Published in final edited form as:

Econ Hum Biol. 2012 July ; 10(3): 232–241. doi:10.1016/j.ehb.2011.08.002.

Socioeconomic disparities and the familial coexistence of child stunting and maternal overweight in guatemala

Jounghee Lee^a, Robert F. Houser^a, Aviva Must^{a,b}, Patricia Palma de Fulladolsa^c, and Odilia I. Bermudez^{a,b,*}

Odilia I. Bermudez: odilia.bermudez@tufts.edu

^aGerald J. and Dorothy R. Friedman School of Nutrition Science and Policy, Tufts University, Boston, MA 02111, United States

^bDepartment of Public Health and Community Medicine, Tufts University, Boston, MA 02111, United States

^cRegional Food and Nutrition Security Program for Central America, Boulevard del Hipodromo No. 523, Colonia San Benito, San Salvador, El Salvador

Abstract

The double burden of malnutrition, defined here as households with a stunted child and an overweight mother (SCOM), is a growing problem in Guatemala. We explored the magnitude of SCOM and the identification of socio-economic factors associated with this malnutrition duality. From the 2000 Living Standards Measurement Study from Guatemala, we obtained a sample of 2492 households with pairs of children 6–60 months and their mothers (18–49 years) and estimated the prevalence of SCOM. Economic characteristics of this sample were assessed with the Concentration Index (CI). Results revealed higher prevalence of child stunting, but a lower prevalence of maternal overweight among the poor compared to the rich households. Economic inequality in child stunting was greater than economic inequality in maternal overweight (CI = –0.22 vs. +0.14). SCOM pairs were more prevalent among the poor and middle SES groups as compared to the rich households. A multivariate logistic regression model showed that SCOM was more likely to occur in households from the middle consumption quintile than in those from the first quintile (odds ratio = 1.7). The findings reported here add new insights into the complex phenomenon observed in households with both extremes of the malnutrition continuum, and support the need for the identification of economic, social and biological interventions aimed at, on the one hand, the prevention of this duality of the malnutrition in those households where it is still non-existent, and on the other hand, to deter or correct the economic, social and biological environments where those mother-child dyads are already affected by such phenomena.

Keywords

Guatemala; Child stunting; Maternal overweight; Malnutrition; Socio-economic inequality; Height; Obesity; Body mass index

1. Introduction

Guatemala is an ethnically diverse country with large inequalities in the nutritional status and socio-economic status (SES) of its population. With a population of about 12 million during 2002, the indigenous population, mainly of Mayan, Xinka and Garifuna ancestries, represented 41% of its total population (Pan American Health Organization, 2007). Of the 21 Mayan groups, the largest are the K'iche' (29%), Q'eqchi' (19%), and Kaqchikel (19%). The majority of the indigenous groups (68%) live in rural area in contrast with 44% of the non-indigenous who also live in rural settings (Pan American Health Organization, 2007).

As the per capita gross national income increases in Guatemala, the gap in the prevalence of overweight in women decreases between urban and rural areas (Mendez et al., 2005). Therefore, we need to know how the large gap is and pay urgent attention to the task of preventing adult overweight from rapidly affecting all SES groups in both rural and urban areas in developing countries like Guatemala. We also should continue to be aware that the opposite relationship of SES to child stunting and female overweight requires a sensible method for the examination of the socioeconomic determinants of this occurrence. Particularly if they occur simultaneously in a family, well-targeted preventive and corrective measures to protect the vulnerable population groups should be undertaken. In this paper, we aimed at the determination of the economic and geo-political distribution of SCOM in Guatemala and at the assessment of the magnitude of socio-economic inequalities in child stunting, maternal overweight and SCOM in this country. Because rural residency, poverty and economic disparities are higher in child stunting than in maternal overweight, we hypothesized that these factors are associated with a higher prevalence of SCOM.

In Guatemala, prevalence of malnutrition in children ranks among the highest in Latin America, with 49% of stunting and 23% of low weight for age in children under 5 years of age in 2002 (UNICEF, 2009). Adult over-nutrition, particularly overweight in women, is also highly prevalent, with about 49% of women of 20 and above years of age classified as either overweight or obese (Marini and Gragnolati, 2003; Lee et al., 2010), based on body mass index (BMI) equal or higher than 25 (BMI equal or above 30 is the cut off for obesity).

