	-2.0528	-0.1380
Tertiary education	-0.4901	-2.3185	-0.1909
Ethnicity			
Ga/Adangbe	0.4407	2.1704	0.1716
Akan/Ashanti/Fanti	0.4128	1.7028	0.1609
Ewe	0.3014	1.2572	0.1174
Household characteristics			
Household members between 0 – 4 years	-0.1416	-2.4017	-0.0551
Household members between 5 – 14 years	-0.2238	-1.3368	-0.0872
Household members between 15 – 39 years	0.0194	0.0756	0.0076
Household members of age 40 years and older	0.1439	1.3382	0.0560
Mother is overweight	0.1053	2.4837	0.0410
Mother is obese	0.3464	2.5783	0.1349
Presence of a TV set	0.0729	1.5472	0.0284
Per capita expenditure	0.1531	1.6146	0.0059
Mother's work			
Farm or garden	0.1163	1.4882	0.0452
Shop or factory or office	0.1704	1.6986	0.0664
Street or market	0.0958	1.0572	0.0373
Mother married	-0.0829	0.9381	-0.0323
Wald test statistics for joint significance			
Mother's education		χ^2_4 =18.93	
Mother's work status		χ^2_3 =15.26	
McFadden R^2		0.381	
Log-likelihood ratio		162.73	
Observations		724	

Note: The dependent variable is a binary variable equal to 1 if child's BMI is above the 90th percentile for his/her age.

Socioeconomic Characteristics and Obesity in Underdeveloped Economies: Does Income Really Matter?

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Socioeconomic Characteristics and Obesity in Underdeveloped Economies: Does Income Really Matter?

ABSTRACT

Available evidence suggests that overweight and obesity prevalence is increasing worldwide at an alarming rate in both developed and developing countries. This study focuses on the determinants of overweight in mothers and children, using a unique data set collected in urban Accra, in Ghana. The findings show that mothers' education, employment status and ethnicity significantly exert influence on the generation of body weight. In particular, those who attained secondary and tertiary education had lower body mass indices and were much less likely to be overweight or obese, lending support to the notion that more educated women normally have better health knowledge and are more likely to consume healthy foods and also engage in physical exercises that help to control weight gain. Mother's education was also found to exert a negative and significant impact on the weight status of children. Furthermore, household expenditure was found to exert a positive and significant impact on the probability of being a mother being overweight or obese, but no significant impact on the probability of a child being overweight.

Key words: Body mass Index (BMI), overweight, obesity, socioeconomic status, bivariate probit

I. INTRODUCTION

The high and rising overweight and obesity rates world-wide is increasingly gaining attention from both researchers and policy-makers (WHO, 2000; Monteiro et al., 2001). In particular, obesity has reached epidemic proportions globally, with more than 1 billion adults overweight. Often coexisting in developing countries with under-nutrition, obesity is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socioeconomic groups (WHO, 2004).

Martorell (2000) argues that obesity is not a problem everywhere in the developing world, but appears to become a problem as income increases, particularly in urban households. Available estimates indicate that over 40 percent of the populations in Colombia and Chile are overweight, while the corresponding figures for Ghana and Togo are 18 and 20 percent, respectively (WHO, 2000). A recent survey of 300 households consisting of 1,243 persons in a township near Cape Town in South Africa revealed that 75 percent of the women in the sample were either overweight or obese (Case and Deaton, 2005). The WHO asserts that childhood obesity is already an epidemic in some areas and is on the rise in others, with about 22 million children under five estimated to be overweight worldwide. This gives cause for concern, given that childhood overweight and obesity are important predictors of adult overweight and obesity. Available evidence indicates that more than 40% of 5 to 7 year old overweight children remain overweight or become obese (Power et al., 1997).

Traditionally, major causes of illness and death in developing countries have been linked to infectious diseases and under-nutrition, and these are still major public health problems in several regions of the world. But recent projections by the World Health Organization (2000) indicate that in 20 years, non-communicable diseases will account for over 60% of the disease burden and mortality in the developing world. Obesity is recognized as an underlying risk factor for many of these chronic conditions. It is a major risk factor for diabetes, hypertension, cardiovascular disease, stroke, gall bladder disease, respiratory

dysfunction, osteoarthritis, and some forms of cancer (Costa-Font and Gil, 2004). Furthermore, a recent large scale study of U.S. cancer deaths concluded that adults being overweight or obese accounted for about 14 percent of all deaths from cancer in men and 20 percent of those in women (Calle et al., 2003). Baum and Ford (2004) also show in their study that obesity has a statistically significant negative effect on the wage of young men and women, but the penalty is larger for women's than men's wage. Hence, human obesity translates with a time lag into future human health problems, including morbidity and mortality, reduced labor productivity, and increased demand for health care. Overweight and obesity in children and adolescents may also have more immediate impacts, particularly on mental health because of social rejection and low self esteem (Costa-Font and Gil, 2004).

