EXPLAINING CHANGE IN CHILD OVERWEIGHT IN LESS DEVELOPED COUNTRIES: A DECOMPOSITION ANALYSIS

Kelly Balistreri
Department of Sociology
Bowling Green State University

Claire Altman
Department of Sociology
The Pennsylvania State University

Jennifer Van Hook
Department of Sociology
The Pennsylvania State University

Extended Abstract

Draft: September 21, 2012

ABSTRACT

Considerable attention has focused on the rise in child overweight and obesity in developing countries. We pool eighty-seven nationally representative Demographic and Health Surveys (DHS) conducted between 1990 and 2008 from 30 developing countries and draw upon non-linear decomposition techniques to understand how much of the change in child weight between the 1990s and 2000s is due to shifts in household factors (e.g., maternal employment and education) and how much is due to shifts in country level factors of globalization and economic development while accounting for the shifting composition of regional populations. The largest contributor to the increase in child weight in less developed countries appears to be the shift in regional composition of children. Due to declines in fertility in 'thinner' regions of the world, children were more likely to live in heavier regions of Africa and the Middle East.

INTRODUCTION

In recent years, considerable attention has focused on the rise in child overweight and obesity in developing countries (de Onis 2010 et al.; Popkin 2012). Not only do nearly 35 million of the world's 42 million overweight preschool children reside in less developed countries, but in the last two decades the rates of child overweight have increased 65 percent in developing countries compared to just 48 percent in developed countries. This increase in weight is particularly problematic because many rapidly developing countries face the paradoxical co-occurrence of increasing levels of child obesity alongside the persistence of child under-nutrition and the problems associated with managing infectious disease.

The increase in weight worldwide has typically been explained through the lens of the nutrition transition theory, which relates economic development, urbanization and expansions of global food markets to increases in weight and reductions in physical activity (e.g., Popkin 2001; Popkin 2002). A major limitation of this work however is the assumption that children and adults respond to these factors in a similar manner. For example, research on adults (predominately women) has found that economic development is associated with reduced food prices and increased availability of calorically-dense nutrient-poor foods (citation) which has contributed to increased levels of obesity worldwide. Yet recent work by Van Hook et al. (2012) find evidence that economic development is negatively related to excess child weight in developing countries, challenging the idea that the factors underlying the worldwide nutrition transition operate similarly among adults and children.

It may be that globalization, characterized not just by increases in economic development but by the expansion of global forms of governance, and the increased spread of ideas and technologies (Dreher, Gaston, and Martens 2008), is associated with child weight in ways not currently anticipated under the nutrition transition theory framework. Indeed, there is some recent evidence which suggests that globalization processes related to child weight may operate differently at varying levels of development. Sub-Saharan Africa has experienced an average growth in GDP above 5% and a doubling of foreign direct investment in recent decades (Olesen and Parker 2012), yet improvements in child nutrition have stalled or even reversed. Vorster and colleagues (2011) find that non-communicable, nutrition-related diseases have emerged in sub-Saharan Africa at a faster rate and at a lower economic level than in other more developed countries. This 'double burden' of disease is occurring in the context of massive rural-urban migration, and rapid urbanization (M. Ruel, et al. 2008).

The goal of this paper is to shed further light on the relationship between globalization, economic development and child overweight. It may be that the effects of globalization on child nutrition are context dependent, operating in different ways over varying levels of economic development. For example, in contexts in which average incomes are low, the globalization of food markets and communications may *not* lead to increases in the prevalence of obesity and overweight if average income families remain too poor to purchase supermarket and convenience foods. Globalization processes may even reduce the prevalence of overweight if it is associated with shifts to cash crop agriculture, depletion of local (low-cost) food markets, and increased food insecurity. But as average incomes rise and a larger share of the population has money with which to purchase new goods and services, the infiltration of food markets with Western-style foods may quickly lead to changes in diet and increases in overweight and obesity.

We add to the literature by taking a new approach. We draw upon non-linear decomposition techniques (Fairlie 2005) to understand how much of the change in child weight between the 1990s and 2000s is due to shifts in household factors (e.g., maternal employment and education) and how much is due to shifts in country level factors of globalization and economic development while accounting for the shifting composition of regional populations.