Child stunting and maternal overweight are important because they can result in negative health consequences. Adult obesity and child stunting contribute to the burden of poor health because obese adults are more likely to develop chronic diseases, such as cardiovascular disease, type-2 diabetes, osteoarthritis, and certain types of cancer (Must et al., 1999). In addition, child stunting, which is a known indicator of faltering cumulative linear growth, has been associated with poor cognitive function and obesity in later childhood (Berkman et al., 2002; Sawaya and Roberts, 2003). When considering the negative health effects, dual burden households of malnutrition demand particular attention.

Guatemala has the highest prevalence (16%) of the coexistence of child under-nutrition and maternal overweight in Latin America, based on a published report from Garrett and Ruel (2005). The study showed that in six out of eight Latin American countries, including Guatemala, the prevalence of SCOM pairs was higher in rural areas than in urban areas. Child stunting is more prevalent in rural than in urban areas, while the prevalence of women overweight is higher in urban areas than in rural areas (Marini and Gragnolati, 2003). Between 1995 and 2003, maternal overweight increased from 35% to 49%. These increases were more dramatic in the proportion of obese women, which doubled from 8% to 16%, while prevalence of only overweight went up 24 percentage points (Marini and Gragnolati, 2003).

The presence of those nutrition problems are due to more than one set of causal factors (e.g., income distribution, changes in traditional food patterns and changes in amount and

intensity of physical activity) and that the nature of the situation is complex and most likely multi-directional. However, the association between malnutrition and SES in the Guatemalan population is strong but runs in opposite directions between SES and child stunting (lower SES, more stunting) and SES and maternal overweight (lower SES, less overweight) (Marini and Gragnolati, 2003). As developing countries undergo their nutrition transitions, the prevalence of adult obesity initially rises in households with higher socioeconomic status (SES), but then it rapidly affects households with low SES (Eckel et al., 2004; Monteiro et al., 2004; Custodio et al., 2010), and Guatemala is not escaping from this trend.

2. Methods

We used a cross-sectional, nationally representative dataset from the Guatemalan Living Standards Measurement Survey (LSMS) collected in 2000 (World Bank, 2006). The LSMS survey employed the same cartographic sectors used by the Guatemalan population census of 1994 and followed the methodology developed by the World Bank (World Bank, 2006). A complex survey design was applied in the LSMS to complete a nationally representative sample of 7276 households and 37,771 household members. To use this dataset for the secondary analysis reported here, we obtained exempt status from the Tufts Medical Center/ Tufts University Institutional Review Board (Table 1).

2.1. Sample selection

Children 6–60 months of age, of either sex, living with their mothers in the same household were selected for this study, for which we followed the methodology and selection criteria applied by Garrett and Ruel (2005). Children less than 6 months of age were excluded because we could not control for one of the main contributing factors, low birth weight, associated with stunting in early childhood. We initially identified a total group of 5214 children in the established age range. We excluded children living without a mother ($n = 160$) or with two pairings of children and mother in multi-family households ($n = 365$). We also excluded 253 children without acceptable values for the anthropometric measures needed to estimate the indicator for stunting, height for age. In households with two or more children 6–60 months of age, we randomly selected one child and his/her mother to end with a group of 3112 children.

Excluded were 330 pregnant women and 156 women in postpartum that delivered less than three months prior to the measurements. Fifty-three had incomplete anthropometric information, while another group of women ($n = 59$) were excluded due to their age, which fell outside the inclusion range (18–49 years). Another group ($n = 19$) was excluded due to having maternal BMI outliers (<6.2 or >42.6 BMI) or with missing information on maternal education ($n = 3$) (Larson, 2006; Lee et al., 2010). From the original 7276 households, we obtained a final sample of 2492 households of the child and mother pairs for this study.

2.2. Child malnutrition

We used the nutrition indicator height-for-age, expressed as Z scores (HAZ), to define child malnutrition. Children with short stature below 2 standard deviations (SD) from the mean of the reference population were classified as stunted. Those at or higher than 2.0 SD were not stunted or of normal length of height. The sample was processed with the WHO Anthro 2005 software program (World Health Organization, 2005), which compared anthropometric values from our sample with the WHO international reference group. The Anthro program flagged cases with incomplete or implausible data. We used this information to inform our sample selection, as detailed in the previous section.

