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Net Food Imports and Obesity in Selected Latin American & Caribbean Countries

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Abstract

We investigate the effects of food imports on the prevalence of obesity in selected LAC countries. Cross sectional data for 25 selected LAC countries for the year 2002 were collected. Regression analyses with a semi-log functional form were developed to investigate whether food imports and other socio-economic variables influenced the prevalence of total population, male and female obesity. Total obesity model had an adjusted R^2 of 0.72. Total food imports and gross national product per capita negatively influenced the prevalence of total obesity in net food importing countries (NFICs) whereas the total number of television sets had a positive effect. NFICs had a lower prevalence of obesity. For female obesity the equation had an adjusted R^2 of 0.52. Food imports negatively influenced the prevalence of female obesity in NFICs, whereas gross national income per capita and the total number of television sets had positive effects. For male obesity, the equation had an adjusted R^2 of 0.83 and the variables affecting the prevalence of obesity were similar but this time domestic food production had a positive effect. The sign for net food imports were similar in all equations indicating that individuals in NFICs had lower prevalence of obesity.

JEL classification numbers: I00, F1, F4
Keywords: Imports, obesity, Latin, America, Caribbean

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1 Introduction

Obesity presents a major health problem to policy makers in developed and developing nations [Poirer and Despres, 2005]. Obesity has become a major health concern to middle and low income countries, especially in Latin America and Caribbean [LAC]. Wright-Pascoe [2009] indicated that from 1970 to 1990 the prevalence of overweight/obesity increased from 7% in men and 20% in women to 22% in men and 58% in women in LAC countries. Researchers have attributed the growing rates in obesity to changes in lifestyles and diets which are heavily related to imports of cheap foods, especially by the lower income groups of LAC countries [Sinha and McIntosh, 2009; Pi-Sunyer, 1990; and Phillips and Young, 2000]. Food availability and security in LAC countries depend heavily on imports [Shapouri and Rosen, 2010]. The existing food gap in LAC countries which triggers the importation and dependence on cheap, but unwholesome diets, is related to inequitable income distribution and poverty [Cox, 2008]. Given the rise in obesity and the dependence on food imports in LAC countries, it is important to examine the effects of food imports on obesity in LAC net food importing countries [NFICs].

Comparison of overweight and obesity prevalence from LAC countries with that of the United States showed that on average the LAC situation is almost the same for many lower income LAC countries (Table1). The average prevalence of obesity in most LAC countries is expected to rise by 2010. The average prevalence for women and men in 2010 in Barbados, Trinidad and Tobago and Dominica is higher than most countries in LAC countries and is expected to increase in the future [Table1]. Women experienced a marked higher prevalence than men [Filozof et al. 2001].

According to PAHO (1998) obesity in LAC countries can be expressed as energy imbalance emanating from a positive net caloric intake [PAHO, 1998]. However, the reasons for this growing and acute problem might be facilitated by a number of factors including: 1) economic prosperity which is stimulated by income and wage increases that encourage greater purchase and consumption of food; 2) lower price of food in the past that encouraged purchase of cheaper imported caloric-dense foods; 3) technological change which encourages a sedentary lifestyle that limits physical movement and energy expenditure from food ingestion [Philipson and Posner, 1999]. Though a number of LAC countries are food secure, it is believed that the availability of cheap food imports and increased income [Rosen and Shapouri, 2010] in some of the lower income net food importing countries [NFICs], augmented by freer trade and globalization, is mainly responsible for the recent rapid increase in obesity. In this paper, we examine whether the prevalence of obesity in NFICs is influenced by food imports.

Table 1: Overweight estimates for selected Latin American and Caribbean countries, 2010 and net food import indicators

Countries	2010		Net food importing
	Female	Male	
Antigua and Barbuda	25.3	12.4	(-)
Bahamas	29.5	16.0	(-)
Barbados	57.2	22.0	(-)
Belize	21.0	9.0	(+)
Dominica	52.6	25.8	(-)
Grenada	23.6	11.0	(-)
Guyana	19.4	7.9	(-)
Jamaica	48.3	7.7	(-)
St Kitts and Nevis	25.8	12.8	(-)
St Lucia	41.7	9.8	(+)
St Vincent and the Grenadines	21.6	9.5	(-)
Trinidad and Tobago	52.7	19.1	(-)
United States of America	48.3	44.2	(+)
Argentina	37.8	37.4	(-)
Dominican Republic	38.7	11.2	(-)
Haiti	21.1	1.3	(-)
Mexico	41.0	30.0	(-)
Honduras	16.7	6.2	(-)
Surinam	19.6	8.1	(-)
Paraguay	19.6	8.0	(-)
El Salvador	20.2	8.5	(+)
Brazil	24.5	12.4	(-)
Panama	22.2	9.9	(-)
Costa Rica	30.5	17.5	(-)
Columbia	26.6	19.6	(-)
Venezuela	33.0	29.5	(+)
Guatemala	36.8	20.5	(-)

