Global Patterns in Overweight
Among Children and Mothers in Less Developed Countries

Abstract

Past research has identified increases in national income and urbanization as key drivers of the global obesity epidemic. This work further identifies educational attainment as an important moderator of these effects. However, this work has tended to assume that children and adults respond in the same way to these factors. In this article, we evaluate how the socioeconomic and country-level factors associated with obesity differ between children and their mothers. We analyzed 95 nationally representative health and nutrition surveys conducted between 1990 and 2008 from 33 developing countries (N = 482,097 mothers and children). Consistent with prior research, we found that mother's risk of overweight was positively associated with economic development, urban residence, and maternal education. Additionally, economic development was associated with steeper increases in mothers' risk of overweight among those with low (versus high) levels of education and among those living in rural (versus urban) areas. However, these associations were far weaker for children. Child overweight was unassociated with maternal education and urban residence, and negatively associated with national income. We speculate that the distinctive patterns for children may arise from conditions in middle-income developing countries that increase the risk of child underweight and poor nutrition.

Introduction

Although the prevalence of obesity and overweight is highest in wealthy countries like the United States, it is rapidly increasing in several less developed countries among both adults and children (Swinburg et al. 2011). Following United Nations' definitions, the term ''less developed countries'' (or regions) refers to countries in Africa, Asia (except Japan), Latin America, the Caribbean, and Oceania (except Australia and New Zealand). A less developed country is one with a relatively low standard of living, an undeveloped industrial base, and moderate to low Human Development Index (HDI). As underscored in the recent United Nations Report of the Secretary-General (2011), the troubling increase in obesity in less developed countries will add to health care costs for societies that are already burdened with poverty and the challenges of managing infectious disease.

In a recently-published series of articles in the *Lancet*, the editors emphasized that "the increasing weight of people worldwide is the result of a normal response by normal people to an abnormal environment." (Lancet, 2011: 741). This perspective is most evident in the widely cited Nutrition Transition theory (Popkin 2002), which relates economic development and urbanization to shifts in food consumption and physical activity patterns, and these to increases in obesity. Consistent with this view, past research has identified increases in national income and urbanization as key drivers of the global obesity epidemic (Swinburg et al. 2011). This work further identifies educational attainment as an important moderator of these effects, such that those with less education become increasingly susceptible to obesity as national income increases (Monteiro et al. 2004).

One limitation of this work, however, is that it has tended to assume that children and adults respond in the same way to these factors. Although some research has focused on children, the empirical evidence linking obesity to rising national income, urbanization, and education is best established for women. Child obesity is distinctive in several ways, so it may not correspond with the same macro-level factors as adult obesity. Tellingly, in several middle-income countries, households that contain both underweight children and overweight adults ("dual burden households") are common, particularly in urban areas (Doak et al., 2000; Doak et al., 2005; Khan 2006; Khorshid and Galal 1995). In this article, we evaluate how the socioeconomic and country-level factors associated with obesity differ between children and their mothers. By comparing children with their mothers, we ensure that the communities and home environments of the children and adults in our sample are identical.

Another limitation of past research is that it tends to deduce the effects of increasing national income by comparing *across* countries with different levels of income (e.g., Martorell et al. 2000; Monteiro et al. 2004), rather than assessing changes *within* the same country over time. By estimating models with country-level fixed effects, we hold constant the non-time-changing characteristics of countries and their populations (e.g., culture, geography, genetics) to more accurately identify the factors leading to growth in obesity during the last two decades within 33 developing countries.

Throughout, we use the Center for Disease Control definitions of obesity and overweight. For adults (18+), obesity is defined as having a body mass index (BMI) ≥ 30, and overweight as BMI ≥25. For children, obesity is defined as having a BMI ≥ 95th percentile on age- and sex-specific growth charts, and overweight as having a BMI ≥ 85th percentile. Weight

assessments based on the CDC and International Task Force on Obesity measures are highly correlated (Wang et al. 2000).

Global Shifts in Obesity and the Nutrition Transition

Obesity is now classified as one of the most serious public health problems of the 21st century due to its linkage to a number of serious health conditions, including hypertension, elevated blood pressure, cancer, and diabetes (Deckelbaum and Williams 2001; Dietz 1998; Strauss and Pollack 2003). Beyond its impact on physical health and mortality, obesity is related to difficulties in social adjustment, poor mental health, and lower academic achievement (Datar, Sturm, and Magnabosco 2004; Strauss and Pollack 2003), and thus has wide-ranging implications for children's quality of life (Swallen et al. 2005) and productivity as adults (Cawley 2004). As such, obesity is likely to impose heavy health care burdens to societies.