2.3. Maternal malnutrition

Maternal BMI outliers were identified if BMI was $< \text{first quartile} - 3 \times (\text{the inter-quartile range: IQR})$ or $> \text{third quartile} + 3 \times \text{IQR}$ (Larson, 2006). The inter-quartile range for maternal BMI was calculated to be 5.2 by subtracting the first quartile from the third quartile (27.0–21.8); maternal BMI outliers were < 6.2 and > 42.6 .

2.4. Measurement of SCOM households

We determined SCOM if there were a stunted child ($\text{HAZ} < -2$) and an overweight mother ($\text{BMI} \geq 25$) in the same household. The study sample of households with child/mother pairs were categorized as one if the condition was satisfied (stunted child + overweight mother). Otherwise, pairs of child/mother were set to zero.

2.5. Measures of socioeconomic status

2.5.1. Total household consumption per capita of food and non-food items—

The Guatemala National Institute of Statistics estimated total annual household consumption per capita (World Bank, 2003). Household consumption included these seven categories: food, consumer goods and services, household services, housing, durable goods, health, and education. Because the cost of living is different by regions, household consumption was adjusted by the respective regional price index (estimated range 0.99–1.07) using comparison of the Guatemalan city level (the geographical price index = 1). The value of total household consumption adjusted by regional differences was divided by total number of household members to obtain total household consumption per capita. We used total household consumption per capita instead of per adult equivalent because the classification of the category did not change considerably. Employing total household consumption per capita and per adult equivalent by quintiles and by deciles, 100% and 99% of population were in the same or neighboring category, respectively (World Bank, 2003).

2.6. Household and maternal factors

Guatemala was divided into eight geo-political regions as follows: Metropolitan, North, Northeast, Southeast, Central, Southwest, Northwest and Peten. Area of residence was assigned as urban or rural. The level of the mother's education was grouped into three categories (no education; preparatory or primary education; secondary or higher education). Maternal ethnicity was classified as indigenous or non-indigenous, based on the self-identification of the mothers. Those that reported belonging to an indigenous group were either Mayan (Kiche, Qeqchi, Kaqchikel, Mam, and other Mayan) or a non-Mayan (Garifuna and Xinka).

2.7. Measures of nutrition disparities

To explain nutrition inequality, the relative concentration index has been recently employed as a useful tool. Several researchers have used the relative concentration index (RCI) to quantify the magnitude of nutrition inequality of specific disease, obesity and child malnutrition (Zere and McIntyre, 2003; Zhang and Wang, 2004). The RCI has three characteristics which are appropriate for measuring nutrition inequalities (Wagstaff et al., 1991). First, it allows us to investigate the magnitude of nutrition inequality across socioeconomic status; second, it reflects the distribution of poor nutrition in the total population as opposed to a simple comparison of a few groups (e.g., the poorest vs. the richest); and third, it can sensitively detect change of poor-nutrition as the economic status of subjects change in the entire population.

Because the exploratory nature of our study, we decided to assess nutrition inequalities with both indices: RCI and ACI, plus a third indicator, the Index of Disparity. For the

construction of those indices, we define rates or prevalence of malnutrition as child stunting, maternal overweight or SCOM.

Relative Concentration Index (RCI)—Relative concentration indices provide the relative magnitude of nutrition inequality across economic groups. RCI is defined as twice the area between the 45° line and the concentration curve (Harper and Lynch, 2006a,b). The relative concentration curve plots the cumulative proportion of malnutrition against cumulative proportion of population ranked by economic status from the poorest to the richest. The formula for the RCI is:

$$RCI = \frac{2}{N \cdot \mu} \sum_{i=1}^n x_i r_i - 1 = 1 - 2 \int_0^1 L(x) dx$$

where N is the total number of individuals in the population; $\mu = (1/N) \sum_{i=1}^n x_i$ is the prevalence rate of malnutrition in the population; x_i is the malnutrition status of the i th individual; r_i is the relative rank of the i th individual in the living standards distribution; $L(x)$ is the concentration curve.