2 Review of Literature

Obesity has become one of the leading foundations of chronic diseases in the world [Grundy, 1998]. It is estimated that over the next 10 years, that the condition will worsen in LAC countries and cardiovascular diseases will become one of the leading causes of death [Ordúñez et al., 2001]. Obesity is related to high blood pressure, breast cancer in women, diabetes, coronary disease, strokes, gall bladder disease, osteoarthritis, and sleep apnea [Bray and Bellanger, 2006]. The relationship between obesity, health risks and socio-economic, physical and genetic factors are seen in Figure 1. Obesity is both a local and global problem.

Globalization has been seen as one of the main drivers of freer trade and hence food availability. Globalization according to [Yach et al., 2006, and Yach and Bettcher, 1998]

not only refers to economic processes or the development of global institutions but also describes the global interconnection between individuals. Globalization is defined as the process of increasing economic, political, and social interdependence and global integration that involves the movement of capital, traded goods, persons, concepts, images, ideas, and values [Hurrel, 1995; Jolly et al., 2006]. McIntosh and Sinha [1994] believed that the removal of the barriers to trade, encouraged by globalization in the 1990s, facilitated the westernization of the diet and lifestyle of the developing countries where trans-national corporations seized the opportunity to target new markets and increased advertising of foods that are less healthy for human consumption [PAHO, 1998].

Globalization has both demand and supply components. Hawkes [2006] stated that globalization is associated with changing income and lifestyles. Globalization alters production and consumption habits, extends the nature of trade, increases involvement of international corporations into food delivery systems, and hence cost and price changes. For example, most aboriginal populations of the Americas changed their diet and physical activity patterns to fit an industrialized country model. They now derive most of their diet from Western foods and live sedentary, physically inactive lives. Under these circumstances they develop high rates of obesity, insulin resistance, and type-2 diabetes. According to Kennedy et al. [2004] with globalization comes the consumption of more processed foods which are linked to obesity.

On the supply side globalization is related to the increasing availability of cheap foods due to lower tariffs and international prices. Though globalization is intended to eliminate or reduce market distortion, many developed countries with surplus foods are accused of using various mechanisms for dumping their surplus products on the developing countries. These foods can, however, positively influence the nutritional status of poorer countries. On the other hand, these cheap imports are usually refined foods that replace domestic food production and may sometimes create nutritional imbalances [McMichael, 2006]. Many of the trade strategies adopted by the developed countries and multinational corporations come in the form of export subsidies with the intent of trade expansion [Potter and Burney, 2002].