Although the genetic explanation for obesity is generally acceptable, the recent trends in overweight and obesity suggest that other factors may be equally significant. Recent research has therefore focused on the role of environmental factors, including socioeconomic status (Popkin et al., 1995; Martorell et al., 1998; Nayga, 2000; Danielzik et al., 2002; Anderson et al., 2003; Cutler et al., 2003; Chou et al., 2004; Costa-Font and Gil, 2004). The studies have generally reported a significant relationship between socioeconomic status and overweight or obesity. Other environmental factors like technological innovation and television watching have also been found to be influencing overweight and obesity. For example, Gortmaker et al. (1996) report a positive correlation between television viewing and being overweight among children in the United States. The United States Center for Disease Control (2000) recently argued that the growing obesity rates are an indication of a growing long term imbalance between an individual's energy intake from food and drink and energy use in basal metabolism, work, and leisure, and seem to have little to do with the gene pool of the population which is fixed.

As in developed societies, the risk of obesity in developing countries is also strongly influenced by diet and lifestyle, which are changing dramatically as a result of the economic

and nutrition transition. The globalization of food markets has resulted in the introduction of mass-produced, low-cost foods to the domestic food supply of many developing countries. This change, along with advertising campaigns, may have a powerful effect on food choices and dietary patterns of low-income families. For example, the introduction of low-cost vegetable oils from industrialized countries greatly increased the proportion of fat calories in the average diet in countries undergoing the nutrition transition (Caballero, 2005).

Although the few published literature on this topic tend to suggest a positive relationship between socioeconomic status and overweight in both men and women, (Popkin et al., 1995; Nayga, 2000; Costa-Font and Gil, 2004) that may not be true for all developing countries. For example, an empirical analysis of women of childbearing ages from Latin America and the Caribbean, using national data in the mid-1990s revealed a negative association between education levels and obesity in five of nine countries (Martorell et al., 1998). As pointed out by Monteiro et al. (2001), it is reasonable to expect that in any developing society, it is only up to a certain level of economic and technological development that the level of material wealth can remain the basic determinant of how much food an individual may obtain and how much energy he or she will spend along the day. Beyond that level, income differences will determine distinct access to several commodities but not necessarily to food, and energy expenditure during work might tend to converge to low or moderate values in all social classes. Under such circumstances, both rich and poor will be equally exposed to overweight.

Very few studies have empirically examined the determinants of overweight and obesity in developing countries and particularly in sub-Saharan Africa. This is in contrast to the huge literature on the topic in developed economies. Given the increasing significance of this phenomenon in this part of the world, additional work needs to be done to shed more light on the factors contributing to overweight and obesity problems in the society and to provide appropriate recommendations for public policy.

This study focuses on the determinants of overweight and obesity in mothers and children, using a unique data set collected in urban Accra, in Ghana. Given that the data set is cross-sectional, we are only able to examine the impact of individual and household characteristics on the probability that a mother is overweight or obese, as well as household and child characteristics on the probability that a child is overweight. The paper may be outlined as follows. Section 2 presents a simple behavioral model of the determinants of overweight, using a health production theoretical framework. Section 3 discusses the data employed and the specification used in the empirical analysis, while section 4 presents the empirical findings and discussion of the results. Concluding remarks are presented in the final section.

II. CONCEPTUAL FRAMEWORK

The conceptual framework underpinning our empirical analysis of the determinants of overweight and obesity derives from the well-known household production model in the tradition of Becker (1981). This framework has also been employed by Nayga (2000) to examine the effect of schooling and health knowledge on obesity. The framework assumes that households maximize utility which is dependent on the consumption of commodities and services, C_i, leisure, L_i, and health status H_i of each household (of which body weight, is one dimension). Without considering the household decision-making process, assume that the household maximizes utility U, represented as:

$$U = U(H_i, C_i, L_i; K, Z_i) \quad (1)$$

where K and Z, respectively represent individual and household characteristics, some of which are unobserved. The production of a household member's health may be described by the production function

$$H_i = g(I_i, K, Z, \mu_i) \quad (2)$$

where I denotes the current inputs into the production function such as nutrient intake, energy output, health care practices and illness and μ_i represents the unobservable determinants of H. Household allocation choices are made conditional on the budget constraint for purchased goods

$$\sum_i P_i C_i = Y \tag{3}$$

where P_i is a vector of exogenous prices and Y is exogenous money income. Individual characteristics, K, such as age, employment or work status of the individual and education, ethnicity as well as household characteristics, Z, such as education of household head or mother, household income and household composition may affect health outcomes through their impact on allocation decisions or directly through the health production function. Maximization of equation (1) subject to the constraints (2) and (3) result in the household reduced form demand for goods

$$C_i = C(I_i, K, Z, Y, P_i, \mu_i) \tag{4}$$

The reduced form demand function in the present study for health outcome H_i, of the households may be expressed as (Lancaster, 1971; Nayga, 2000)

$$H_i = f(I_i, K, Z, Y, P_i, \mu_i) \tag{5}$$

III. THE EMPIRICAL SPECIFICATION

With prices held constant, the health outcome equation (5) can be used to specify the overweight and obesity equations as

$$H_i = f(I_i, K, Z, Y, \varepsilon_i) \tag{6}$$

where ε_i represents unobservable determinants of H. The above specification is employed to examine the determinants of health outcomes such as overweight and obesity of mothers and children in the household.

The key outcome variable, an indicator for whether the individual is overweight, is based on the body mass index (BMI). BMI is defined as weight in kilograms divided by

height in meters square (kg/m^2) and is a commonly used measure to define overweight and obesity in individuals. Optimal BMI levels are generally believed to lie between 20 and 25. BMI below 20 is considered thin, BMI between 25 and 30 is overweight, and BMI above 30 is obese.