Absolute Concentration Index (ACI)—Absolute concentration indices present the absolute magnitude of nutrition inequality across economic groups (Clarke et al., 2002; Konings et al., 2010). This is calculated as the relative concentration multiplied by total prevalence rate as follows:

$$ACI = \mu \cdot RCI = 2cov(m, r)$$

Where $\mu = (1/N) \sum_{i=1}^n x_i$ is the prevalence rate of malnutrition in the population; RCI is the relative concentration index; m is the malnutrition status of the i th individual; r is the relative rank of the i th individual in the living standards distribution; cov is the covariance.

Index of disparity (ID)—The index of disparity shows disparities among groups in relative terms by estimating the average deviation of the prevalence of malnutrition compared to the lowest prevalence in the reference group (Percy and Keppel, 2002; Harper and Lynch, 2006a,b; Harper et al., 2008; Singh et al., 2008). As indicated earlier, for this study, we used child stunting, maternal overweight and SCOM as malnutrition indicators. Therefore, we used the index of disparity to represent nutrition disparities for child stunting, maternal overweight and SCOM if there were more than two levels in the exposure variable of interest (such as geographical regions and maternal education levels) within the population. We applied the following formula to estimate the ID:

$$ID = \frac{\left(\sum_{i=1}^{J-1} |m_i - m_{ref}| / J \right)}{m_{ref}} \times 100$$

where m_i is the measure of nutrition status in the i th group; m_{ref} is the nutrition status indicator in the reference group; J is the number of groups.

Percent difference—To measure disparity between two groups, we used absolute percent difference and relative percent difference.

2.8. Statistical analysis

All statistical analyses were done with weighted data, which was adjusted for the complex survey design applied to the LSMS.¹

Underweight mothers were excluded from the analysis as this group was too small to provide meaningful information and to have cleaner comparison groups: overweight vs. normal weight mothers. Urban residence was used in the models as a dichotomous variable with reference to the rural residence group. Age in mothers was treated as a categorical variable. In addition, ethnicity of mothers (indigenous/non-indigenous) was entered into the models as a dichotomous variable, with reference to the non-indigenous mother group. We used multivariate logistic regressions to determine associations of socioeconomic and geographic factors with child stunting, maternal overweight and SCOM pairs after controlling for the mother's age and the child's age.

A standard error for the concentration indices was computed by using the delta method and the standard error was adjusted for within-cluster correlation (O'Donnell et al., 2007). This standard error indicates whether the concentration index has a statistical difference in nutrition inequality. The equations for the standard errors of the RCI and the ACI were:

$$\text{RCI} : 2\sigma_r^2 \left(\frac{\chi_i}{\mu} \right) = \beta_0 + \beta_1 r_i + \varepsilon_i$$

$$\text{ACI} : 2\sigma_r^2 (\chi_i) = \beta_0 + \beta_1 r_i + \varepsilon_i$$

where σ_r^2 is the variance of the fractional rank; χ_i is the weighted average level of malnutrition in the i th income group; $\mu = (1/N) \sum_{i=1}^n x_i$ is the prevalence rate of malnutrition in the population; β_1 is an estimate of the concentration index; r_i is the relative rank of the i th income group.

To identify household socioeconomic characteristics associated with the prevalence of child stunting, maternal overweight, and familial coexistence of maternal overweight and child stunting, we reported adjusted odds ratios (OR) and the 95% CI (confidence interval) for each factor employing multivariate logistic regression.

3. Results

3.1. Characteristics of children, mothers and households

The prevalence of child stunting reached 47.3% in our study sample. Overall, 42.2% of mothers were overweight. About two thirds of child and mother pairs resided in rural areas. At the household level, close to 17% of child and mother pairs consisted of a stunted child and an overweight mother.

¹Data management was performed with the statistical software SPSS version 16.00 (SPSS Inc., Chicago, IL). Additionally, data analyses were carried out using Intercooled STATA version 10 (StataCorp, College Station, TX).

3.2. Child stunting, maternal overweight and occurrence of SCOM pairs by total household consumption per capita

Child stunting was negatively associated with higher household economic status, while maternal overweight was positively related to higher economic status (Fig. 1). The prevalence of child stunting dropped substantially from the lowest to the highest quintile group. However, the absolute difference in the prevalence was less pronounced for maternal overweight between the first and fifth quintile group. The prevalence of SCOM pairs associated with household economic status had an inverted U shape, showing the highest prevalence in the middle economic quintile group.