DATA AND METHODS

Data. To construct our sample, we pool eighty-seven nationally representative Demographic and Health Surveys (DHS) conducted between 1990 and 2008 from 30 developing countries. The surveys include 1 country in East Asia and the Pacific; 2 in Europe and Central Asia; 5 in Latin America and the Caribbean; 3 in the Middle East and North Africa; 3 in the South Asia sub-continent; and 16 in Sub-Saharan Africa. The DHS survey mothers aged 15 to 49 and their children under the age of 5 to collect data on health, nutrition, and family planning practices.

To assess the contribution of globalization and economic development on changes in the prevalence of overweight within countries across the 18 year time period, we include two surveys per country. To be in the sample, a country had to have a minimum of two surveys at different points in time at least 3 years apart with one survey in the early time period from 1990 to 2000 (Time 1) and one in the late period from 2001 to 2008 (Time 2). When a survey spanned two years, the survey year is treated as being conducted in the earlier year.

A child-level file was created which included one record for each child in the 87 surveys. Mother's information is attached to each child record. We restrict the sample to countries with measured height and weight information of the child and mother. Measuring BMI is confounded by pregnancy, so mothers who are pregnant and their children are dropped from the sample. The sample is further restricted to children with complete information on the analysis variables. The final analytic sample includes 235,607 children.

Dependent variable. All of the DHS surveys have a trained interviewer measure the height and weight of the child and mother. Overweight status for children (=1) is the dichotomous dependent variable constructed using a child's body mass index (BMI = kg/m^2). BMI is converted to an age and sex standardized percentile BMI using CDC growth charts. Children are coded as overweight with a percentile BMI score at or above the 85^{th} percentile.

Independent Variables. Economic development and level of globalization are the independent variables. 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. Globalization of the children's country of residence in the year of interview was measured using the KOF Index of Globalization (Dreher, Gaston, and Martens 2008). The summary globalization index captures the economic, social, and political dimensions of globalization. The index ranges from 0 to 100, but as a point of reference the Globalization Index for the United States in 2009 was approximately 75 (http://globalization.kof.ethz.ch/query/showData).

Controls included child gender (1=male), the ages of the child (in years) and mother (in years), duration the child was breastfeed in months, marital status of the mother (1=married/0=otherwise), working status of the mother (1=currently working), the age of the youngest child in the household (in months), urban residence (1=urban), and a series of dummy indicators for world region. 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.

An asset index was constructed from the mean of the presence of the following items in a child's household: piped water, toilet facilities, finished flooring, electricity, a refrigerator, a radio or television, a bicycle, and a motorcycle or car. The level of child mortality in the children's country of residence in the year of interview was included as a control. Child mortality is measured as the number of deaths to children aged 0 to 5 per 1000 births.

Analysis. Our first step was to examine descriptive statistics on the variables in the analytic sample. The descriptive statistics are estimated separately by time period. Next, we estimated multivariate logistic regression models predicting the likelihood of overweight again separately by time period. We focus on the association between economic development (GNI) and globalization with overweight. To assess whether the association between globalization and overweight varied by level of economic development, we tested an interaction between economic development and globalization.

In the next step of the analysis, we estimated Fairlie's non-linear decomposition (2005) using the Fairlie command in STATA 12.1 (Jann 2006). This method was developed as an extension of the Blinder-Oaxaca regression decomposition method (Blinder 1973; Oaxaca 1973) for logistic regression (Fairlie 2005). Building from logistic regression models of overweight at time 1 and time 2, it estimates the share of change in the prevalence of overweight that is due to changes in the composition of each of the predictors in the model. To derive the composition effects, the method weights changes in composition by a combination of time 1 and time 2 coefficients. The results are sensitive to the order in which variables are evaluated (a result of the non-linearity of the logistic regression model). To average across possible ordering combinations and to estimate standard errors of the decomposition estimates, we averaged decomposition results across 500 randomly drawn replicate samples while randomizing the order of the variables. We will describe this method in greater detail in our final paper.