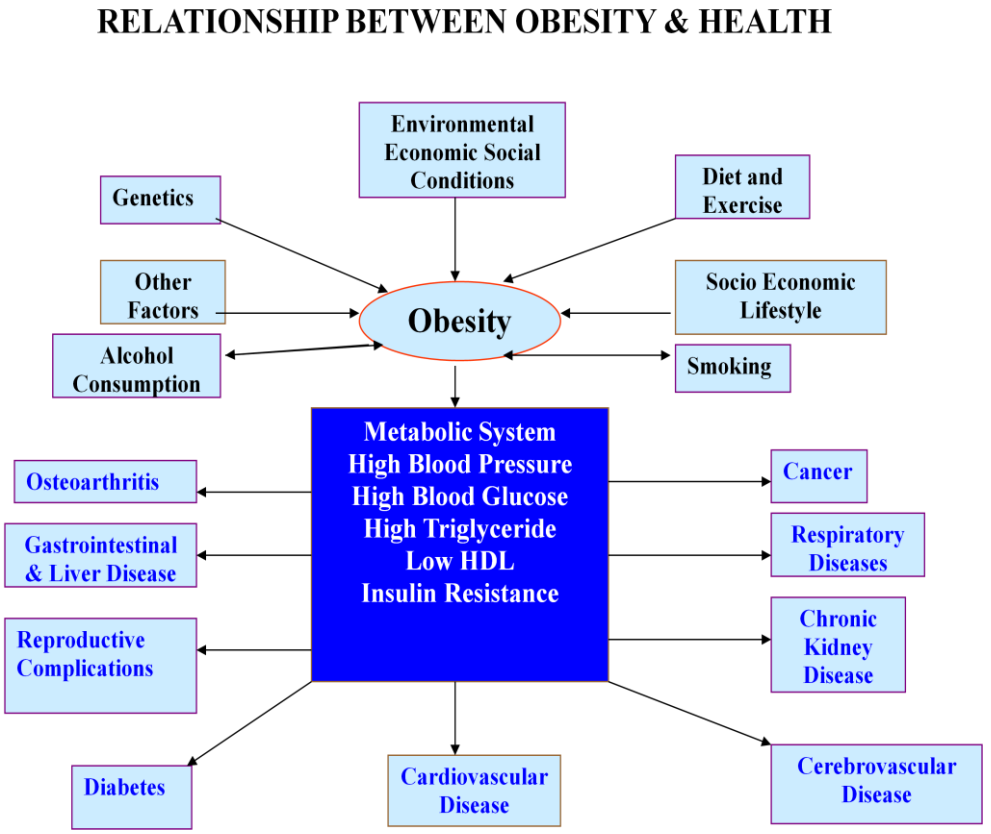

Figure 1: Relationship between obesity and health

These subsidies are not acceptable under the World Trade Organization [WTO] regulations but the developed countries disguise them as sale strategies. For instance, the NFICs receive grants and loans at zero interest to purchase foods from the more developed economies. These loans are guaranteed by the governments of the exporting countries. Such financial facilitations, as delivering the foods to the developing countries with payment due six or 12 months afterwards at zero interest, lower the real price of the food to the developing countries and expand the developed countries international market share of the particular food item. Hence, cheap foods from developed countries enlarge food availability in the developing countries which is associated to increased caloric intake and obesity [Watkins and von Braun, 2002]. There have been attempts to reduce export subsidies under WTO but some of the NFICs have resisted this attempt. Hence, it is important to investigate whether food imports are linked to obesity and whether it is more pronounced in NFICs. The NFICs of the LAC are pro-programs that encourage imports and as can be seen in figure 2 food imports have increased from 1992 to 2006 while the population trend has been rather constant. In spite of recent rise in food prices during the period 2010 and 2011, food imports still increased. We see from Figure 2 that the rate of imports of meat and cereal is higher than that of population growth in LAC countries. Both prices and imports have been increasing in the LAC. It means that there is more food available per capita as domestically produced food is replaced by imports.