3.3. Concentration curves of child stunting, maternal overweight and SCOM

The relative concentration curves of child stunting and maternal overweight were in the opposite directions; the relative concentration curve of child stunting was above the egalitarian line (45° line), while the curve of maternal overweight was below the egalitarian line (Fig. 2). However, although in opposite directions, we observed that the concentration curves for child stunting and maternal overweight were similar, almost at the same distance from the egalitarian line at the bottom 40% of the socioeconomic distribution. We observed that SCOM resulted from those two off-setting functions. Relative concentration indices indicated that there were statistically significant economic inequalities in child stunting ($p < 0.001$), maternal overweight ($p < 0.001$) and SCOM pairs ($p < 0.05$) (Fig. 2). Moreover, as seen in Fig. 2, absolute concentration indices demonstrated that there were statistically significant economic inequalities in child stunting ($RCI = -0.22 \pm 0.02$; 95% CI = -0.25 to -0.19 ; $p < 0.001$), maternal overweight ($RCI = 0.14 \pm 0.02$; 95% CI = 0.11 – 0.18 ; $p < 0.001$) and SCOM pairs ($RCI = -0.082 \pm 0.032$; 95% CI = -0.144 to -0.020 ; $p < 0.05$). However, the area between the relative concentration curve and the line of equality showed that the magnitude of economic inequality in child stunting was greater than that for maternal overweight.

Additionally, the degree of economic inequality in the absolute concentration curve was higher in child stunting ($ACI = -0.11 \pm 0.01$; 95% CI = -0.12 to -0.09) compared to that in maternal overweight ($ACI = 0.06 \pm 0.01$; 95% CI = 0.05 – 0.08) (Fig. 3). Due to the very high concentration of child stunting among the poor, both the relative concentration and absolute concentration for SCOM households placed above the egalitarian line.

3.4. Socio-demographic and regional disparities in child stunting, maternal overweight and SCOM pairs

Regional disparity index was 63.3 for child stunting and 39.8 for maternal overweight. Moreover, the index of disparity by mother's education reached 124.3 for child stunting and 26.3 for maternal overweight (Table 2).

SCOM households were more prevalent in rural areas because there were substantially greater urban-rural disparities in child stunting than in maternal overweight (absolute difference = 25.3% vs. 10.9%, relative difference = 28.5% vs. 12.6%) (Table 2). Additionally, SCOM pairs were more prevalent in households with indigenous mothers because indigenouness disparities were higher in child stunting than in maternal overweight (absolute difference = 32.6% vs. 12.9%, relative difference = 32.4% vs. 15.8%).

3.5. Socioeconomic factors associated with child stunting, maternal overweight and SCOM

After adjusting for socioeconomic and demographic factors, maternal overweight was significantly associated with high total household's consumption per capita and with indigenous mothers (Table 3). Additionally, the SCOM pairs were 1.74 times more likely in the middle quintile group of total household consumption than in the first quintile group

(adjusted OR = 1.74; 95% CI = 1.13–2.67) in a multivariate logistic regression adjusted by area of residence, regions, child age, maternal age, maternal education and ethnicity of the mothers (Table 3).

4. Discussion

The above findings underscore the complexities of the relationships between SES and nutritional status of populations from countries like Guatemala, which are in the middle of rapidly occurring economic, demographic and nutritional transitions. Although child stunting affected primarily those in the poorer segments of the economic wealth distribution and maternal overweight affected women in the upper quintiles, households that were in the middle appear to be more vulnerable to the dual burden of malnutrition, as it was there where the two phenomena interconnected more. This finding clearly indicated that lack of access to food geared to the satisfaction of dietary energy is not necessarily the main determinant of the existence of SCOM households (defined previously as households with a stunted child and an overweight mother), as mothers seemed to be exceeding their energy intakes, but not their children. Social and cultural issues related to how families perceive the nutritional needs of their members and the norms for intra-family food distribution are particularly useful to be investigated. Pressing is also the need to discriminate more in depth the dynamics of the household's economy in order to learn which are the other needs that, at the household level, take precedence over the nutritional needs of their children. The double burden of malnutrition requires prompt and effective strategies for addressing it and for avoiding what is already a third level of burden: overweight in stunted children, as it has already occurring in other countries like China, Russia and South Africa (Popkin et al., 1996) as well in Equatorial Guinea (Custodio et al., 2010).