The regression models adjust for the clustering of children in the same household in each country and year. The descriptive statistics, models, and decomposition were weighted based on adjusted-population level weights. Adjusted population weights were created for each country at both Time 1 and 2 by multiplying the sample weight provided in each country-year specific DHS file by the population estimate of children aged 2 to 4 from each country at each point in time and dividing it by the sum of the sample weights within each country-year[1]. The adjusted population weights are essentially DHS sampling weights that have been weighted up to the population of children aged 2 to 4 in each country in the particular survey year.

Results

Table 1 presents the weighted means for the sample variables by Time Period. Between Time 1 and 2, overweight increased from 12 to 15 percent among children in the countries in our sample, a finding consistent with prior research on childhood obesity in developing contexts (de Onis et al. 2010). The two percent increase in overweight may be related to the age of the children or the age of the mother. For example, the age of children and mothers increased in Time 2 compared to Time 1 (41.36 months vs. 32.24 months for children and 29.18 vs. 27.47 years for mothers). Also, in Time 2 the youngest child in the household was almost 8 months older than the youngest child in Time 1 (39.29 vs. 31.64) which may indicate an increased spacing of births. However, there was little change in the other child, maternal, and household characteristics commonly used to explain increases in child overweight.

In contrast, there were large contextual changes between time periods. National income increased by 18 percentage points between Time 1 and 2. Globalization also increased by more than 6 points, from 41.89 to 48.11. Child mortality declined substantially from 100 deaths to children aged 0 to 5 per 1000 births to just over 84. Additionally, there were shifts in regional compositions largely attributable to declines in fertility in many regions of the world except for Africa and the Middle East. In Time 1, the sample is

[1] If a country has more than 2 surveys in Time 1 or 2, we average the population estimates and divide by the number of surveys in each respective time period (i.e. Time 1 and Time 2) to produce the population estimate. The population estimates come from the International Data Base at the U.S. Census Bureau http://www.census.gov/population/international/data/idb/informationGateway.php.

dominated by children residing in the South Asia Subcontinent. But by Time 2, almost equal numbers of sample children live in Sub-Saharan Africa as the South Asia Subcontinent region.

Next, we turn to multivariate analysis shown in Table 2. We run two logistic regression models for each time period. Model 1 shows that child overweight is associated with child and maternal characteristics as well as country and regional contexts for both time points. In both Time 1 and 2, child overweight is associated with younger age and earlier weaning or not having been breastfed. Children whose mother has a post-secondary level education are more likely to be overweight than children whose mother has lower levels of education in both time points. In Time 2 particularly, boys are more likely to be overweight than girls (exp 0.05=5% higher odds), having a working mother increases the likelihood of a child being overweight by almost 13 percent (exp 0.12), and children residing in rural areas are more likely than urban children to be overweight.

Economic development (GNI) is associated with child overweight in both time points, but the direction of the effect changes. In Time 1, children residing in countries with lower levels of economic development are more likely to be overweight (b= -0.30); however, in Time 2, children in higher income countries are more likely to be overweight (b= 0.18). The Globalization Index is only associated with overweight for children in Time 1 such that children in more globalized countries are more likely to be overweight. Country level child mortality is associated with overweight only in Time 1.

In order to evaluate if the association between globalization and overweight varied by level of economic development, we included an interaction between economic development and globalization for both time points. Model 2 reveals a significant interaction between GNI and the Globalization Index in both time points. In Time 1, as expected, when GNI is low, globalization is associated with lower prevalence of overweight. But when GNI is high, globalization is associated with greater prevalence. At Time 2, these associations change such that both globalization and GNI appear to be associated with overweight, perhaps because the countries in the sample have reached a certain threshold in income or globalization that reduces the ability of the regression model to pick up on the interaction. We will explore these ideas more in the final version of the paper.