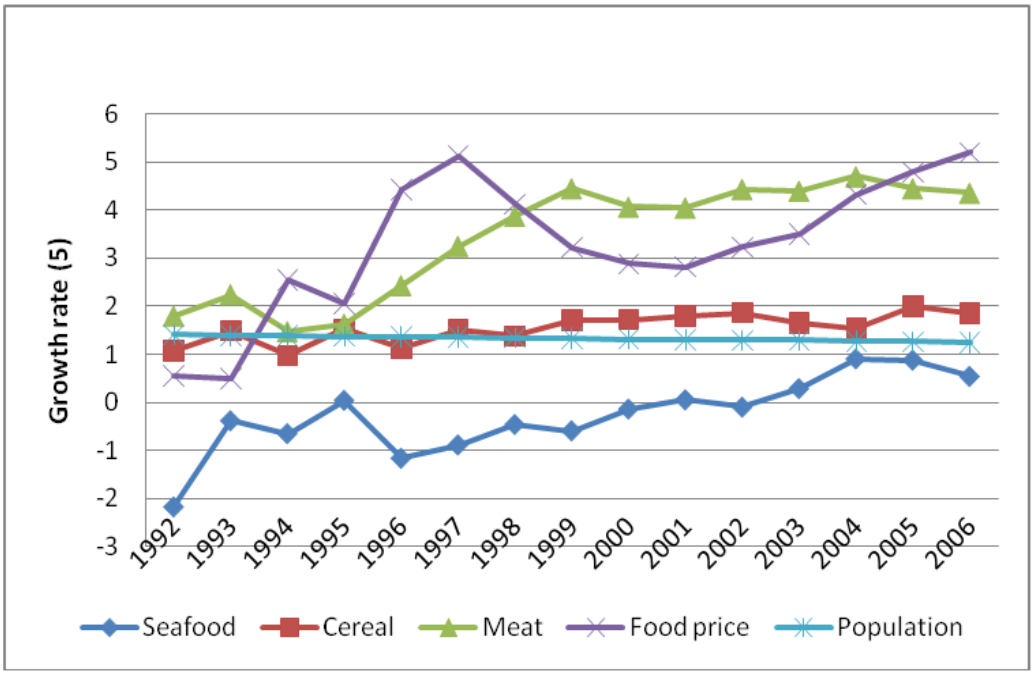

Figure 2: Growth rates food imports and food price index

3 Theoretical Framework and Model Development

A rise in food imports increases food availability which may influence the desired weight of an individual and the weight change. Hence the expectation is that individuals in a society will search for a desired body weight that will maintain it in a state of good health. We assume that the society has a norm for a healthy body weight which may differ from a particular individual's norm [Philipson and Posner, 2003]. This body weight is associated to a body mass index [BMI]. A healthy BMI heavily depends on the quantity and quality of food the person consumes. It is expected that, if the individual consumes more food than desired, the BMI will increase. Also, if the quality of food is poor, calorie dense, with low levels of fruits and vegetables, the individual's BMI will increase. The desired BMI is also based on the source of the nutrients.

Other factors, such as alcohol consumption and smoking, can substitute for food and may affect the BMI. It is believed that, if the consumption of alcohol is accompanied by a balanced meal, BMI may increase. If, however, the calories from alcohol replace calories from food, the individual may become emaciated over time [Ligeon et al., 2007]. Researchers [Lieber, 1988; Feinmam, 1989] believe that alcohol reduces the feeling of hunger, and hence may have a negative effect on BMI. The effects of smoking on BMI may, however, be indeterminate.

Physical exercise results in energy expenditure and the subsequent reduction of body mass. The more one takes part in physical activities where energy is used, the less the BMI. Technological change has enabled a proliferation of machines that have replaced physical energy output in the workplace [Philipson, 2001; Lakdawalla and Philipson, 2002]; thus triggering a reduction in human energy outlay and an increased prevalence of obesity.

Advances in technology may also signal lower price of foods and higher income for workers which may encourage food consumption growth and the possibilities of an increase in obesity prevalence. A sedentary lifestyle which may be enhanced by television viewing time, coupled with time spent playing video games, working on computers, and other devices, reduces caloric expenditure during free time, and encourages snacking, the consumption of larger portions, and increased intake of high-calorie foods [Embelling et al., 2002].

An increase in the amount of leisure involving physical activities results in an upsurge in energy expended. Also a lack of physical movement and lethargy results in lower energy consumption. The rapid increase in obesity among children and adolescents has been attributed to a lack of play-time or a substitution of play time by sedentary activities that are linked to television watching [Finkelstein et al., 2005].

The composition of a population in terms of male and female, and age distribution among groups influence obesity prevalence in the population. Loureiro and Nayga [2005] found that there was a negative relationship between those who were only obese (BMI> 30) and those who were both obese and overweight [BMI>25], and being older than 65 years old. That means the degree of overweight decreases with age over 65.

A decline in food prices increases real income and hence the quantity and quality of food available. A fall in food prices translates into an increase in calories consumed and hence an increase in body weight [Philipson and Posner, 2003]. Economists believe that a decrease in the price of food encourages food consumption (Mitra, 2001). The source of food also influences the levels of obesity. It is believed that as consumers "eat out" more, the levels of consumption increase and consumers are presented with caloric dense foods that are tasty but unhealthy. Take- away- foods in the Netherlands seem to influence obesity [Mc Crory et al., 1999].

Income is necessary to purchase food and other goods especially in non-autarkic societies. Income availability enhances consumption. As wages rise and buyers have more income, they tend to purchase more foods, especially packaged foods or foods served by restaurants. Hence BMI is expected to vary positively with increases in income. People with lower income may also tend to purchase foods with lower nutritional value [Drewnowski and Darmon, 2005].

