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

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Abstract

Objective—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.

Design—In this article, we evaluate how the socioeconomic and country-level factors associated with obesity differ between children and their mothers.

Setting—We analyzed 95 nationally representative health and nutrition surveys conducted between 1990 and 2008 from 33 developing countries.

Subjects—Our sample includes children aged 2 to 4 (N=253,442) and their mothers (N = 228,655).

Results—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.

Conclusions—We speculate that the distinctive patterns for children may arise from conditions in low- and 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 (1). Worldwide obesity prevalence has doubled since 1980 (2), and obesity among women in some middle-income countries like Mexico and Egypt are about as high as in the United States (1). Among preschool children (ages 0–5) in less developed countries, the prevalence of overweight and obesity[1] increased in nearly every country for which data are available (3). One group estimated that it increased worldwide from 3.7% in 1990 to 6.1% in 2010 (4). As underscored in the recent United Nations Report of the Secretary-General (5), the troubling increase in obesity in less developed countries will add to health

[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.

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” (6). This perspective is most evident in the widely cited Nutrition Transition theory (7), 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 (1). A major limitation of this work, however, is the assumption that children and adults respond to these factors in a similar manner. Although some research has focused on children, the empirical evidence linking obesity to rising national income, urbanization, and education is best established for women.

Among adults (women), prior research has shown that economic development is associated with reduced food prices, particularly of unhealthful foods, and has contributed to the rise in body weight worldwide (8). Growing urbanization encourages greater reliance on convenient packaged foods. Urban dwellers in both more 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 (9). This work further identifies educational attainment and urban residence as important moderators of the effects of economic development (10). In the early stages of the nutrition transition, obesity tends to be concentrated in urban areas and among people with higher socioeconomic status (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 (9, 11–14).

Yet, economic development and urbanization may be only weakly related to the rise in childhood obesity. Martorell and his colleagues (15) examined nutritional surveys conducted during the late 1980s and 1990s across 50 less developed countries finding a weak positive association between the prevalence of child overweight and Gross National Product (GNP) ($r = 0.28$). 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). A systematic review of the literature on trends in childhood obesity prevalence across 42 countries suggested that the largest increases occurred within economically developed and urbanized countries (3). However, apart from the Martorell et al. study (15) (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 in less developed countries.

Like adult obesity, education is clearly an important predictor of child obesity in less developed countries. For example, Martorell et al. (15) 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 (16), India (17), China (18), and Mexico (19), overweight and obesity remain more prevalent among children with higher educated mothers than less educated mothers. One possible exception

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may be in Brazil, where most research finds no relationship between maternal education and child weight (20).

These findings suggest that child obesity may not correspond with the same macro-level factors as adult obesity. In this article, we evaluate how the socioeconomic and country-level factors associated with obesity differ between children and their mothers. We use 95 surveys from 33 less developed countries to model the likelihood of overweight for preschool children (ages 2–4) and their non-pregnant mothers. By comparing children with their mothers, we ensure that the community and home environments of the children and adults in our sample are identical, thus allowing us to focus on how children and women respond differently to urbanization and economic development.

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.

We were interested in assessing change in the prevalence of overweight within countries. To be included in the analytic sample, therefore, 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 treated as having been conducted in the earlier year.

There are two analytic data files. The child file contains a record for each child in the 95 surveys, with mothers' information attached to each child record. The mother file contains a record for each mother of the children in the child file. Both files are restricted to countries with information on child and mother's measured height and weight. Pregnant women and their children are dropped from the samples due to the confounding between BMI and pregnancy. We restrict all analysis to children (and their mothers with children) between the ages of 2 and 4 because of the difficulties assessing overweight for younger children. Only cases with complete information on the dependent and independent variables were used in the analysis. The final analytic samples include 253,442 children and 228,655 mothers.