The results of the decomposition are presented in Table 3. The changes in composition more than explained the overall 2.5 percentage point increase in overweight among children in less developed countries. This may mean that unobserved factors counterbalanced the compositional factors that would have—on their own—led to a very large increase in child weight. The largest contributor to the increase in child weight in less developed countries appears to be the shift in regional composition of children. Due to declines in fertility in ‘thinner’ regions of the world, children were more likely to live in heavier regions of Africa and the Middle East. Apart from regional composition, increases in national income (.60%) and child spacing (.50%) contributed to about a one percentage point increase in overweight, while increase in the age of children in the sample contributed to about .7 percentage point decline in overweight. Results from Model 2 further shows that increases in national income (lnGNI) and globalization would have led to a substantial increase in overweight (1.2 and 2.6 percentage points respectively), except that this effect was offset by declines in overweight associated with the interaction of these two factors (-3.5 percentage points), most likely this is picking up the negative effects on overweight of increases in globalization in the context of persistent and widespread low income in some parts of the world.

Table 1. Child and Country Characteristics (Means) by Time Period

	Time 1[1] (1990s)	Time2[2] (2000s)	Change
Child, Maternal & Household Characteristics			
Overweight	0.12	0.15	0.02
Male	0.53	0.52	-0.01
Age in Months	32.24	41.36	9.11
Breastfeeding duration (months)	20.47	20.21	-0.26
Mother's Education			
No Schooling	0.42	0.38	-0.04
Primary	0.24	0.29	0.05
Secondary	0.26	0.27	0.01
Beyond Secondary	0.08	0.06	-0.03
Married Mother	0.95	0.90	-0.05
Age of Mother (years)	27.47	29.18	1.72
Mother Currently Working	0.35	0.44	0.09
Minimum Age of Child in the Household (months)	31.64	39.29	7.65
Assets Index	0.47	0.49	0.02
Country & Regional Contexts			
Urban	0.30	0.36	0.06
Log of Gross National Income (GNI)	7.55	7.74	0.18
Globalization Index	41.89	48.11	6.22
Child Mortality (deaths age 0-5 per 1000 births)	100.58	84.32	-16.26
World Region			
East Asia and Pacific	0.00	0.01	0.00
East Central Asia	0.02	0.06	0.05
Latin America and Caribbean	0.02	0.03	0.01
Middle East and North Africa	0.05	0.14	0.09
South Asia Subcontinent	0.77	0.39	-0.37
Sub Saharan Africa	0.14	0.37	0.22

Source: Demographic and Health Surveys

Sample: Children aged 2 to 4 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] Sample Size at Time 1 (1990s): 107,486

[2] Sample Size at Time 2 (2000s): 128,121

Table 2. Logistic regression models of Overweight among Children in Developing Countries, by Time Period

	Model 1		Model 2	
	Time 1 (1990s)	Time 2 (2000s)	Time 1 (1990s)	Time 2 (2000s)
Child, Maternal, & Household Characteristics				
Male	0.01	0.05 **	0.01	0.05 **
Age in Months	-0.01 ***	-0.01 ***	-0.01 ***	-0.01 ***
Breastfeeding duration (months)	-0.01 +	-0.01 ***	-0.01 +	-0.01 ***
Mother's Education				
No Schooling	-0.24 +	-0.28 ***	-0.23 +	-0.28 ***
Primary	-0.27 *	-0.15 **	-0.27 *	-0.15 **
Secondary	-0.26 *	-0.17 ***	-0.25 +	-0.17 ***
Beyond Secondary	---	---	---	---
Married Mother	0.03	-0.06 +	0.04	-0.06 +
Age of Mother (years)	0.00	0.00	0.00	0.00
Mother Currently Working	-0.08	0.12 ***	-0.08	0.12 ***
Minimum Age of Child in the Household (mont	0.01 **	0.01 ***	0.01 **	0.01 ***
Assets Index	0.23	-0.11 +	0.21	-0.10 +
Country and Regional Context				
Urban	-0.12 +	-0.07 **	-0.12 +	-0.07 **
Log of GNI	-0.30 ***	0.18 ***	-0.93 ***	0.37 ***
Globalization Index	0.01 ***	0.00	-0.11 ***	0.03 *
x Log of GNI	---	---	0.02 ***	0.00 *
Child Mortality (deaths age 0-5 per 1000 births	0.001 *	0.000	0.003 ***	0.000
World Region				
East Asia and Pacific	-0.83 ***	-1.69 ***	-0.74 ***	-1.70 ***
East Central Asia	0.31 **	0.51 ***	-0.18	0.59 ***
Latin America and Caribbean	0.60 ***	0.14 **	0.48 ***	0.16 **
Middle East and North Africa	0.95 ***	0.42 ***	0.77 ***	0.44 ***
South Asia Subcontinent	-0.71 ***	-1.53 ***	-0.68 ***	-1.54 ***
Sub Saharan Africa	---	---	---	---
Constant	0.47	-2.28 ***	4.51 ***	-3.67 ***

Source: Demographic and Health Surveys

Sample: Children aged 2 to 4 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.