Given that the survey include only height and weight measures for children and mothers, we use the height and weight measures for the children and mothers to calculate the BMI of these groups. There has not been a level of agreement over the classification of overweight and obesity in children as in adults. In particular, there has been some confusion both in terms of a globally applicable reference population and of the selection of appropriate cut-off points for designating a child as overweight or obese. Most authors therefore use percentile distributions as cut-off points. For example, Dietz and Bellizzi (1999) conclude from their study that a BMI above the 85^{th} percentile for a child's age and sex group is likely to accord with the adult definition of overweight, and above the 95^{th} percentile with the adult definition of obese. Following Langnaese et al. (2002), we classify those children with a BMI above the 90^{th} percentile (17.7 kg/m^2) of this distribution (for their sex-age group) as "overweight".

The theory predicts several possible relationships between income and weight, which are positive, negative or inverted U-shaped. Demand for food, that raises weight, could increase with income increases. Continued growth in weight, however, would depend on whether income growth encourages weight control or not. Weight could decline if rising income leads to reduced demand for food and food consumption. Philipson and Posner (1999) argue that in technologically less developed economies, in which the share of income spent on food is large because food is expensive to produce, a positive relation between income and weight will be expected because richer individuals care more about their health. For the same reason, in technologically advanced economies, in which income is high relative to the price of food, income and weight will exhibit a negative relation.

Given that a major motivation of the study is to examine the relationship between socioeconomic factors and overweight, it is essential that household resource availability is adequately measured. As argued by Thomas et al. (1996), non-wage income is normally very difficult to measure, and is not likely to reflect long-run resources. Besides, if households smooth consumption over income shocks, then expenditure is likely to be a better indicator of long-run resources.[1]

The mother's work status, which tends to affect her physical activity, will be expected to influence her weight. Lakdawalla and Philipson (2002) and Cutler et al. (2003) stress the significance of energy spent on the job and in commuting to work in explaining the increase in obesity over time. The amount of time that one works and the character of the work affects weight in two respects: the first is through increasing earned income, which as explained above, has an effect on weight. The second is through affecting the amount of calories expended on the job.[2]

The number of children in the family may also influence the mother's work status, since a mother may continue to work outside home with only one child, and choose to stay home when there are several children. For biological reasons, age could have an effect on the probability of being overweight. Specifically, people may gain weight as they approach middle age, but then begin to lose weight as they enter old age, resulting in an inverted U-shape relation between weight and age.

Education and ability may affect both the individual's employment patterns and health. Schooling, which is connected with health knowledge, may affect overweight and obesity in a number of ways. It potentially increases the efficiency of health production by expanding

[1] While the reported mean total expenditure per capita per year of the households used in this study was 1,028,000 Cedis, the reported mean total income per capita per year was 536,300 Cedis, revealing that on average, households consumed more than they earned, most probably as a result of transfers from other family members and friends, or under-reporting of earned income.

[2] It is interesting to note that some authors suggest that increased numbers of women at work have increased the demand for eating outside and for eating less healthy food. However, Cutler et al. (2003) reject this theory of obesity and rather propose a theory of obesity based on reductions in the time cost of food, which in turn has allowed more frequent food consumption of greater variety and, thus resulted in higher weight gains.

knowledge concerning what constitutes a healthy diet. Nayga's (2000) findings for the US indicate that schooling's effect on relative weight and the probability of being obese are explained by differences in knowledge. Komlos et al. (2004) also suggest that education may also influence an individual's BMI by altering time preference. An individual's consumption level has been shown to depend on the rate at which future health benefits are discounted in the individual's consumption decisions, with individual fitness being negatively associated with a high rate of time preference (or impatience). Thus, if individuals are less willing to trade current benefit (utility) for potential future health benefits, then they will most likely consume more calorie dense foods and engage in more sedentary leisure pursuits despite the future adverse consequences. Smith et al. (2005) hypothesize that an increase in the marginal rate of time preference has contributed to increasing obesity. In contrast, Cutler et al. (2003), argue that little of the differences in health behaviors, including obesity, can be explained by variations in time preference and are instead largely due to variations in genetics and situational influences.

With regard to children, individual as well as the maternal and household characteristics described above may affect the likelihood of a child being overweight. Mother's weight status may reflect either the impact of genetics on the child's likelihood of being overweight or the effects of common home environment on the family's weight status. Moreover, popular opinion consistently draws a direct link between mothers working and poor health outcomes for children. There are a number of ways through which children's eating habits and level of physical activity may be affected by having parents who work outside the home. Parents who work outside home may serve more high-calorie prepared or fast foods, and unsupervised children may make poor nutritional choices when preparing their own after-school meals or snacks. Unsupervised children may also spend a great deal of time indoors, watching television or playing video games rather than engaging in more active outdoor pursuits (Anderson et al., 2003). Alternatively, there may not be any adverse effects of parents

working on childhood weight problems. Parents' participation in the labor market may even have a negative impact on children's probability of being overweight if households where mothers work earn enough money to purchase more healthy meals. Children from such households may also be more likely to participate in after-school sports, thereby increasing their activity levels.