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

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body mass index (BMI = kg/m^2). For children and mothers younger than 20, we used the *zanthro* program in Stata 11.0 to convert BMI to percentile BMI based on CDC growth charts which are standardized based on age and sex (21). Weight assessments based on the CDC and International Task Force on Obesity measures are highly correlated (22). Children with a percentile BMI score at or above the 85th 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 (GNI), converted to 2000 U.S. constant prices and adjusted for purchasing power parity. As in prior research, we use country-specific urban-rural designations from the DHS, MxFLS, and CHNS. The variability in measurement of urbanicity across countries is a limitation of our data, but standard practice in cross-national research with DHS data (15). 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 (in years) 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.

Analysis

We first used the child and mother files 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. Changes in prevalence over time were evaluated for statistical significance with t-tests.

We next estimated multivariate logistic regression models predicting the likelihood of overweight. We were chiefly interested in the association of economic development (GNI), maternal education, and urban residence with overweight. We pooled the mother-child files (N=482,097) to assess whether associations differed significantly between children and their mothers by testing interactions between the independent variables and a "mother indicator" (1=mother record/ 0=child record). When we found significant differences between children and mothers, we estimated separate models for mothers (based on the mother file) and children (based on the child file). We were also interested in whether the relation between economic development and overweight varied by maternal education and urban residence. We tested two-way interactions between education or urban residence and economic development in the separate child and mother models. In supplementary analyses of the pooled mother-child file, we also assessed whether these two-way interaction effects differed significantly between mothers and children by testing three-way interactions among the "mother indicator", economic development, and urban residence or education.

To help interpret the multivariate results, we present the predicted percentage overweight by varying levels of gross national income, maternal education, and urban/rural residence for mothers and children, while setting all other variables equal to their mean values.

All models included fixed effects for country of residence (i.e., a dummy variable for each country). By estimating models with country-level fixed effects, we hold constant the non-time-changing (and slowly-changing) characteristics of countries and their populations (e.g., geography and genetics) (23). Thus the estimated coefficient for GNI (which changes over time within countries) gives the association of within-country changes in GNI with changes in overweight. In supplementary analyses, we further used the pooled mother-child sample to estimate household-level fixed effects models:

$$W_{ih}=a+B_1(M_{ih}{}^{*}GNI_h)+B_2(M_{ih}{}^{*}Ed_h)+B_3(M_{ih}{}^{*}Urban_h)+e_h \quad \text{(eq. 1)}$$

where W_{ih} is person i’s weight status (overweight=1) in household h, M_{ih} is a dummy variable indicating the person is a mother, GNI_h, Ed_h, and $Urban_h$ indicate Gross National Income, Maternal Education, and Urban residence, and e_h is a household-level error term. B_1, B_2, and B_3 provide estimates of the *difference* in the effects of effects of Gross National Income, Maternal Education, and Urban residence between mothers and their children, net of the effects of the shared environment of mothers and their children (these models cannot estimate main effects for these variables because they do not vary within households).

Except for the household fixed effects models, all 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 distinguished among three levels of statistical significance: $p < .05$, $p < .01$, and $p < .001$.

Results

Table 1 presents the weighted sample descriptives for the child and mother samples. Mothers are more likely to be overweight than their children (28.6% versus 20.8%). 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 is about 3 years for children 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 most recent 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 the sample countries mothers have a higher prevalence of overweight in both time points compared to children. Unlike children, mothers tend to experience larger gains in overweight prevalence between the earliest and latest surveys.

Having established the dissimilar patterns in overweight for mothers and children within countries over time, we turn to the multivariate analysis. Using a file which pools the mother and child files together, we first assessed whether the associations of economic development, urban residence and maternal education with overweight differed significantly

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

between children and their mothers. They did. All three interactions between these factors and a "mother indicator" were highly significant (p = .000, .000, and .000, respectively). We therefore estimated and presented separate models for mothers and children.