It is well established that more developed countries like the United States face a significant obesity epidemic (Swinburg et al. 2011). Yet both children and adults in less developed countries are also at risk. Worldwide obesity prevalence has doubled since 1980 (WHO 2011), and obesity among women in some middle-income countries like Mexico and Egypt are about as high as in the United States (Swinburg et al. 2011). Among preschool children (ages 0-5) in less developed countries, the prevalence of overweight and obesity increased in nearly every country for which data are available (Wang and Lobstein 2006). One group estimated that it increased worldwide from 3.7% in 1990 to 6.1% in 2010 (De Onis,

Blossner, and Borghi, 2010). Although the prevalence of overweight or obese[1] children in more developed countries is roughly double that in less developed countries (11.7% versus 6.1%) the majority, or roughly 35 million children, live in less developed countries (de Onis, Blossner, and Borghi2010).

Global patterns and trends in obesity tend to be understood as a consequence of the nutrition transition, or the shifting of diets towards foods higher in fat, refined carbohydrates, and processed foods, and reductions in physical activity (Popkin and Gordon-Larsen 2004; Bermudez and Tucker 2003; Popkin 1998; Popkin 1994). Importantly, economic development and urbanization are thought to be the driving forces of the nutrition transition (Popkin & Gordon-Larsen, 2004; Swinburg et al. 2011).

Economic development is closely tied to globalization or the increasingly rapid flow of goods and information across time and space, rising household incomes, and changing lifestyles (Hawkes 2006). This process not only alters the types and quantity of foods available, but also tastes and preferences for particular brands and categories, especially non-traditional foods in less developed countries. Further, economic development may be associated with reduced food prices, particularly of unhealthful foods, contributing to the rise in body weight worldwide (Cutler et al 2003).

Urbanization is thought to be associated with obesity due to its contemporary forms of transportation, post-industrial jobs (involving the mechanization of tasks and processes), and rising incomes, all of which reduce the need for physical activity in daily life. Urbanization also encourages increasing reliance on convenient packaged foods. Urban dwellers, in both more

[1] Overweight in the referenced study is defined as the proportion of preschool aged children greater than 2 standard deviations from the WHO growth standard median; obesity as greater than 3 standard deviations.

and less developed countries, consume more animal sourced foods and caloric sweetened foods and participate in less physical activity than those living in rural areas (Popkin and Gordon-Larsen 2004).

Finally, high individual socioeconomic status (SES) and urban residence buffers the effects of economic development on obesity. In the early stages of the nutrition transition, obesity tends to be concentrated in urban areas and among people with higher SES (i.e., those with more education and income). However, as national income increases, obesity tends to increase the most among the poor and in rural areas (Popkin 1994; Popkin-Gordon Larsen 2004; Monteiro, Conde, Lu, & Popkin, 2004). For example, in Mexico in the late 1990s, Mexicans with higher SES were more likely to be overweight (Martorell et al 1998), yet during the past decade, the burden of obesity has been increasingly shifting to the poor. Indeed, this phenomenon of a shifting obesity burden has been occurring in many other low and middle-income countries (Hawkes 2006; Monteiro, Conde, Lu, & Popkin, 2004; Rivera et al. 2004).

Childhood Obesity and the Nutrition Transition

Much of the research cited above, including several multi-national comparative studies (Monteiro, Moura, Conde, & Popkin, 2004; Monteiro, Conde, Lu, & Popkin, 2004; Popkin-Gordon Larsen 2004; Sobal & Stunkard, 1989), has clearly established that economic development, urbanization, and education are important factors shaping the global rise in adult obesity. However, these associations are less firmly established for children.

Economic development and urbanization may be only weakly related to the rise in childhood obesity. Martorell and his colleagues (2000) examined nutritional surveys conducted

during the late 1980s and 1990s across 50 less developed countries. They found that the prevalence of overweight children was weakly associated with higher Gross National Product (GNP) ($r = .28$). Additionally, they found that in only about half of the countries they examined, children living in urban areas were significantly more likely to be overweight than children in rural areas; there was no difference between urban and rural areas in most of the other countries, and children in rural areas weighed more than in urban areas in two countries (Yemen and Pakistan). Other research conducted within selected countries is suggestive but not conclusive. For example, the percentage of children who are overweight has increased in several countries undergoing economic development, including Brazil (from 4.2% to 14.1% between 1974 and 1997), China (from 6.4% to 7.7% between 1991 and 1997) (Wang, 2001), and Mexico (from 21.9% in 1988 to 28.7% in 1999 among children ages 2–4) (Ridaura, Barquera, Prado, & Rivera, 2007). A systematic review of the literature on trends in childhood obesity prevalence across 42 countries further suggested that the largest increases occurred within economically developed and urbanized countries (Wang and Lobstein 2006). However, apart from the Martorell et al. (2000) study (which used older data), we know of no recent work that systematically models the relationship between changes in national income or urbanization and changes in the prevalence of childhood obesity.