In addition to the socioeconomic factors discussed above, the socio-cultural environment may also influence an individual's weight status. Given that overweight and obesity are household-produced goods, an individual's self-image and social interactions are likely to play a role in determining his or her weight. Several studies report that blacks and Hispanics in the United States tolerate, and may even encourage, larger body size than do whites (Becker et al., 1999). Anderson et al. (2003) show in their study that black children are significantly more likely to be overweight than other groups, while Lakdawalla and Philipson (2002) report that black women tend to be much heavier than white and Hispanic women. Some authors also discuss the role of matching markets (marriage and dating markets) in determining weight. For example, Philipson and Posner (1999) argue that if weight affects one's ability to match, unmarried people today would be expected, as consumers in the marriage market, to be thinner than married people. Marital status may also affect the time available for household chores and active leisure in a variety of ways.

Given that a mother that is obese is also overweight, although an overweight mother may not be obese, unobservable variables may affect both the propensity to be overweight and obese. A full information maximum likelihood bivariate probit model was therefore employed for the mother's specification, instead of two single probit estimations. However, a probit model was used to examine the probability of a child being overweight.

In estimating the child equation, mother's overweight and obesity status are included as explanatory variables. However, mothers who are overweight or obese are likely to differ from mothers who are not both in observable and unobservable ways. These omitted variables

may bias the relationship between a mother's health outcome and children's overweight status across the sample. In particular, given that mothers and children share food and family resources together, there may be some unobserved factors that influence both a mother's and a child's weight problems simultaneously.[3] While the probit model used in the analysis can account for observable differences across individuals, there may still be unobservable differences that bias the relationship between a mother's weight and her child's weight. To account for this potential bias, a two-stage instrumental variable procedure is implemented to produce consistent estimates for the model (Davidson and Mackinnon, 1993). The first-stage involves estimating probit models for mother being overweight and obese. In the second-stage, where the child equation is estimated, the predicted values are used in place of the observed values for mother being overweight and obese.

IV DATA

The empirical work in this paper is based on a survey conducted by the International Food Policy Research Institute (IFPRI) between January and April 1997. The survey team adopted a two-stage sampling strategy to select 559 households distributed among 16 enumeration areas within the Accra, Ga, and Tema districts. The survey team made use of the primary sampling units that had been mapped out by the Ghana Statistical Service for the Greater Accra area. This sampling frame included 879 urban and 33 peri-urban enumeration areas. Cluster sampling was then employed to select 36 households in the 16 enumeration areas, for a total of 576 households. The basic sampling units for the survey were households with children under the age of three. The sample, therefore, did not include urban residents who do not live in households—that is, street children or homeless population.

Five of the 25 enumerators that were used in the survey were selected for specialized training in anthropometric measurement. The height and weight of children and mothers were directly measured by the trained enumerators. This is an advantage of the survey, compared to

[3] The author is grateful to an anonymous reviewer for drawing his attention to this point.

data on self-reported anthropometric measures. It is well known that self-reported anthropometric variables contain measurement error with heavier persons more likely to underreport their weight. Detailed information on the sampling design and data collection is available in Maxwell et al. (2000).

The survey gathered information on demographic indicators such as household headship, age structure and dependency ratio, available labor in the household, education, and ethnicity. Livelihood indicators collected include reported total per capita household expenditure (used as proxy measure of income at household level), the primary income-generating activity of the head of household, and maternal employment status and place of work, marital status, as well as other household variables such as the availability of a television set and piped water.

About 15 percent of the children in the sample fall in this category. The weight and BMI for mothers are skewed to the right, indicating that overweight and obesity is present in the sample (see Figure 1). About 37 percent of women had a BMI greater than 25, while 13 percent showed a BMI greater than or equal to 30, lending support to the growing concern that obesity is an emerging problem among adults in many large urban areas in developing countries, including Africa (WHO, 2000).

The data also show a direct relationship between age and BMI. Overweight and obesity is quite prominent in the age group of 24 to 40 years. The mean age of overweight women was observed to be 32.8 years whereas that of the non-overweight was 28 years. Overweight households were also larger and had higher per capita expenditures than the non-overweight category. While the mean monthly household expenditure of overweight households was 599,359 Cedis, the average for the non-overweight group was 488,120 Cedis. Definitions, means and standard deviations of all variables employed in the regressions are contained in Table 1. The per capita household expenditure is used as a proxy for income or wealth. The

predominant ethnic group is the Ga/Adangbe tribe, who traditionally, are home in Accra and its surroundings.

V. EMPIRICAL RESULTS

The reduced form bivariate probit estimates of the probability of a mother being overweight and obese are presented in Table 2, while the single equation probit estimates of the probability of child being overweight are presented in Table 3. The results in Table 2 show that the estimate of ρ (correlation between the errors) that maximized the bivariate probit likelihood function was 2.81 and was significantly greater than zero at the 1% level. This suggests a positive correlation between the unobservables that determine overweight and obesity status. This result also provides a justification for using a bivariate probit model in estimating the equation for overweight and obesity.[4] The marginal effects of the regressors on the probability of being overweight or obese, which are calculated by multiplying the coefficient estimates $\hat{\gamma}$ by $\phi(\hat{\gamma}' X)$ at the mean values of X, are also reported with the coefficient estimates.