As shown in Table 3 and depicted as predicted percentages in Figure 1, maternal education, urban residence, and GNI were significantly and positively associated with overweight among mothers, consistent with prior research on less developed countries. But these patterns did not operate in the same direction for children. Maternal education was not significantly associated with the likelihood of children being overweight. Also, children living in urban areas were about 5% less likely to be overweight than rural children, while urban mothers were twice as likely to be overweight as rural mothers. Finally, a ten percent increase in GNI was associated with a 9% decline (B = −.89; $\exp^{(-.89*.10)} - 1 = -.09$) in the likelihood of overweight for children, but a 6% increase (B = .57; $\exp^{(.57*.10)} - 1 = .06$) for mothers. Independent of changes in education, urban residence, and GNI, the likelihood of overweight increased for both children and their mothers over time. Each additional year in time was associated with a 2% increase in the odds of being overweight among children and a 1% increase among mothers.

We next tested whether the association between economic development and overweight varied by maternal education and urban residence (models available upon request). It did. In separate mother and child models, the interactions between economic development and maternal education and between economic development and urban residence were highly significant for mothers (p=.000 and p=.000) and children (p=.000 and p=.000). Additionally, we assessed whether these two-way interaction effects differed significantly between mothers and children. Using the pooled mother-child file, we 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. Both three-way interaction effects were highly significant (p=.000; p = .000).

Because children and mothers differed significantly, we used the results of the separate child and mother models to generate predicted percentages overweight (Figure 2). Among mothers, the association between national income and the risk of overweight increased the most among those with the lowest levels of education and among those living in rural areas. Among children, however, the risk of overweight declined as national income increases regardless of maternal education or urban residence.

We conducted supplementary analyses to test the robustness of our findings. We tested multivariate models that included a control for the duration of time the child was breastfed and duration of breastfeeding for the mother's most recent birth. We had not included these variables in the other models because not all countries collected information about breastfeeding. The coefficients, while significant, did not significantly or substantively change the results. We additionally tested models separately for the youngest (age 2) and oldest (age 4) children in the sample. The results (available from author) are consistent regardless of the age of the child.

Finally, we wondered whether children and mothers differ in their responses to GNI, maternal education, and urban residence because they tend to live in different types of households. For example, children may tend to live in larger, higher-fertility households than mothers. We therefore estimated household fixed effects models to control for all unmeasured characteristics of the household and community environment shared by mothers and their children. Consistent with the other findings presented here, the household-fixed effects models showed that the associations of GNI, maternal education, and urban residence were significantly stronger and more positive for mothers than their own children[3].

Discussion

It is well established that developed countries face a significant obesity epidemic, and recent estimates suggest that less developed countries are now 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 direction for children as it does for mothers, at least in our sample of less developed countries. 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 among children, we find weak associations of maternal education and urban residence with overweight, and a negative association between national income and overweight negative regardless of maternal education or urbanicity. It may be that other worldwide changes influence children's body weight in developing countries (e.g., advances in technology, exposure to media and advertising, availability of processed food products). We were unable to examine or control for these factors within the limitations of our data. However, our analysis controlled for calendar year. Thus, the effects of GNI, education, and urban residence were estimated net of time period and the associated global changes that may be affecting all countries.

This raises the possibility that rapidly changing dietary environments in developing regions may impact children in different ways than it does adults (24). The nutrition transition model assumes that diets converge such that locally grown traditional foods are replaced by high-calorie, low-nutrient foods (25). However, there is some evidence that the shift in diets may occur differently between and within groups (11). For example, Leatherman and colleagues (26) 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 (27), 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 (28, 29).

We further speculate that income increases at the national level may be associated with worse 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 (30), yet only 38% of 0 to 5 year old children in developing

[3]The coefficient for the interaction between the mother indicator and urban residence was 0.22 (p-value=0.000); the interaction between the mother indicator and economic development was 0.16 (p-value=0.000); the interaction between the mother indicator and primary school was 0.07 (p-value=0.000), secondary school was 0.23 (p-value=0.000), and post-secondary school was 0.25 (p-value=0.01).

countries are exclusively breastfed (31). Increases in maternal labor force participation in developing countries are typically accompanied by reductions in breastfeeding and an increased reliance on processed foods. Although our results did not change after we controlled for the duration of breastfeeding, this underexplored factor remains a possible explanation for the distinctive patterns we observe for children, particularly for children of employed mothers.