Like adult obesity, education is clearly an important predictor of child obesity in less developed countries. For example, Martorell et al. (2000) found that overweight among preschool children was more common in children of mothers with more education in Latin America, the Caribbean, the Middle East and Northern Africa, and in no developing countries was child overweight more common among those with poorly educated mothers. However,

there exists little evidence that the association between economic development and childhood obesity is stronger for children with less educated mothers. Even among middle-income countries experiencing rapid economic development such as Iran (Maddah and Nikooyeh 2010), India (Chakraborty and Anderson 2010), China (Dearth-Wesley, Gordon-Larsen, Adair, et al 2011), and Mexico (Hernandez et al. 2003), overweight and obesity remain more prevalent among children with higher educated mothers than less educated mothers. One possible exception may be in Brazil, where most research finds no relationship between maternal education and child weight (Duncan et al. 2011).

Hypotheses

In this study, we compare the associations of socioeconomic and country-level factors with overweight between children and mothers. We use 95 surveys from 33 less developed countries to model the likelihood of overweight for preschool children (2-4) and their non-pregnant mothers. Based on the prior literature, we developed three hypotheses:

H1: Economic development, urban residence, and maternal education are positively associated with overweight.

H2: Economic development is associated with steeper increases in overweight among those with low (versus high) levels of maternal education and among those living in rural (versus urban) areas.

H3: The associations tested in H1 and H2 are weaker for children than mothers.

In testing these ideas, we make several methodological improvements over past research. By controlling for country of residence in our models, we hold constant any unmeasured non-time-varying characteristics of countries and their populations, such as cultural practices in child rearing, norms about body weight, or genetic factors related to height or weight. Additionally, by pooling mothers and children in the same sample and by employing household-level clusters to test H3, our research design allows us to directly compare the associations of economic development, urbanization, and educational attainment between children and their mothers while controlling for the effects of the environments that children and their mothers share.

Methods

Data. Ninety-five nationally representative health and nutrition surveys conducted between 1990 and 2008 from 33 developing countries were pooled for the analysis. The surveys include 2 countries in East Asia and the Pacific; 2 in Europe and Central Asia; 6 in Latin America and the Caribbean; 3 in the Middle East and North Africa; 3 in the South Asia sub-continent; and 17 in Sub-Saharan Africa.

The majority of the data comes from the Demographic and Health Surveys (DHS), which use standardized survey instruments across countries. The DHS are nationally representative household surveys of mothers aged 15 to 49 and their children under the age of 5. The DHS collect information primarily on health, nutrition, and family planning. To supplement the DHS, we use comparable data collected in Mexico and China. The Mexican data sets come from the Mexican Family Life Survey (MxFLS), which is a nationally representative survey of individuals,

households, and communities. The MxFLS collects social, economic, demographic, and health behavior information from all respondents. The Chinese data sets come from the China Health and Nutrition Survey (CHNS), a survey that covers nine geographically and socio-demographically diverse provinces in China. The focus of the survey is to collect health, nutrition, and family planning data.

To be included in the analytic sample, a country had to have a minimum of two surveys at different points in time at least 3 years apart with the most recent survey occurring in the 2000s. If the survey was collected over two calendar years, the survey year is considered to be conducted in the earlier year.

There are two analytic data files. The first contains a record for each child in the 95 surveys, with mothers' information attached to each child record. The sample is restricted to countries with information on child and mother's measured height and weight. Pregnant women and their children are dropped from the sample due to the confounding between BMI and pregnancy. We restrict analysis to children between the ages of 2 and 4. Only cases with complete information on the dependent and independent variables were used in the analysis. The final analytic sample contains 253,442 child-mother pairs. We also constructed a person-level file that contains a record for each mother and each of her children (N = 482,097). For example, a family with two children between the ages of 2 and 4 and a mother would contribute three cases to the person-level file.

Dependent variable. All 95 surveys collected measured height and weight of the mother and child. The key dependent variable is a dichotomous indicator of overweight status (=1) constructed separately for the children and adults. Overweight status was determined by an

individual's body mass index (BMI = kg/m^2). For children and mothers younger than 20, we used the *zanthro* Stata program to convert BMI to percentile BMI based on CDC growth charts which are standardized based on age and sex (Vidmar et al. 2004). Those with a percentile BMI score at or above the 85^{th} percentile were coded as overweight. For mothers age 20 and older, those with a BMI greater than or equal to 25 were coded as overweight.