The log-likelihood ratio statistic was significant at the 1% level, suggesting that the independent variables taken together influence weight status. The McFadden R^2, an indication of goodness of fit and the log-likelihood statistics (indicator of the significance of all covariates) are also presented in each Table. The results show that household expenditure exerts a positive and significant impact on both the probability of being overweight and obese, with non-linear effects. That is, the probability of being overweight or obese first increases with increasing expenditure and later declines with additional per capita household expenditures, a result that contradicts with some findings based on U.S. data (e.g., Stunkard, 1996), but is in line with findings reported by Costa-Font and Gil (2004) for Spain. As argued

[4] We also estimated comparable models using BMI as a continuous measure as dependent variable and obtained qualitatively similar results.

by Philipson and Posner (1999) in less developed economies, where the share of income spent on food is large, income will tend to exert a positive impact on weight.

The results also indicate that at younger ages an increase in age increases the risk of overweight and obese with the maximum effect occurring at thirty-nine and half years for overweight and thirty-nine years for obesity. At older ages, the risk of overweight and obesity decreases as age increases. This finding is consistent with the results reported by Costa-Font and Gil (2004) for Spain.

Education generally has little effect on weight of women with primary or middle education, but with women who have secondary and tertiary education, schooling tends to reduce the likelihood of being overweight or obese. The marginal effects of secondary and tertiary education for overweight are 0.09 and 0.11, respectively. The corresponding figures for obese are 0.10 and 0.15, respectively. These later findings are consistent with results reported by Cutler et al. (2003), who show that obesity for U.S. women is negatively associated with education. As argued earlier, more educated women generally have more health knowledge and as such are more likely to consume healthy foods and also engage in physical exercises that help to control weight gains. A test of the null hypothesis that the coefficients of the four education variables are jointly equal to zero is rejected for both overweight and obese. The sample value of the Wald statistics distributed as χ^2_4, are 16.59 and 17.56, with a critical value of 13.3.[5]

Work status appears to be associated with the risk of overweight and obesity. All the variables representing type of work are negative and statistically significant, implying that relative to their unemployed counterparts, women engaged in the labor market are less likely to be overweight or obese. The marginal effects suggest that relative to their counterparts in other employments, women working on farms or gardens (marginal effect of -0.09 and -0.13) are least likely to be overweight and obese. The negative and highly significant coefficients of

[5] Note that obtaining tertiary education involves going through primary, middle and secondary schools.

the variables representing work on farm or garden suggests that women engaged in these activities expend large amounts of energy and are therefore less likely to be overweight and obese. The same applies to the variables for working in the market or street. Compared to women who are not engaged in the labor market, this group of women spend some time commuting to work and also engage in some work exercises. Although women at home might spend some time cooking, they are not likely to expend as much energy as those who commute to work and engage in physical activities on the job, that require substantial amounts of calories. A test of the null hypothesis that the coefficients of the three work status variables are jointly equal to zero is rejected for both overweight and obesity. The sample value of the Wald statistics distributed as χ_3^2, are 13.97 and 14.29 for overweight and obesity, respectively, with a critical value of 11.30.

The effects of ethnicity are also quite significant for overweight and obesity, with the Ga/Adangbe and Akan/Fanti/Ashante more likely to be overweight and obese than the other ethnic groups, with substantial marginal effects. In particular, Ga/Adangbes have significantly higher measures of outcomes. This finding is not surprising, given the fact that members of this ethnic group is generally known to be heavier than other ethnic groups in the country. Compared to other ethnic groups, Ewes do not seem to be significantly more likely to be overweight or obese.

In contrast to the findings of Costa-Font and Gil (2004), who report a notable effect of marital status on body mass in Spain, the results here reveal no significant effect of marriage on the probability of being overweight or obese. Although we do not focus on their coefficients, we also control for other variables such as household composition and household consumption of calories derived from fruits. While the negative, *albeit* insignificant coefficients of the variable for calories from fruits might indicate that greater quantities of fruits consumed tend to reduce the likelihood of overweight and obese, there is a question as to how the coefficients of the household composition variables may be interpreted. For

example, the negative and significant (at the 10% level) coefficients of the variable for children under the age of five may either be linked to maternal employment patterns or household resources.[6]

Table 3 reports the results on the influence of individual and household effects on the probability of a child being overweight. A striking result is the impact of mother's weight on the child's weight status. To capture the differential impact of overweight and obese status of the mother, we include variables for obese and overweight mothers.[7] Both variables exert positive and significant impacts on the probability of a child being overweight, although the impact is greater for obese mothers. Given that obese mothers (BMI of at least 30) are also overweight (BMI of at least 25) in the present study, the marginal effect of a mother being obese is 0.16, which is the sum of the two marginal probabilities. This finding is in line with the notion that body mass index has large genetic components, although it might also reflect the effects of the common home environment. If mothers for some reasons rely on calorie-rich prepared and fast foods, then one would expect everyone in the family to be more likely to be overweight.

Mother's education also appears to influence the probability of a child being overweight. The variables representing secondary and tertiary education are both negative and significant, implying that children with mothers that have attained secondary and tertiary education are less likely to be overweight.[8] A test of the null hypothesis that the coefficients of mother's education variables are jointly equal to zero is rejected, with a sample value of a Wald statistic of $\chi_4^2 = 19.02$ against a critical value of 13.30. This last finding would seem to confirm evidence provided by Langnäse et al. (2002) on the role of education in contributing

[6] As argued earlier, if the presence of younger children in the household compels the mother to stay more at home, her presence may ensure that children eat more healthy foods that would reduce the likelihood of the child being overweight or obese. Particularly in a poor developing country, larger household size may be associated with budget limitations, resulting in reduced intake of calories.
[7] The predicted values of the variables are used in place of the observed values.
[8] As pointed out by Glewwe (1998), father's schooling, apart from its income effect, is less likely to be important for maintaining children's health.

to the epidemic of child obesity in Germany. It is, however, interesting to note that interpretation of such a finding poses a question as to whether maternal education actually has an impact on children's weight, or mothers with more education have other attributes that are different and tend to reduce the likelihood that their children will be overweight. As argued by Nayga (2000), the better health information knowledge of more educated women is probably responsible for the negative impact of mother's education on overweight.