Apart from children's diets, reductions in occupational physical activity (PA) among mothers but not children may help to explain why the prevalence of overweight among mothers (but not children) increases with increases in national income. Increases in national income are associated with reductions in PA due to the mechanization of labor and transportation (32). Research from China suggests that decreases in PA, especially work-related activity, are associated with increases in BMI for adults, particularly in urban areas (33, 34). Infectious disease may also help explain the findings. Uneven economic development may increase access to a continuous supply of energy-dense foods, but may also increase crowding and poor water sanitation. Children are particularly susceptible to intestinal illnesses, and these illnesses make it difficult for the body to absorb nutrients from food (35). In contexts with high levels of intestinal disease, children may be less able to gain weight than adults, even if they consume similar amounts of food.

Finally, we note that 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.

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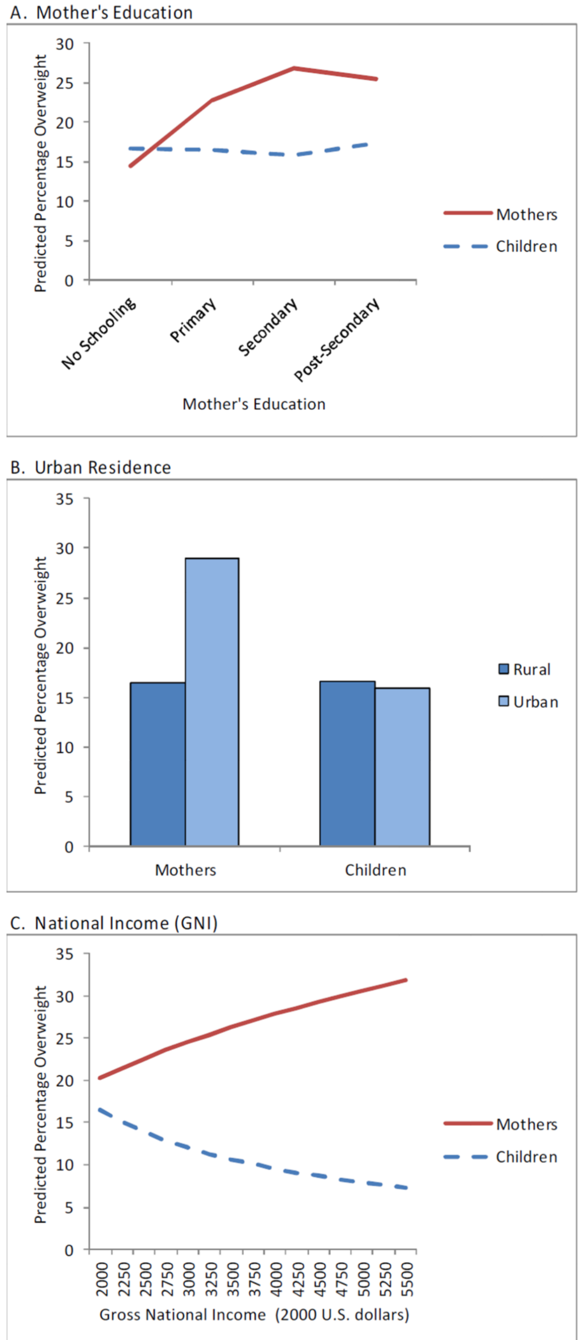

Figure 1.