Independent Variables. The independent variables included economic development, urban residence, and mother's educational attainment. Economic development of the children's country of residence in the year of interview was measured as the logged real Gross National Income per capita, converted to 2000 U.S. constant prices and adjusted for purchasing power parity. We harmonized indicators of mothers' education across all of the surveys and years, distinguishing among four categories: no formal education (reference), attended primary school, attended secondary school, and attended post-secondary school.

Controls included the gender (1=male), the ages of the child and mother in years, marital status of the mother (1=married/0=otherwise), the age of the youngest child in the household in months, the year of the survey, and a dummy indicator for each country. In analyses involving the person-level file (which pools mothers and children), we also use a "mother indicator" (=1 if the person is a mother as opposed to a child).

Analysis. We first used the child-level file to examine descriptive statistics on all variables in the analytic files. Also, to compare trends in overweight between children and mothers, we estimated the prevalence of overweight among children and mothers from the earliest and most recent survey years for each country separately.

To assess the hypotheses, we used the person-level file (which pools both mother and child records) to estimate logistic regression models of overweight. To evaluate H1, we included economic development, urban residence, and education as independent variables while controlling for the "mother indictor" and other control variables. To assess H2, we tested interactions between economic development and mother's education and (in separate models) between economic development and urban residence. To test H3, we tested two-way interactions between the "mother indicator" and each of the three independent variables. These interaction terms indicated the difference between mothers and children in the associations of economic development, urban residence, and education with overweight. We also tested three-way interactions among the "mother indicator", economic development, and urban residence; and in a separate model, among the "mother indicator", economic development, and education. For ease of interpretation, we present predicted probabilities of overweight by varying levels of gross national income), maternal education, and urban/rural residence, while setting all other variables equal to their mean values.

All models included fixed effects for country of residence. Additionally, the models adjust the standard errors for the clustering of mothers and children in the same households in each particular country and year, and were estimated using the logit command in STATA version 11.2. All descriptive statistics and models were weighted based on provided person-level survey weights[2]. We used a p-value of .05 as a cut off for all tests of significance.

Results

[2] The MxFLS and CHNS do not include survey weights; therefore, each child has a weight of one for these surveys.

Table 1 presents the weighted sample descriptives for the child-mother pair sample. Mothers are more likely to be overweight than their children (28.8% versus 20.7%). This is consistent with prior empirical research on weight prevalence among women and children. More than 36% of mothers in the sample have no formal schooling while one-third of mothers have a primary level education. Another quarter of the sample has a secondary level education and the remaining 6% have more than secondary schooling. The mean age for children is 40 months or about 3.3 years and 29.7 years for mothers. Almost 80% of the mothers are married. The majority of the sample resides in a rural location (36% urban).

The prevalence of overweight in the earliest and latest survey for each country is shown in Table 2 separately for children and mothers. In the earliest survey, the prevalence of overweight for children ranged from 5.3% in Bangladesh to 41% in Armenia. The pattern was similar in the latest survey; Bangladesh again had the lowest prevalence at 2.5% while Egypt had the highest prevalence at 40%. The change in overweight prevalence for children between the two surveys was minimal for most countries; many countries experienced small declines over time (14 out of 33). The prevalence of overweight exhibits a much wider range for mothers: from about 2% in Nepal to over 60% in Mexico and Jordan in the earliest survey. Additionally, in a majority of our sample countries mothers have a higher prevalence of overweight in both time points compared to children. Finally, unlike children, mothers experience larger gains in overweight prevalence between the earliest and latest surveys.

Having established the patterns in overweight for mothers and children within countries over time, we turn to our multivariate analysis using the pooled mother and child sample. Consistent with our first hypothesis, the results in Model 1 suggest that maternal education and

urban residence are positively associated with overweight among the pooled sample of mothers and children. There is a positive gradient in education such that the odds of overweight are highest when maternal educational attainment is highest. In contrast to our first hypothesis, however, economic development (logged GNI) is negatively related with overweight. At the highest levels of economic development, the likelihood of overweight is the lowest.

Model 2 tests the idea that the association between economic development and overweight varies according to maternal education, with those at lower levels of education more likely to be overweight. The interactions between economic development and secondary schooling and higher than secondary schooling are significant. The interaction results suggest that at higher levels of economic development more highly educated mothers, especially those with higher than a secondary level education, and their children are less likely to be overweight. We further test our second hypothesis, by including an interaction between urban residence and economic development (Model 3), finding that a 10% increase in national income reduces the odds of being overweight by about 2% for rural residents ($e^{-.19 \text{ Log } 1.1}$=0.98), and by 3% for rural residents ($e^{(-.19 - .12) \text{ Log } 1.1}$=0.97). This is inconsistent with our second hypothesis because we had not expected national income to be negatively associated with the overweight.