The purchase of food increases directly with income, especially if the food is considered a normal good. Food trade accounts for 11% of world trade and processed food trade makes up about three-fourths of total food trade [Chopra, 2002]. Lee [2005] suggests that the consumption of highly processed foods may be responsible for problems of obesity. The alliance of agricultural food companies into large transnational companies [TNC] also stimulates the consumption of highly processed foods [Lee, 2005]. The marketing policies of TNCs encourage the substitution of nutritious domestic foods by highly processed foods that are marketed to individuals from the developing countries. Since TNCs invest heavily in advertisement, they are able to outspend the WHO $500 to $1 in its effort to encourage the consumption of nutritious foods [Lee, 2005]. Hence countries that are open to trade are likely to spend more on foods and are likely to experience a change in BMI.

Obesity is also linked to a mixture of lifestyle and excessive energy intake [Pi-Sunyer, 1990; and Phillips and Young, 2000]. An increase in urbanization with increases in fatty food intake, coupled with reduced amounts of physical exercise, result in increased positive energy balances in both developed and developing countries. Obesity is also related to genetics, but environmental factors operating during life may contribute seriously to obesity.

Economic status has been associated with global obesity. Peña and Bacallao [2000], however, indicated that obesity was previously associated with perception of wealth and an abundance of food, but today the majority of the victims of obesity are trapped in poverty. Drewnoski and Specter [2004] found the greatest rate of obesity in the U.S. is among women with the highest rate of poverty, and the least education level. This finding was not applicable to men. Pomerleau et al. [1999] reported that the epidemiology of obesity in women is different than that of men. In a study conducted in the United Kingdom [UK] the researchers found a distinct inverse relationship between obesity and socioeconomic status in women, but not in men. Fraser [2003] noted a high rate of obesity in women in Barbados, an English-speaking Caribbean island, with dramatic changes in lifestyle and socioeconomic status within the past 30 years. He also found that the gradient in obesity for women [Nigeria 5%, urban Cameroon 13%, Jamaica 18%, Barbados 30% and a U.S. urban city, Chicago 36%] was closely correlated with economic development. In Latin America, obesity prevalence is high in the adult population, especially among women with less schooling. In developed populations, obesity occurs more frequently among the poor; the opposite occurs in less developed societies, where in households undergoing nutritional transition, underweight can coexist with obesity [Kain et al., 2002].

A study in South Africa found that women with no education had a lower BMI than those with schooling. The highest rate of obesity was found in urbanized, higher educated, older white men [Puoane, et al., 2002]. This is in contrast to the findings by Sundquist and Johansson [1998] who indicated that women with low education had high BMI. In China, the prevalence of obesity is associated with high income groups [Yang, 2001], but in the U.S. the highest rate is frequently associated with poverty. A recent study by Chang [2005] found that this disparity may be changing. An increase in obesity was observed in all levels of income and the greatest weight gain was not experienced by the poor.

Urbanization is one of the driving forces of obesity in developing countries. As individuals migrate to urban areas their money income increases and they tend to purchase more processed and calorie dense foods. In low-income and middle-income countries there is a shift towards urbanization [Finkelstein et al, 2005 and Ewing et al., 2003]. Urban residency is linked to large changes in diet, body weight and body composition [Popkin, 1999]. Urbanization also results in decreased physical activity and a more sedentary lifestyle that can lead to overweight or obesity. An increase in urbanization with increases in fatty food intake, coupled with reduced amounts of physical exercises result in increased positive energy balances in both developed and developing countries. On the other hand, some researchers argue that urban dwellers are opened to more forms of recreation and ways of expending energy, so they are less likely to be obese. Fraser (2003) noted that in the English-speaking Caribbean, urbanization has resulted in obesity shifting from a single digit to near 20% within the last two decades.

3.1 Implicit Trade Model

Philipson and Posner [1999] proposed a utility function, in which, weight, food, leisure, and other consumption activities determine individual's utility. Lakdawalla and Philipson [2002], and Lakdawalla et al. [2005] simplified the utility function by considering only weight (W), food consumption (F), and other goods consumption (C). The individual utility, U (W, F, C), has a monotonic, positive relationships with food and goods consumption, meaning that $U_F > 0$ and $U_C > 0$. Philipson [2003] and Posner and Lakdawalla and Philipson [2002] assumed that individuals choose their level of food

consumption, goods consumption and their body weight to maximize their utility subject to their budget constraint, as generalized below:

Max U [Wt, Fc, C] s.t. budget constraint (1)

Body weight is increasing with food consumption (Fc) and decreasing with level of physical strenuousness. The level of physical strenuousness is from both work (H) and leisure activities (L). Hence, individual weight is a function of Fc, working hours, and leisure hours (H&L).