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

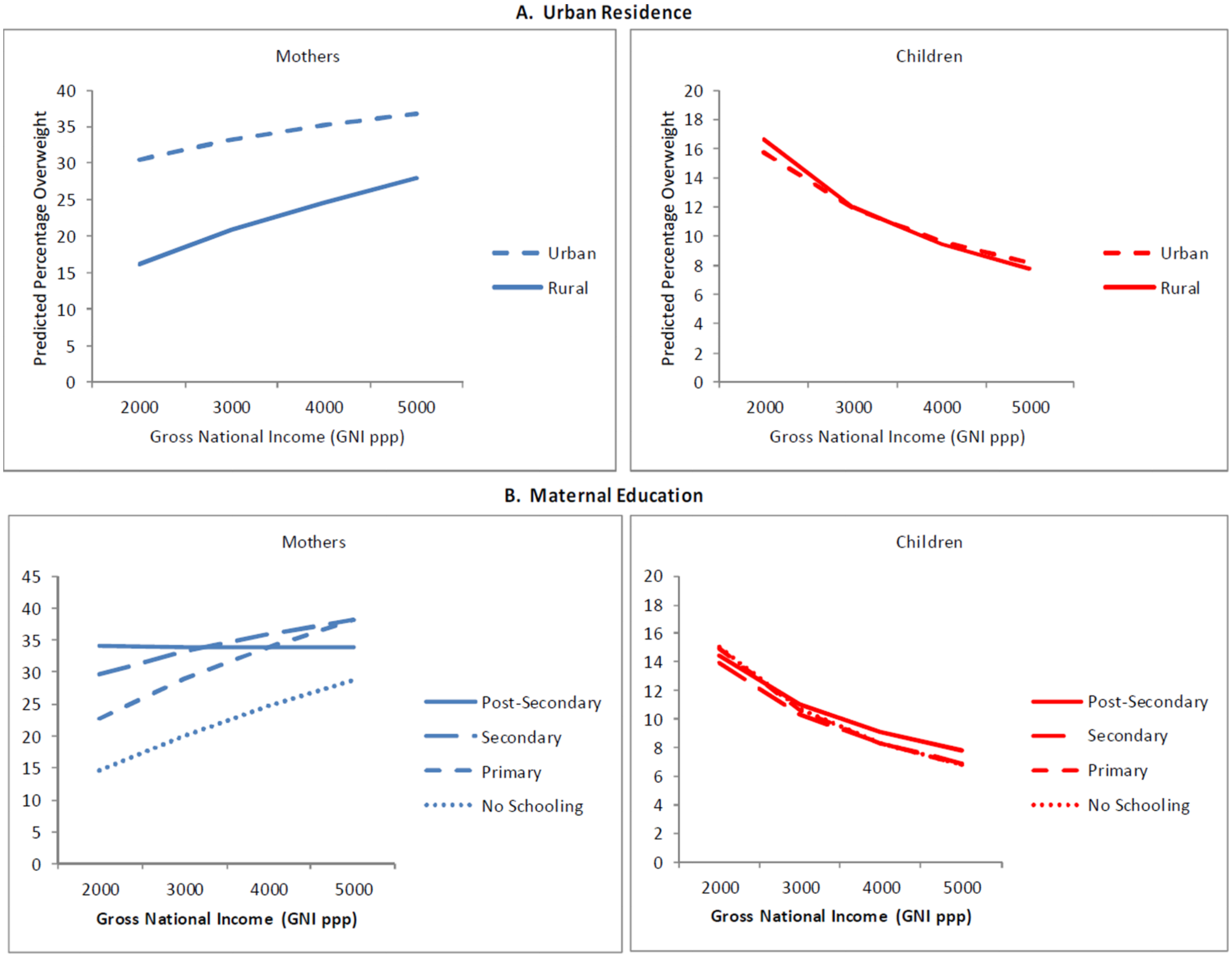

Figure 2.

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

Table 1

Weighted Sample Descriptives

	Children		Mothers	
	Mean or %	**SE(B)**	**Mean or %**	**SE(B)**
Overweight[1]	20.77%		28.57%	
Mother's Education				
No Schooling	36.23%		36.33%	
Primary	33.01%		32.79%	
Secondary	24.95%		25.00%	
Higher than Secondary	5.81%		5.88%	
Child is Male	50.87%			
Age	2.96	0.00	29.73	0.02
Minimum Age of Child in Household in Months	38.71	0.02	39.50	0.03
Married Mother	79.16%		78.91%	
Urban Residence	36.25%		36.32%	
Log of Gross National Income[2]	7.61	0.00	7.60	0.01
Year	2001.37	0.01	2001.37	0.01
Sample Size	253,442		228,655	

Source: Demographic and Health Surveys; Mexican Family Life Survey; China Health and Nutrition Survey.