We therefore turn to Model 4 to test our final hypothesis—do the socioeconomic and country-level factors associated with obesity differ between children and their mothers? We test whether the associations established in the first three models are weaker for children than they are for mothers by including two-way interactions between the mother indicator and educational level, urban residence, and economic development. The three sets of interactions

are statistically significant, suggesting that the effect of all three independent variables on overweight is weaker for children than for mothers. To help interpret the results, Figure 1 presents the predicted obesity prevalence by mother's education, urban residence and national income based on Model 4[3]. As found in prior research, the predicted percentage overweight among mothers is higher at higher levels of maternal education, in urban areas (compared with rural areas), and at higher levels of national income. However and as expected, the patterns are much weaker among children. Maternal education and urban residence are unassociated with children's risk of being overweight, and national income is negatively associated with overweight.

Finally, we estimated additional models (not shown) that include three-way interactions among the mother indicator, economic development, and urban residence; and in a separate model, among the mother indicator, economic development, and education. The results suggest that there are significant moderating effects of national income on the relationship of overweight with urban residence and mother's education. We present the predicted probabilities of overweight for mothers and children across levels of national income (Figure 2). Again, the patterns for mothers are consistent with prior research on the nutrition transition. The association between national income and mothers' risk of overweight increases the most among those with the lowest levels of education and among those living in rural areas. Among children, however, the risk of overweight declines as national income increases regardless of maternal education or urban residence.

[3] Predicted values are generated from the coefficients in Model 3 setting mother's age equal to 20, child's age equal to 4, and logged GDP equal to 7.6.

Discussion

It is well established that developed countries face a significant obesity epidemic, yet recent estimates suggest that less developed countries are also at risk. While past research has predominately focused on women in developing countries, often making cross-country comparisons, this study evaluates the socioeconomic and country-level factors associated with overweight and makes direct *within country* comparisons between children and their mothers.

Our findings challenge prior studies which assume that the factors underlying the worldwide nutrition transition, namely urbanization and economic development, operate similarly on overweight for mothers and children. In fact, we find that the relationship between overweight and level of economic development appears to operate in the opposite director for children than it does for mothers. Additionally, we provide evidence of the weak associations of maternal education and urban residence with overweight for children.

As in prior studies, we find that urban residence, education, and national income is associated with higher prevalence of mothers' risk of overweight, and that the burden of overweight appears to increase with rising national incomes among the least educated women and among women living in rural areas. But why is the relationship between national income and child overweight negative regardless of maternal education or urbanicity? One possibility is that rapidly changing dietary environments in developing regions may impact children in different ways than it does adults. The nutrition transition model assumes that diets converge such that locally grown traditional foods are replaced by high-calorie, low-nutrient foods (Drewnowski and Popkin 1997). However, there is some evidence that the shift in diets may

occur differently between and within groups (Hawkes 2006). For example, Leatherman et al (2004) examined the impact of rapid increases in national income in a less developed region, finding ample evidence of a swift nutrition transition. As local diets shifted to a higher consumption of processed calorie-dense but nutrient-poor foods, adults increasingly became obese yet the children exhibited signs of growth stunting. Stunting occurs due to an absence of adequate nutrients during gestation and up to the second or third year of life (Branca and Ferrari 2002), and leads to higher likelihood of obesity in adulthood. The existence of "dual burden" households (households characterized by over-nutrition among adults and under-nutrition among children) in developing countries offer further evidence that children and adults may respond differently to a rapidly shifting nutritional environment.

While our results demonstrate a decline in the prevalence of child overweight with increasing national incomes; income increases at the national level may not necessarily be related to improvements in child nutrition. The benefits of increased income which often accrues due to a shift from subsistence farming to wage earning among women, may be offset by reduced access to locally produced nutritious food, and decreases in health promoting activities such as breastfeeding. Indeed, research has identified a protective effect of breastfeeding against child overweight and obesity (Owen et al 2005), yet only 38% of 0 to 5 year old children in developing countries are exclusively breastfed (Unicef 2008). Increases in maternal labor force participation in developing countries are typically accompanied by reductions in breastfeeding and an increased reliance on processed foods.