Although the maternal work status variables are all positive, only the variable for the category shop/factory/office category is marginally significant, suggesting that the mother merely working does not necessarily have an impact on the child's weight status. The positive and significant impact of the shop/factory/office variable may be reflecting income effects on weight status, since this category of workers generally earn higher wages than their counterparts working on farms and gardens. Anderson et al., (2003) attribute the positive and significant impact of maternal work status on the probability that a child is overweight to constraints on mother's time.

Several of the other coefficients are also worth noting. As in the estimates for mothers, ethnicity also appears to influence the weight status of children. Relative to other ethnic groups, Ga/Adangbe children are significantly more likely to be overweight. Children from larger families are less likely to be overweight, compared to those from smaller families. Similarly, children from households with greater number of children under five years old are less likely to be overweight.

Interesting enough, per capita expenditure does not seem to have any significant impact on the likelihood of a child being overweight. This is probably because the socioeconomic status of the mother is well controlled for by education, ethnicity, weight, and work status. In particular, expanding labor market opportunities for women normally result in significant increases in families' command of real resources and higher living standards. In order to verify if the socioeconomic variables were responsible for the insignificance of the

expenditure variable, we run a regression without the variables, but with per capita expenditure. Not surprisingly, there is a positive and significant impact of per capita expenditure, confirming that the inclusion of the socioeconomic status of the mother renders the expenditure term insignificant.

Another interesting observation is the positive, *albeit* insignificant relationship between the presence of television in a household and weight of the child. The insignificance of the variable is probably due to the fact that it is a dummy that captures the presence or absence of a TV set in the household, and not the extent of TV viewing, as in other studies. Particularly in Accra and several towns in Ghana, people from households without TV sets normally move from their homes to watch television in other homes, implying that TV viewing is a better variable to capture the impact. Since the data employed in the present study does not contain information on TV viewing, using the presence of TV in the household provides information on TV viewing.

VI. SUMMARY AND CONCLUSIONS

Researchers and policy makers are presently concerned about the sharp increase in the number of overweight children and adults in recent decades. Although it is quite apparent that weight gain arises from taking in more energy than one expends, the reasons for the sharp divergence between energy intake and expenditure in the last few decades remain unclear. While the genetic explanation for being overweight or obese may be compelling, the recent rapid increase in overweight suggests that other factors may be important as well. In particular, socioeconomic status and technological innovations are among the factors that have been considered as important contributors to overweight problems.

This paper employed a unique data set to examine the influence of individual and household characteristics on the overweight and obesity among women and children in urban Accra, in Ghana. The data reveal that around 36 percent of women had a BMI greater than 25,

while 13 percent showed a BMI greater than or equal to 30, lending support to the growing concern that obesity is an emerging problem among adults in many large urban areas in developing countries, including Africa. The empirical examination of the determinants of overweight and obesity suggests a significant role for public policy in influencing the weight problems of urban Ghanaians.

Consistent with previous research, we find that mother's work status significantly affects her body mass index and probability of being overweight. In particular, women engaged in farm or garden work and market or street work were found to be much less likely to be overweight relative to those who were unemployed and stayed at home. This finding suggests that women working on farms or gardens, or even market and street work must normally commute to work and probably engage in work-related exercise, and as such are less likely to be overweight or obese. Commuting to work and engaging in work-related exercise require larger amounts of energy, which contributes to a reduction in weight gains.

Our results further reveal that mothers who attained secondary and tertiary education had lower body mass indices and were much less likely to be overweight, lending support to the notion that education is negatively related to the probability of being overweight or obese. As shown by Nayga (2000), more educated women normally have better health information knowledge and are more likely to consume healthy foods and also engage in physical exercises that help to control weight gains. Mother's education was also found to exert a negative and significant impact on the weight status of children. Thus, children with mothers who had secondary and tertiary education were far less likely to be overweight than those with only primary education or no schooling.

Our results also indicate that household expenditure exerts a positive and significant impact on the probability of a mother being overweight or obese, but at a decreasing rate, suggesting the importance of the relationship between income and weight control. In contrasts to findings from studies with U.S. data which report a negative relationship between income

and weight, this observation indicates that at lower income levels, weight increases with increasing income, but tends to decline after a certain level of income. However, we find no evidence that household resources expressed through household expenditure affects the likelihood of a child being overweight.

Children whose mothers are obese are also more likely to be overweight, as the coefficients for overweight and obese both turned out to be positive and significant. Ethnicity also appears to be an important determinant of overweight and obesity, with Ga/Adangbe women and children being more likely to be overweight, compared to other ethnic groups. Although a much higher percentage of the Ga/Adangbe women than the other ethnic groups are overweight, it is generally known that particularly among the less educated groups in urban areas, thinness continues to be a signal of possible poverty and poor health, malnutrition, or even bad habits such as alcoholism and AIDS. It is therefore not altogether surprising that in spite of the increasing trend towards slenderness, some women still view increasing weight as a sign of attractiveness.