Living in rural areas, having an indigenous mother, and lower economic level were associated with a higher prevalence of child stunting; urban residency, non-indigenous mother, and higher economic status were associated with a higher prevalence of maternal overweight. Socioeconomic and geographic disparities in child stunting were higher than in maternal overweight. The prevalence of SCOM was significantly associated with rural residency, indigenous mothers, and relatively low economic status. After adjustment for confounding factors, households in the middle-consumption quintile were more affected by the presence of SCOM than those in the lowest quintile.

However, despite the valuable characteristics of the RCI (Relative Concentration Index), it has some limitations. For example, this index cannot be compared when the nutrition outcome variable is dichotomous (Zhang and Wang, 2007). The mean of binary nutritional status determines the possible range of scores of the RCI. The range of the relative concentration index lies between $\mu - 1$ and $1 - \mu$, where μ is the prevalence rate of the nutrition outcome variable. As the prevalence rate increases, the possible range of the RCI diminishes (Wagstaff, 2005). Thus, one could be led to an erroneous conclusion because a higher prevalence of poor-nutrition tends to lower nutrition inequality in cases where the prevalence rates of two nutrition outcomes are substantially different. Without this acknowledged limitation, researchers have employed only the RCI in most studies. In their analysis of SES inequalities in rates of overweight in US children, Zhang and Wang (2007) argued that we should focus on all overweight US adolescents regardless of their socioeconomic status because the RCI decreased between the early 1990s and the early 2000s (Zhang and Wang, 2007). However, this could be a misleading conclusion because the possible score range of the RCI also decreased due to the increased prevalence of overweight adolescents over the same time period. To overcome misinterpretation of nutrition inequality using the RCI, Wagstaff (2005) suggests an alternate method, called the absolute concentration index (ACI), derived by normalizing the RCI (Wagstaff, 2005).

However, we also acknowledge that ACI may be insensitive to the changes in the distributions of malnutrition (Erreygers, 2009).

Previous publication already reported the high prevalence of SCOM in Guatemala (Lee et al., 2010). In addition, another study showed similar prevalence of child stunting, maternal overweight and SCOM pairs compared to our current findings. Using data from the 2000 Demographic Health Survey (DHS) in Guatemala, Garrett and Ruel reported that 45.5% of children were stunted, 44.5% of mothers were overweight, and 16.0% of child and mother pairs contained a stunted child and an overweight mother (Garrett and Ruel, 2005). We used the WHO 2006 child growth standards to measure child nutritional status, while the DHS study used the National Center for Health Statistics (NCHS) 1978 growth references and the Centers for Disease Control and Prevention (CDC) 2000 growth charts (World Health Organization, 1979). The finding we report here indicated only a slightly higher prevalence of child stunting compared to the previous study, perhaps because of the use of the new WHO reference group. When the new WHO 2006 references are used, rather than the NCHS and CDC charts/references, it leads to a higher proportion of child stunting at all age groups (Schwarz et al., 2008) due to the fact that the WHO standards were developed more recently and with an multi-country, multi-ethnic, breast-fed, healthy cohort across different countries (de Onis et al., 2004; Borghi et al., 2006).

The finding that indigenous mothers were significantly associated with SCOM pairs deserves attention. We partially attributed this to the fact that more indigenous women have short stature compared with non-indigenous women. Statistics from the Pan American Health Organization have indicated that only 15.2% of non-indigenous women have height below 145cm compared with 47.5% of indigenous women (Pan American Health Organization, 2007). Maternal short stature may be a contributing factor to SCOM households. Short stature in adults could reflect malnutrition from maternal gestation and childhood. This may lead to obesity due to a lower fat oxidation rate, lower energy expenditure, higher susceptibility to weight gain, and impaired control of energy intake (Sawaya and Roberts, 2003). There is evidence that maternal short stature is associated with maternal obesity and child stunting (Hernandez-Diaz et al., 1999; Barquera et al., 2007). Moreover, another study shows that maternal central adiposity was significantly associated with an increased risk of child stunting (Ferreira et al., 2009). Consequently, short maternal height, reflecting early malnutrition, is suspected to be one of the most important predictors of increased risk for SCOM.