In addition, the full impact of the nutrition transition on children in developing countries may become more apparent as children "age into" the burden of overweight and obesity. The

children in our sample are very young, and the acquisition of extra body weight is cumulative. Differences in patterns of overweight by maternal education and urbanicity may emerge as children grow older and are increasingly exposed to poor nutritional environments. Data on school aged children in developing countries is needed to more fully understand specific causes of child overweight in nutrition transition settings. In future research we plan to examine the full range of child weight distribution to understand whether the relationships between economic development and maternal education might vary for those children at risk of overweight or underweight.

Table 1. Sample Descriptives (N=253,442)

	Mean or %	SE(B)
Child Overweight	20.77%	
Mother Overweight	28.80%	
Mother's Education		
No Schooling	36.23%	
Primary	33.01%	
Secondary	24.95%	
Higher than Secondary	5.81%	
Child is Male	50.87%	
Child Age in Months	40.84	0.02
Minimum Age of Child in Household	38.19	0.02
Woman's Age in Years	29.68	0.02
Married Mother	79.16%	
Urban Residence	36.25%	
Log of Gross National Income	7.61	0.00
Year	2001.37	0.01

Descriptives are weighted

Table 2. Prevalence of Overweight for Earliest and Latest Survey by Country (N=253,442)

	Children			Mothers		
	Earliest Survey	Latest Survey	Change	Earliest Survey	Latest Survey	Change
Latin American & Caribbean						
Peru (91; 07)	37.1	31.2	-5.9	41.8	53.4	11.6
Colombia (95; 05)	17.6	15.7	-2.0	41.6	40.7	-0.9
Nicaragua (98; 01)	25.0	24.0	-1.0	39.7	48.3	8.6
Mexico (02; 05)	20.4	21.1	0.7	62.6	59.9	-2.7
Haiti (94; 05)	10.4	12.3	1.9	11.8	22.2	10.4
Bolivia (93; 08)	24.9	33.1	8.2	39.6	54.8	15.3
South Asia						
India (98; 06)	8.5	4.4	-4.1	6.1	8.9	2.8
Nepal (95; 06)	7.1	3.5	-3.6	1.9	7.3	5.4
Bangladesh (96; 07)	5.3	2.5	-2.8	4.0	8.8	4.8
East Asia & SE Asia						
Cambodia (00; 05)	6.9	4.6	-2.3	6.6	9.7	3.1
China (00; 06)	24.5	31.2	6.7	12.2	21.2	8.9
Subsahara Africa						
Senegal(93; 05)	10.2	5.4	-4.8	18.2	23.0	4.8
Malawi (92; 04)	34.3	30.5	-3.8	9.3	13.7	4.3
Uganda (95; 06)	23.7	21.8	-1.9	10.9	14.7	3.9
Tanzania (91; 04)	19.3	17.5	-1.8	11.6	15.2	3.5
Kenya (93; 08)	17.2	15.5	-1.7	13.4	21.7	8.3
Namibia (92; 07)	9.6	10.1	0.5	22.2	28.1	6.0
Burkina Faso (92; 03)	13.2	14.4	1.2	7.6	7.4	-0.2
Rwanda (00; 05)	25.2	26.9	1.7	14.9	13.2	-1.6
Madagascar (97; 04)	9.0	10.9	1.9	4.0	4.9	1.0
Mozambique (97; 03	23.1	25.7	2.5	10.5	11.9	1.5
Cameroon (98; 04)	25.2	28.7	3.5	21.5	26.3	4.8
Mali (95; 06)	9.5	13.1	3.6	11.1	17.2	6.1
Nigeria (03; 08)	17.9	21.8	3.9	23.5	23.8	0.2
Ghana (93; 08)	9.9	15.4	5.5	14.4	28.3	14.0
Zambia (92; 07)	19.8	25.7	5.8	16.4	17.3	0.9
Niger (92; 06)	7.5	14.0	6.6	8.8	14.7	5.9
Benin (96; 06)	9.6	21.6	12.1	10.0	16.8	6.8
North Africa, Middle East, Eastern Europe						
Armenia (00; 05)	41.1	29.2	-11.9	31.1	31.9	0.8
Morocco (92; 03)	29.8	26.6	-3.3	33.0	43.9	10.9
Egypt (92; 08)	39.7	40.1	0.4	56.1	70.5	14.3
Turkey (93; 04)	19.2	29.3	10.0	51.4	56.6	5.3
Jordan (97; 07)	12.6	22.7	10.2	61.1	60.2	-0.9

Weighted Percentages

Table 3. Logistic Regression Predicting Overweight Status (N=482,097)