It is worth mentioning that in developing economies, overweight and obesity problems are emerging at a time when under-nutrition remains a significant problem. The nutrition transition appears to be facilitating rapid gains in body weight in low income and undernourished populations. Hence, strategies that consider both undernourishment and overweight problems will need to be considered. As pointed out by Cabarello (2001), unless there is a concurrent reduction in childhood stunting and an improvement in adult stature, normalizing BMIs might not confer the same reduction in mortality risk as that in developed countries populations. Continuing gains in BMI beyond the normal range will increase the potential risk associated with low stature. While reducing the health risk associated with obesity in developed countries requires a focus on controlling excess body weight, the task in developing countries also demands an effort to combat childhood malnutrition that would increase the stature of future generations of adults.

With regards to overweight and obesity in developing economies, public interventions like education programs with a focus on healthy food choices, incorporation of physical activity and a decrease in sedentary behavior will all be important. Moreover, promoting healthy behaviors to encourage, motivate and enable individuals lose weight by eating more fruits and vegetables, as well as nuts and grains would be quite significant in reducing the incidence of overweight and obesity. Future research in this area will still need to consider a broader understanding of other contributors to weight problems. It would be particularly interesting to know more about adult's and children's opportunities for vigorous exercises and access to recreational facilities.

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Figure 1: Body Mass Index Distribution of Mothers, 1997

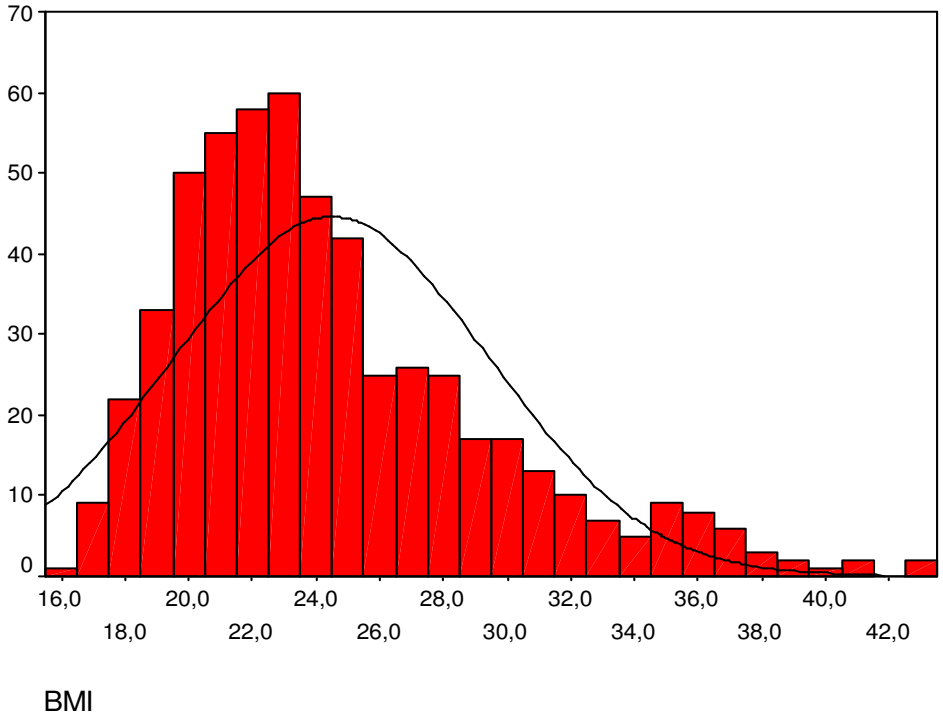

Table 1: Definitions, Means and Standard Deviations of Variables

Variable	Variable Description	Sample Mean	Standard Deviation
	Dependent Variables		
Mother overweight	1 if body mass index is equal to or greater than 25 but less than 30, 0 otherwise	0.24	—
Mother obese	1 if body mass index is equal to or greater than 30, 0 otherwise	0.13	—
Child overweight	1 if weight of child falls outside the 90th percentile of the sampled children, 0 otherwise	0.16	—
	Independent Variables		
Household size	Total number of people in household	5.1	2.3
Mother's age	Age of mother in completed years	29.76	7.69
Mother married	1 if mother is married, 0 otherwise	0.75	—
Child's age	Age of children between 0 and 6 years in months	17.55	9.91
No school	If primary care giver has no school education	0.11	—
Primary school	If primary care giver has primary school education	0.23	—
Middle/Islamic	If respondent has middle or Islamic school education	0.40	—
Secondary school	If primary care giver has some secondary or Islamic school education	0.16	—
Tertiary	If primary care giver has tertiary school education	0.10	—
Ga/Adangbe	If primary care giver is GA or Adangbe	0.37	—
Ewe	If primary care giver is Ewe	0.28	—
Akan	If primary care giver is Akan/Ashanti/Fanti	0.22	—
Other	If primary care giver is a different tribe	0.13	—
Age at 0 – 4	Household members between 0 – 4 years	0.26	0.11
Age at 5 – 14	Household members between 5 – 14 years	0.23	0.13
Age at 15 – 39	Household members between 15 – 39 years	0.39	0.21
Age at 40 and older	Household members of age 40 years and older	0.31	0.29
Farm or garden	1 if mother works on a farm or garden, 0 otherwise	0.69	—
Shop/factory/office	1 if mother works in a shop, factory or office, 0 otherwise	0.59	—
Street or market	1 if mother sells items on the street or in the market, 0 otherwise	1.15	—
FRUITCAL	Daily per head calorie consumption of fruit calories	50.42	127.8
TV	If TV present in household, 0 otherwise	0.50	—
Household expenditure	Log of per capita household monthly expenditure	8.73	0.50