Sample: Children aged 2 to 4 and their mothers in 33 less developed countries betweeen 1990 and 2008.

Countries had a minimum of 2 surveys at least 3 years apart with the most recent survey in the 2000s.

[1] Child Overweight is based on CDC age and sex standardized growth charts. A percentile BMI at or above the 85th percentile is coded overweight. Mother Overweight is defined as a BMI greater than or equal to 25.

[2] Gross National Income is measured per capita in 2000 U.S. contant prices and adjusted for purchasing power parity. The measure is log transformed.

Table 2

Weighted Prevalence of Overweight[1] for Earliest and Latest Survey by Country

	Children				Sample Size		Mothers				Sample Size	
	Earliest	Latest	Change		Earliest	Latest	Earliest	Latest	Change		Earliest	Latest
Latin American & Caribbean												
Peru (91; 07)	37.1	31.2	−5.9	***	3807	5656	42.1	53.4	11.3	***	3306	5252
Colombia (95; 05)	17.6	15.7	−2.0	†	2359	6490	41.2	40.8	−0.4		2085	5947
Nicaragua (98; 01)	25.0	24.0	−1.0		3672	3109	40.5	48.3	7.8	***	3158	2752
Mexico (02; 05)	20.4	21.1	0.7		1409	957	63.2	60.1	−3.1		1267	875
Haiti (94; 05)	10.4	12.3	1.9		1230	1167	11.4	22.3	10.9	***	1073	1038
Bolivia (93; 08)	24.9	33.1	8.2	***	733	4040	39.6	55.0	15.4	***	732	3639
South Asia												
India (98; 06)	8.5	4.4	−4.1	***	5986	20208	6.1	9.1	3.0	***	5966	18092
Nepal (95; 06)	7.1	3.5	−3.6	***	870	2695	1.9	7.4	5.5	***	865	2435
Bangladesh (96; 07)	5.3	2.5	−2.8	***	2033	2663	4.1	9.1	5.0	***	1905	2497
East Asia & SE Asia												
Cambodia (00; 05)	6.9	4.6	−2.3	*	1635	1822	6.6	10.0	3.4	**	1509	1654
China (00; 06)	24.5	31.0	6.5		175	168	12.4	21.1	8.7	*	170	166
Subsahara Africa												
Senegal(93; 05)	10.2	5.4	−4.8	***	1929	1162	18.0	22.4	4.4	*	1712	1053
Malawi (92; 04)	34.3	30.5	−3.8	*	1307	3434	9.2	13.6	4.4	***	1195	3197
Uganda (95; 06)	23.7	21.8	−1.9		1463	1033	10.5	15.1	4.6	**	1400	895
Tanzania (91; 04)	19.3	17.5	−1.8		2708	3204	11.5	15.0	3.5	**	2466	2860
Kenya (93; 08)	17.2	15.5	−1.7		2368	1139	13.4	23.0	9.6	***	2051	1002
Namibia (92; 07)	9.6	10.1	0.5		999	1534	22.3	28.5	6.2	**	905	1443
Burkina Faso (92; 03)	13.2	14.4	1.2		1913	3490	7.7	7.5	−0.2		1791	3297
Rwanda (00; 05)	25.2	26.9	1.7		2629	1699	14.7	12.6	−2.1	†	2344	1492
Madagascar (97; 04)	9.0	10.9	1.9		635	2103	3.9	5.2	1.3		633	1906
Mozambique (97; 03)	23.1	25.7	2.5		707	3586	10.5	12.1	1.6		703	3305
Cameroon (98; 04)	25.2	28.7	3.5		396	1350	21.4	26.1	4.7	†	389	1201
Mali (95; 06)	9.5	13.1	3.6	**	880	4432	11.1	17.0	5.9	***	879	4003