P-value: $^{+}$p<0.10; *p<0.05; **p<0.01; ***p<0.001

[1] Sample Size at Time 1: 107,486

[2] Sample Size at Time 2: 128,121

Standard Errors Clustered at the Household Level; All Models are weighted to population size

Table 3. Decomposition of Change in Proportion Overweight

Change in Overweight Due to Compositional Change in:	Based on Model 1	Based on Model 2
Male	0.000 +	0.000 +
Age in Months	-0.007 ***	-0.007 ***
Breastfeeding duration (months)	0.000	0.000
Mother's Education	0.000	0.000
Married Mother	0.000	0.000
Age of Mother (years)	0.000	0.000
Mother Currently Working	0.000 *	0.000
Minimum Age of Child in the Household (montl	0.005 ***	0.005 ***
Assets Index	0.000 +	0.000
Urban	-0.001 **	-0.001 *
LnGNI	0.006 ***	0.012 *
Globalization Index	-0.001	0.026 +
x LnGNI	---	-0.035 *
Child Mortality	0.000	0.000
World Region	0.063 ***	0.064 ***
Total Change in proportion Overweight	0.025	0.025
Total Explained	0.064	0.065
Unexplained	-0.040	-0.040

Source: Demographic and Health Surveys

Sample: Children aged 2 to 4 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.

P-value: †p<0.10; *p<0.05; **p<0.01; ***p<0.001

References

Blinder, A.S. 1973. "Wage Discrimination: Reduced Form and Structural Variables." Journal of Human Resources 8(Fall):436-55.

de Onis, Mercedes, Monika Blossner, and Elaine Borghi. 2010. “Global prevelance and trends of overweight and obesity among preschool children.” *American Journal of Clinical Nutrition* 92: 1257-1264.

Fairlie, Robert W. 2005. "An Extension of the Blinder-Oaxaca Decomposition Technique to Logit and Probit Models," *Journal of Economic and Social Measurement*, 30(4): 305-316.

Jann,Ben. 2006. "FAIRLIE: Stata module to generate nonlinear decomposition of binary outcome differentials," Statistical Software Components S456727, Boston College Department of Economics, revised 26 May 2008.

Oaxaca, R.L. 1973. "Male-Female Wage Differentials in Urban Labor Markets." International Eco- nomic Review 14(October):693-709.

Olesen, Ole F. and M. Iqbal Parker. 2012. “Health Research in Africa: getting priorities right.” *Tropical Medicine & International Health* 17(9): 1048-1052.

Popkin, Barry M. 2001. “The nutrition transition and obesity in the developing world.” *Journal of Nutrition* 131:871S-873S.

Popkin, Barry M. 2002. “An overview on the nutrition transition and its health implications: the Bellagio Meeting.” *Public Health Nutrition* 5:93-103.

Popkin, Barry M. 2012.

Ruel, M., J. Garrett, and L. Haddad. 2008. Rapid urbanization and the challenges of obtaining food and nutrition security (updated). In *Nutrition and health in developing countries*, ed. R. D. Semba and M. Bloem, 2d ed. Totowa, NJ: Humana Press.

Van Hook, Jennifer, Claire E. Altman, and Kelly S. Balistreri. 2012. “Global patterns in overweight among children and mothers in less developed countries.” *Public Health Nutrition*.

Vorster, Hester H., Annamarie Kruger, and Barrie M. Margetts. 2011. “The Nutrition Transition in Africa: Can It Be Steered into a More Positive Direction?” *Nutrients* 3(4): 429-441.