Wt= W (Fc, H, L(C)) (2)

where, H is working hours; L is leisure hours, related to level of goods consumption. Food consumption (Fc) can be separated by the sources, domestic food (F_D) and imported food (F_I): Eating more food will increase body weight; hence $W_F > 0$. Body weight gained from total food consumption (Fc) is a function of domestic food (F_D) and imported food (F_I) consumption. Hence the function of body mass index can be represented by:

BMI = (Domestic Food, Imported Food, Income, Education, Labor Participation, Price, Television, exercise, Net food importing country, Other goods) (3)

3.2 The Explicit Model

Income and education are used interchangeably and influence BMI [Kain et al., 2002]. Education and income influence dietary intake, physical activities, obesity and other risk factors. According to Shrewsbury and Wardle [2008] there is an inverse relationship between BMI and education when obesity and overweight are combined. In some Latin American middle income countries there seemed to be greater levels of obesity among the poor [Monteiro et al., 2000; Uauy et al., 2001].

Domestic Food Production (Fprod) is the average food production index for a given country for the period 1970 to 1973. The desired BMI is influenced by the quantity and quality of food the person consumes. It is expected that domestic food production rich in fiber will have a lower effect on the BMI, but as more imported refined foods are consumed BMI will increase. Sinha [1995] in an ecological study of food availability and disease pattern clearly indicates that there is a significant positive relationship between the increase in total calories and diabetes, and between total fat and coronary diseases and BMI. Hence it is expected that with food availability through food production that $\beta_{1>0.}$

Imported Foods (Fimpc) is average food imports by a specific LAC country for the period 1970 to 1973. The importation of food results in greater diversity and improved health [Houck, 1986]. It is expected that for low income countries substituting locally produced food by low price, calorie dense food imports, the prevalence of obesity will increase. But for the high income importing countries importing protein dense foods and health foods will have lower prevalence of obesity. It is expected that $\beta_{2>0\ or}\beta_{2<0.}$

Labor Participation (Labt) is average participation rate in the labor force of the total population ages 15 to 64. Pomerleau et al. [1999] noted difference in obesity rate between men and women. Loureiro and Nayga found that women participation in the labor force influenced the prevalence of obesity. (Labf) is average participation rate in percentage by women in the total labor force for the period 1970 to 1973, and (Labm) is average male

participation rate in the total labor force. It is expected that for (Labt, Labf and Labm) $\beta_{3>0 \text{ or }} \beta_{3<0.}$

Television (Telev) influences the prevalence of obesity. It is measured by the number of television sets per 1000 people in a given LAC during the period 1970 to 1973. It has been observed that television encourages an inactive lifestyle and influences obesity [Uauy et al., 2001]. Hence a positive relationship is expected between the number of television sets and the prevalence of obesity. Hence it is expected that $\beta_{4>0.}$

Income (Gnip) is the average gross national income GNI per capita, PPP (current international $) for the period 1970 to 1973. Obesity is generally the down side of rising affluence [Rayner, 2008]. The authors do agree that the direction of obesity and rising income is unknown since there are many poor countries like Brazil and Guatemala where the incidence of obesity is fairly high. It is expected that the prevalence of obesity will increase with increase in income in LAC; hence the expectation is $\beta_{5>0.}$

The relationship between income and prevalence of obesity overweight and obesity depends on whether the country is considered rich or poor. Hence a dummy variable (Incd=1 if the country was rich and 0 if poor if the country is poor for the period 1970 to 1973. Drewnowski and Darmon [2005] believe that people with low income tended to purchase foods with lower nutritional quality. The expectation is $\beta_{6>0 \text{ or }} \beta_{6<0.}$

Net Food Importing country (nimport) is represented by a dummy variable. Nimport=1 in net importing and 0 if the country is a surplus importing country for the period 1970 to 1973. It is expected that $\beta_7>0$. The explicit model to be estimated in the study is, therefore, specified in the general form in (4) as:

$$BMI = \beta_0 + \beta_1 (\text{Domestic Food}) \pm \beta_2 (\text{Imported Food}) \pm \beta_3 (\text{Labor Participation}) + \beta_4 (\text{Television}) + \beta_5 (\text{Income}) \pm \beta_6 (\text{Dummy for income groups}) + \beta_7 (\text{Dummy for net import country}) + e \quad (4)$$

Where:
e =error term

BMI is calculated by dividing weight in kilograms by the square of height in meters which correlates to body fat [CDC 2003]. It is characterized by CDC and WHO as the body mass index (BMI) of 30 kg/m² or greater. Here it is the prevalence of kg/m² age range: 15-65 adults for the period 1970 to 1973. The number of variables added depends on the availability and quality of data across countries. Television represents a sedentary lifestyle which implies a lack of physical activities. Other variables which can serve as measures of physical activity, such as number of vehicles, road distribution or gasoline consumed for travel are highly correlated with the number of televisions per capita and were, therefore, dropped from the equation to minimize the incidence of multicolinearity.