	Children				Sample Size		Mothers				Sample Size	
	Earliest	Latest	Change		Earliest	Latest	Earliest	Latest	Change		Earliest	Latest
Nigeria (03; 08)	17.9	21.8	3.9	**	1789	8053	23.5	23.5	0.0		1619	7238
Ghana (93; 08)	9.9	15.4	5.5	**	466	1147	14.1	28.4	14.3	***	460	1045
Zambia (92; 07)	19.8	25.7	5.8	***	1982	2278	16.0	16.8	0.8		1780	2059
Niger (92; 06)	7.5	14.0	6.6	***	1865	1508	8.5	14.2	5.7	***	1677	1373
Benin (96; 06)	9.6	21.6	12.1	***	509	5318	9.9	16.8	6.9	***	502	4871
North Africa, Middle East, Eastern Europe												
Armenia (00; 05)	41.1	29.2	−11.9	***	877	672	30.6	31.5	0.9		757	601
Morocco (92; 03)	29.8	26.6	−3.3	*	2236	2770	33.1	44.2	11.1	***	1958	2554
Egypt (92; 08)	39.7	40.1	0.4		3790	4531	56.9	70.9	14.0	***	3247	4067
Turkey (93; 04)	19.2	29.3	10.0	***	1591	2188	51.9	57.3	5.4	**	1425	1929
Jordan (97; 07)	12.6	22.7	10.2	***	2723	2095	61.5	60.5	−1.0		2154	1731

Source: Demographic and Health Surveys; Mexican Family Life Survey; China Health and Nutrition Survey.

Sample: Children aged 2 to 4 and their mothers in 33 less developed countries between 1990 and 2008. Countries had a minimum of 2 surveys at least 3 years apart with the most recent survey in the 2000s.

[1]Child Overweight is based on CDC age and sex standardized growth charts. A percentile BMI at or above the 85th percentile is coded overweight. Mother Overweight is defined as a BMI greater than or equal to 25.

T-tests indicate significant change:

† p<0.10;

* p<0.05;

** p<0.01;

*** p<0.001

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Table 3

Weighted Logistic Regression of Children's Overweight/Mother's overweight

	Child[1]			Mother[1]		
	Odds Ratio		CI (95%)	Odds Ratio		CI (95%)
Mother's Education (Ref=No Schooling)						
Primary	0.99		0.96–1.02	1.77	***	1.71–1.83
Secondary	0.94	**	0.91–0.98	2.21	***	2.13–2.30
Higher than Secondary	1.05		0.99–1.12	2.02	***	1.90–2.15
Urban	0.95	**	0.93–0.98	2.10	***	2.04–2.16
Log GNI	0.41	***	0.33–0.51	1.77	***	1.42–2.21
Married Mother	1.08	***	1.04–1.12	1.17	***	1.13–1.21
Child is Male	1.10	***	1.08–1.13	1.01		0.99–1.04
Minimum Age of Child in Household				1.003	***	1.002–1.005
Age	1.01		1.00–1.03	1.06	***	1.05–1.06
Year	1.02	***	1.02–1.03	1.01	**	1.00–1.02
Log pseudolikelihood	−116778.44			−115836.69		
Sample Size	253,442			228,655		

Source: Demographic and Health Surveys; Mexican Family Life Survey; China Health and Nutrition Survey.

Sample: Children aged 2 to 4 and their mothers in 33 less developed countries betweeen 1990 and 2008. Countries had a minimum of 2 surveys at least 3 years apart with the most recent survey in the 2000s.

[1]Child Overweight is based on CDC age and sex standardized growth charts. A percentile BMI at or above the 85th percentile is coded overweight. Mother Overweight is defined as a BMI greater than or equal to 25.

The models also include country level fixed effects (not shown).

P-value:

† p<0.10;

* p<0.05;

** p<0.01;

*** p<0.001