Table 2: Bivariate Estimates of whether Mother is Overweight or Obese

Variable	Overweight		Obese	
	Coefficient	Marginal Probability	Coefficient	Marginal Probability
Intercept	-1.9851*** (-4.7007)		-1.4851*** (-4.1014)	
Mother's education				
Primary school	0.0985 (0.8686)	0.0291	0.0941 (0.8743)	0.0324
Middle/Islamic school	0.0674 (1.6180)	0.0198	0.1334 (1.2916)	0.0459
Secondary school	-0.2937** (-2.1713)	-0.0865	-0.3078** (-2.3827)	-0.1061
Tertiary education	-0.3761** (-2.3268)	-0.1108	-0.4382*** (-2.8609)	-0.1510
Ethnicity				
Ga/Adangbe	0.4019** (2.4697)	0.1184	0.3515** (2.8044)	0.1211
Akan/Ashanti/Fanti	0.2528** (2.0035)	0.0745	0.2671** (2.12361)	0.0920
Ewe	0.0356 (1.3159)	0.0104	0.1752 (1.1443)	0.0604
Household characteristics				
Per capita household expenditure	0.0443** (2.2477)	0.0131	0.0768** (2.4336)	0.0265
Per capita household expenditure squared	-0.0055* (-1.9730)	—	-0.0163* (-1.8772)	—
Calories from fruits	-0.0278 (-1.2141)	-0.0082	-0.0958 (-1.37391)	-0.0329
Household members between 0 – 4 years	-0.1954* (-1.8763)	0.0576	-0.0514* (-1.7391)	-0.0177
Household members between 5 – 14 years	-0.1103 (-1.3547)	0.0325	-0.0117 (-1.1414)	-0.0040
Household members between 15 – 39 years	0.1965 (0.3448)	0.0571	0.0148 (1.2208)	0.0051
Household members of age 40 years and older	0.0091 (0.7144)	0.0027	0.0599 (0.9595)	0.0206
Married	0.0884 (1.2049)	0.0260	0.0145 (1.0651)	0.0049
Mother's age in years	0.0015** (-2.6340)	0.0005	0.0014** (2.5214)	0.0005
Mother's age squared	-0.0019** (2.1053)	—	-0.0018** (-2.0658)	—
Mother's work				
Farm or garden	-0.3184*** (-2.7691)	-0.0938	-0.3672** (-2.4950)	-0.1265
Shop or factory or office	-0.2087* (-1.9276)	-0.0615	-0.2265 (-1. 3717)	-0.0781
Street or market	-0.1493* (-1.6884)	-0.0439	-0.1384* (-1. 7892)	0.0477
Rho (1, 2)	0.281 (2.57)			
McFadden R^2	0.396			
Log-likelihood ratio	176.72			
Observations	555			

Notes: t-values errors are in parentheses. Single (*), double (**) and triple (***) denote significant variables at 10%, 5% and 1% levels respectively.

Table 3: Probit estimates of whether child is overweight[++]

Variable	Coefficient	*t* - Value	Marginal Probability
Intercept	-3.1667***	-2.2804	—
Child' age	0.2081	1.5862	0.0813
Mother's education			
Primary school	-0.0287	-1.1266	-0.0112
Middle/Islamic school	-0.1126	-1.3974	-0.0438
Secondary school	-0.3492**	-2.1807	-0.1360
Tertiary education	-0.5628**	-2.4218	-0.2192
Ethnicity			
Ga/Adangbe	0.4716**	2.1879	0.1837
Akan/Ashanti/Fanti	0.4380*	1.7684	0.1706
Ewe	0.2647	1.0952	0.1031
Household characteristics			
Household members between 0 – 4 years	-0.1683**	-2.4628	-0.0655
Household members between 5 – 14 years	-0.2174	-1.3964	-0.0847
Household members between 15 – 39 years	0.0156	0.0875	0.0061
Household members of age 40 years and older	0.0972	1.3379	0.0379
Mother is overweight[+]	0.1486**	2.4758	0.0409
Mother is obese[+]	0.3677**	2.5473	0.1284
Presence of a TV set	0.0729	1.5472	0.0316
Per capita expenditure	0.1653	1.6298	0.0655
Mother's work			
Farm or garden	0.1096	1.4963	0.0427
Shop or factory or office	0.1762*	1.6678	0.0686
Street or market	0.0873	1.0229	0.0341
Mother married	-0.0644	0.8716	-0.0322
Wald test statistics for joint significance			
Mother's education		χ^2_4 =19.02	
Mother's work status		χ^2_3 =16.38	
McFadden R^2		0.379	
Log-likelihood ratio		160.62	
Observations		724	

Notes: Single (*), double (**) and triple (***) denote significant variables at 10%, 5% and 1% levels, respectively.

[++] The dependent variable is a binary variable equal to 1 if child's BMI is above the 90th percentile for his/her age.

[+] The predicted values of these variables are used in place of the observed values.