3.3 Method

The Caribbean countries are a group of islands stretching from Bahamas to Trinidad and Tobago with countries such as Belize and Guyana on the main land which are considered part of the English speaking Caribbean. The Latin American countries selected are on both Central and South America (Table 1). For the sake of data availability 27 countries were

selected and data on domestic food production, food imports, level of education, income per capita, rates of urbanization, and caloric sources were analyzed.
The sources searched included the WHO data base, 2006; the Atlas: Demographic of Tobacco; World Bank Analytical Classification; Food and Agriculture Organization of the United Nations (FAO); FAOSTAT. *TradeSTAT Detailed Trade Data, 2005;* FAOSTAT. *TradeSTAT Detailed Trade Data, 2007;* International Energy Agency (IEA) Statistics Division, 2006. International Road Federation (IRF) 2006, International Telecommunication Union (ITU) and Energy Balances of OECD Countries. The level of obesity for 15 to 65 years old participants for each country was collected from the WHO for the period 1970 to 1973.
Ordinary linear regression models using semi-log functional form where the log of obesity was regressed on the selected independent variables were developed. The semi-log functional form was chosen because it was assumed that the weight of the individual would approach an upper limit since the body frame of an individual would only attain a certain limit [Prichet and Summers, 1996]. The Statistical Analytical System (SAS) was used to analyze the data.

4 Results and Implications

Obesity in LAC countries are almost equivalent to that found in more developed countries. However, the other countries are catching up. Martorell et al. [1998] noted that the prevalence of obesity is trending upwards for most LAC countries. In almost all countries the projected prevalence was slightly higher for women than men. However, the prevalence of food consumption and obesity is on the rise. This does not seem related to the food price because in figure 2 the price of food is growing at a faster rate than population growth rates or protein availability (meat and fish growth rates). The rates of growth of cereal foods are fairly constant while that of meat has increased over time.
Model results in table 2 for the total obesity (males and females) show that the model has a good fit, with an Adjusted $R^2 = .72$ with an F=7.65; P=0.0017 which indicates that the Beta values are different from zero. The variance inflation factors are all less than ten which indicates that multicolinearity is not an issue (Belsley et al., 1990). The Durban Watson Statistic (DW=2.16, Pr<DW=0.613 and Pr>DW=3.87) 2.16, and therefore, we fail to reject the null-hypothesis and hence we state that autocorrelation is not a problem. Heteroscedacity is also not an issue since the X^2 from the White test is 15.08. Obesity is negatively influenced by food imports in LAC countries.

Table 2: Regression of prevalence of total obesity (males & females) on selected variables

Variable	Parameter estimate	Standard error	t Value	Pr > |t|	Inflation variance
Intercept	1.75426	1.63218	1.07	0.3055	0
Fimpc	-2.25103	0.63845	-3.53	0.0047**	2.52069
nimportD	0.30136	0.30492	0.99	0.3442	1.65928
Incd	1.29344	0.40649	3.18	0.0087**	7.27369
Gnip	-6.8E-05	2.31E-05	-2.95	0.0131**	6.31788
Fprod	0.01842	0.01724	1.07	0.3083	2.35876
Labt	-0.01113	0.01032	-1.08	0.3039	1.15334
Telev	0.00195	0.000809	2.4	0.035**	2.58861
F-value	7.65	Pr > F = 0.0017			
R^2	0.8296				
Adjusted R^2	0.7211				
DW	2.167				
White test	Chi^2 = 15.08	Pr > Chi^2 = 0.858			
Shapiro-Wilk	Pr < W = 0.6347				

Model: lnbmit = fimpc nimportd incd gnip fprod labt telev

The results in table 3 show that the elasticity for food imports is -1.068. That means if food imports increase by 1.0 per cent, the obesity prevalence rate will decrease by 10.6 percent. Obesity prevalence is also negatively influenced by income in LAC countries, but positively affected by the number of television sets. If the number of television sets increases by 10.0 percent the prevalence rates of obesity will increase by 4.5 percent. However, obesity prevalence is more likely in high income LAC countries. Net food imports had no effect on obesity prevalence.