	Model 1	Model 2	Model 3	Model 4
Mother's Education (Ref=No Schooling)				
Primary	0.24 ***	0.41 **	0.23 ***	0.15 ***
Secondary	0.33 ***	1.53 ***	0.32 ***	0.03 +
Post-Secondary	0.34 ***	3.26 ***	0.35 ***	0.18 ***
Urban	0.33 ***	0.33 ***	1.29 ***	-0.03 +
Log GNI	-0.23 **	-0.13	-0.19 *	-0.58 ***
*Primary School	---	-0.02	---	---
*Secondary School	---	-0.15 ***	---	---
*Higher than Secondary	---	-0.36 ***	---	---
*Urban	---	---	-0.12 ***	---
Mother Indicator	-0.62 ***	-0.62 ***	-0.63 ***	-6.74 ***
*Primary School (Mother's Education)	---	---	---	0.23 ***
*Secondary School (Mother's Education)	---	---	---	0.63 ***
*Post-Secondary (Mother's Education)	---	---	---	0.37 ***
*Urban Residence	---	---	---	0.73 ***
*Logged GNI	---	---	---	0.68 ***
Married Mother	0.12 ***	0.12 ***	0.12 ***	0.11 ***
Male	0.09 ***	0.09 ***	0.09 ***	0.09 ***
Minimum Age of Child in Household	0.00 ***	0.00 ***	0.00 ***	0.00 ***
Age	0.04 ***	0.04 ***	0.04 ***	0.05 ***
Year	0.02 ***	0.02 ***	0.02 ***	0.02 ***
Constant	-37.38 ***	-37.28 ***	-38.69 ***	-36.50 ***
Pseudo R2	0.13	0.13	0.13	0.16

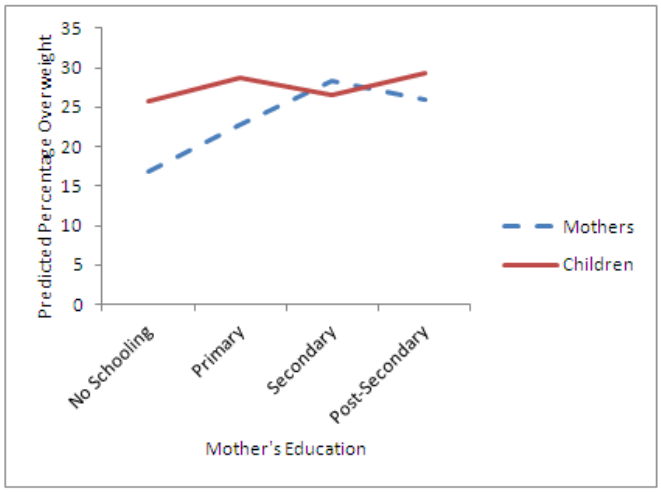
[1] Standard Errors Clustered at the Household Level

All Models are weighted

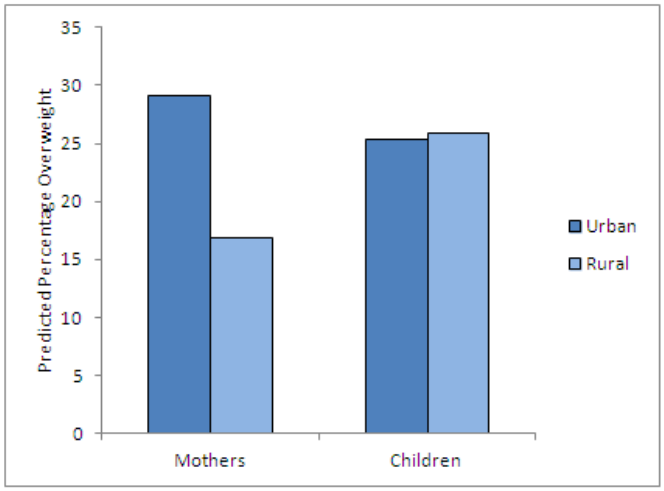
Country Level Fixed Effects are Estimated but not shown in the Table

Figure 1. Predicted Obesity Prevalence by Mother's Education, Urban Residence, and National Income, Among chlldren and mothers