This cross-sectional study has limitations in examining the predictors of child stunting and maternal overweight because current nutritional status reflects chronic nutritional problems. If there was a major change in household socioeconomic status between the past and time of the study, we would miss important predictors regarding the familial coexistence of stunted children and overweight mothers. In short, current household socioeconomic living conditions may not fully explain the current nutritional status of these individuals. Another limitation of this cross-sectional study is that it describes only the association of household socioeconomic living condition with the familial coexistence of child stunting and maternal overweight and not the causal relationship. Additionally, the indices applied to estimate economic inequalities in this study are still imperfect (Wagstaff, 2005; Erreygers, 2009), probably not measuring well all the dimensions of those economic inequalities. We remain alert that simpler and better measurements are needed. Although there are some limitations to the study, its findings could be used for better identifying and targeting of SCOM households by nutrition intervention programs.

As Guatemala continues to advance into transitions related to nutrition and socio-economics, the double burden of malnutrition will continue to be an important problem. This

malnutrition duality seems to affect more those on the middle to low income as well as those in rural areas, in households where mothers have insufficient education or from an indigenous group. The malnutrition, poverty and socioeconomic inequalities underscored in this research require novel and effective strategies aimed at reducing the gaps of those SES inequalities and promoting better nutrition for both mothers and children, simultaneously. Solutions need to be founded on a holistic approach directed at improving the efficiency and timely delivery of actions directed at alleviating not only children and adult malnutrition, but also the SES inequalities observed in developing countries like Guatemala.

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Fig. 1. Child stunting, maternal overweight and SCOM by per capita household consumption. Guatemala, LSMS 2002. *Abbreviation:* SCOM, stunted child and overweight mother.

Fig. 2. Relative concentration curves of child stunting, maternal overweight and SCOM. Guatemala, LSMS 2002. *Abbreviation:* SCOM, stunted child and overweight mother.

Fig. 3. Absolute concentration curves of child stunting, maternal overweight and SCOM. Guatemala, LSMS 2002. *Abbreviation:* SCOM, stunted child and overweight mother.

Table 1

Socioeconomic, demographic and nutritional characteristics of children, mothers and households. Guatemala, LSMS 2000.

Characteristics	Sample size		% or mean ± SD
	Unweighted <i>N</i>	Weighted <i>N</i>	
Child characteristics			
Age of child (months)	2492	729,109	33.6 ± 16.1
Male child	1268	386,379	50.9
Female child	1224	342,730	49.1
Nutritional status			
Stunted (<−2 HAZ)	1172	344,921	47.3
Maternal characteristics			
Age of mother (years)	2492	729,109	29.5 ± 7.0
Indigenusness			
Indigenusness	1020	297,137	40.8
Non-indigenusness	1472	431,972	59.2
Education			
Low (no education)	918	276,885	38.0
Middle (preparatory or primary)	1099	323,211	44.3
High (secondary or higher)	475	129,014	17.7
Nutritional Status			
Underweight (BMI < 18.5)	62	17,642	2.4
Normal weight (18.5 BMI <25.0)	1386	404,015	55.4
Overweight (25.0 BMI)	1044	307,452	42.2
Household characteristics			
Area of residence			
Urban	1054	279,151	38.3
Rural	1438	449,959	61.7
Total household consumption per capita (Q)	2492	729,109	5281 ±5322
Inter-quartile range ^a			3877.0
Household with SCOM	409	122,698	16.8

Unweighted *N* = 2492, weighted *N* = 729,109. *Abbreviations*: SCOM: stunted child and overweight mother; Q: Quetzals (US \$ = 6 Q in 2000).

^aInter-quartile range for total household consumption was calculated by subtracting the first quartile (2270Q) from the third quartile (6147Q).

Table 2

Child stunting, maternal overweight and SCOM pairs by socio-demographic characteristics and summary measures of the nutritional disparities, based on weighed data. Guatemala, LSMS 2000.