A. Mother's Education



B. Urban Residence



C. National Income (GNI)

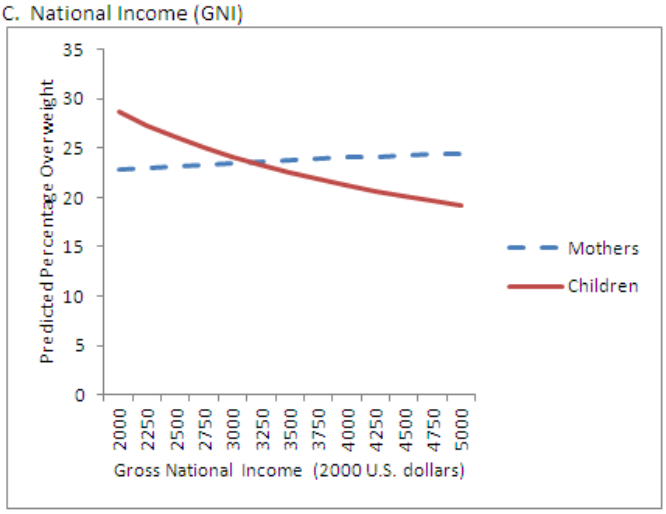
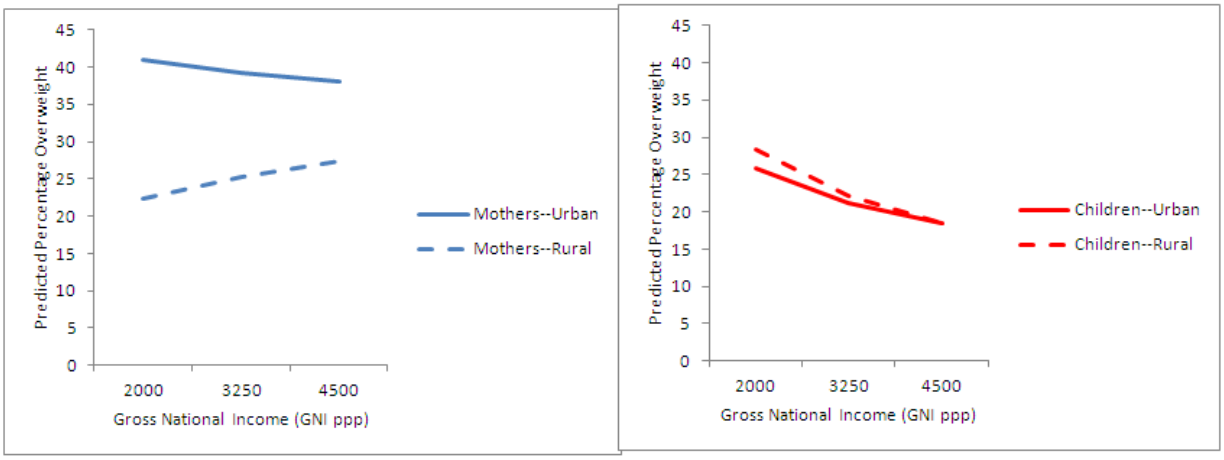
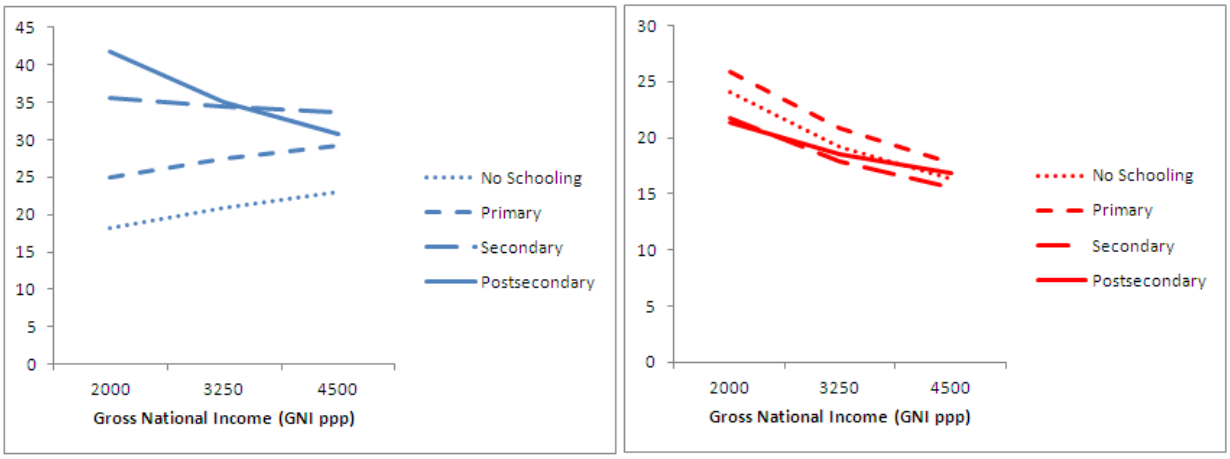


Figure 2. Moderating Effects of National Income on Urban Residence and Mother's Education, Among mothers and children

A. Urban Residence



B. Maternal Education



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