	Prevalence (%)		
	Child stunting	Maternal overweight	SCOM
Region			
Metropolitan	29.2	48.5	13.3
North	52.0	34.5	18.3
Northeast	37.9	45.6	14.1
Southeast	48.8	31.1	11.7
Central	47.7	50.0	22.2
Southwest	52.1	45.7	19.3
Northwest	69.3	29.0	17.4
Peten	44.1	39.6	16.2
Index of disparity ^a	63.3	39.8	39.1
Range	40.2	21.0	10.5
Maternal education			
Low (no education)	63.8	35.0	19.6
Middle (elementary)	44.5	43.3	17.8
High (secondary or higher)	18.9	54.3	8.4
Index of disparity ^a	124.3	26.3	81.7
Range	44.9	19.3	11.2
Area of residence			
Urban	31.7	48.8	13.4
Rural	57.0	37.9	19.0
Absolute difference (%) ^b	25.3	10.9	5.6
Relative difference (%) ^c	28.5	12.6	17.3
Indigenous mothers			
Non-indigenous	34.0	47.4	13.6
Indigenous	66.6	34.5	21.5
Absolute difference (%) ^b	32.6	12.9	7.9
Relative difference (%)	32.4	15.8	22.5

Unweighted data $N = 2492$, weighted data $N = 729,109$. *Abbreviation*: SCOM, stunted child and overweight mother.

^aIndex of disparity was calculated by taking the mean difference between each group rate and the best group rate and summing up the mean difference as a proportion of the best group rate.

^bAbsolute % difference was calculated by subtracting the best group rate from the other group rate.

^cRelative % difference was calculated between two groups by dividing the absolute % difference by the average % and multiplied by 100.

Table 3

Association of socioeconomic characteristics with child stunting, maternal overweight and SCOM. Guatemala, LSMS 2000.

	Child stunting ^a	Maternal overweight ^b	SCOM ^c
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
HH consumption per capita			
Quintile 1 (2078)	1	1	1
Quintile 2 (2079–3040)	0.69 (0.50–0.96) *	1.56 (1.11–2.19) *	1.13 (0.75–1.72)
Quintile 3 (3041–4315)	0.70 (0.48–1.03)	2.37 (1.61–3.49) ***	1.74 (1.13–2.67) *
Quintile 4 (4316–7070)	0.38 (0.24–0.60) ***	3.00 (1.96–4.59) ***	1.20 (0.74–1.96)
Quintile 5 (7071)	0.28 (0.17–0.46) ***	2.81 (1.77–4.44) ***	1.10 (0.56–2.15)
Area of residence			
Urban	1	1	1
Rural	1.37 (1.01–1.86) *	1.00 (0.76–1.32)	1.26 (0.84–1.90)
Maternal ethnicity			
Non-indigenous	1	1	1
Indigenous	2.50 (1.84–3.38) ***	0.73 (0.54–0.99) *	1.51 (1.05–2.18) *
Maternal education			
Low (no education)	1	1	1
Middle (elementary)	0.77 (0.58–1.02)	1.08 (0.82–1.42)	0.98 (0.70–1.39)
High (secondary or higher)	0.50 (0.29–0.88) *	1.21 (0.81–1.83)	0.55 (0.30–1.00) *
Region			
Metropolitan	1	1	1
North	0.53 (0.29–0.97) *	1.22 (0.74–2.02)	0.88 (0.41–1.90)
Northeast	0.83 (0.40–1.70)	1.18 (0.73–1.92)	0.84 (0.37–1.93)
Southeast	1.16 (0.64–2.11)	0.69 (0.43–1.09)	0.68 (0.31–1.48)
Central	1.04 (0.65–1.67)	1.50 (0.99–2.26)	1.34 (0.68–2.63)
Southwest	1.00 (0.61–1.63)	1.39 (0.91–2.14)	1.11 (0.55–2.23)
Northwest	1.35 (0.80–2.29)	0.89 (0.56–1.40)	0.82 (0.39–1.72)
Peten	0.94 (0.53–1.67)	0.96 (0.59–1.57)	0.95 (0.43–2.08)

Unweighted $N=2492$, weighted $N=729,109$. *Abbreviations:* SCOM: stunted child and overweight mother; HH: household. SPSS version 16.00 (SPSS Inc., Chicago, IL).

* Multivariate logistic regression: $p < 0.05$.

** Multivariate logistic regression: $p < 0.01$.

*** Multivariate logistic regression: $p < 0.001$.

^a Child stunting model was adjusted by child's age and sex.

^b Maternal overweight was adjusted by mother's age.

^c SCOM model was adjusted by child's age and sex and mother's age. The comparison is SCOM vs. no SCOM.