Table 3: Elasticity for total, female and male obesity prevalence models

Variable	Total elasticity	Elasticity for female	Elasticity for male
Food import per capita	-1.06847	-0.86565	-1.39796
Gross National Income	-0.69046	-0.72169	-0.75283
Food production	1.862704	1.078993	3.796195
Labor participation	-0.77464	-0.30327	-1.57743
Television set	0.453546	0.393073	0.611705

In table 4 we present the regression for prevalence of female obesity. The adjusted R^2 =.52 and the F=3.8 with P=0.0224. The variance inflation factor is all less than 10 which indicate that multicollinearity is not an issue. The Durban Watson Statistic (DW), (Pr<DW=0.80 and Pr>DW=0.199) is 2.42, and therefore, we fail to reject the null-hypothesis and hence state that autocorrelation is not an issue. Heteroscedacity is not a problem since the X^2 White test is 18.99 and Pr>X=0.46; we thus reject the null hypothesis. For the female model the results were similar to that of total obesity. Television set has a marginal but a positive effect on prevalence of female obesity and for every ten percent increase in television sets female obesity increases by 3.9 percent.

In table 5 we present the regression for male obesity. The adjusted R^2 =.83 and the F=13.76 with P=0.0001. The variance inflation factor is all less than 10 which indicate that multicollinearity is not a problem. The Durban Watson Statistic (DW), (Pr<DW=0.777 and Pr>DW=0.222) is 2.41, and therefore, we fail to reject the null- hypothesis and hence state that autocorrelation is not a problem. Heteroscedacity is not a problem since the White test $X^2$of 12.18 and Pr>X^2=0.909; we reject the null hypothesis.

Table 4: Regression of prevalence of female obesity on selected variables.

Variable	Parameter estimate	Standard error	t Value	Pr > |t|	Inflation variance
Intercept	1.85421	1.83671	1.01	0.3344	0
Fimpc	-1.82373	0.74015	-2.46	0.0315**	2.5371
nimportD	0.2651	0.35104	0.76	0.466	1.647
Incd	1.24346	0.48251	2.58	0.0257**	7.67518
Gnip	-0.00007139	2.7E-05	-2.65	0.0226**	6.42312
Fprod	0.01067	0.02001	0.53	0.6044	2.37913
Labf	-0.00535	0.00723	-0.74	0.4753	1.18389
Telev	0.00169	0.000934	1.81	0.0977*	2.58382
F-value	3.88	Pr > F = 0.0224			
R^2	0.7119				
Adjusted R^2	0.5286				
DW	2.421				
White test	Chi^2 = 18.99	Pr > Chi^2 = 0.457			
Shapiro-Wilk	Pr < W = 0.2116				

Model: lnbmif = fimpc nimportd incd gnip fprod labf telev

Obesity is negatively influenced by food imports in the higher income LAC countries. If the country is a net food importing country male obesity prevalence is likely to increase. Male obesity prevalence is also positively influenced by domestic food production and television sets. If food production increases by 10 percent the prevalence of male obesity is likely to increase by 37.9 percent, but by 6.1 percent if television sets increases by the same percent. As noted in the United States, the men/women prevalence rates are almost the same, whereas in the English-speaking Caribbean countries and other LAC countries, the prevalence rates are significantly different, with women having larger prevalence rates than men. Similar results were obtained for more developed countries by Loureiro and Nayga [2005]. An observation was also made by Henry [2004] who stated that Caribbean women had higher prevalence rates of overweight and obesity than men. The reason given was that women had a tendency to channel extra energy into fat, while men use more of this energy for protein synthesis. It is also believed that as women in LAC countries enter the work force their income increase which allow them to purchase more imported refined foods and foods away from home which are associated to weight gain. A sedentary lifestyle also influences obesity.

Table 5: Regression of prevalence of male obesity on selected variables

Variable	Parameter estimate	Standard error	t Value	Pr > |t|	Inflation variance
Intercept	-1.12571	2.3172	-0.49	0.6366	0
Fimpc	-2.94519	0.79512	-3.7	0.0035**	2.70601
nimportD	0.72583	0.36435	1.99	0.0718*	1.63977
Incd	1.73745	0.4894	3.55	0.0046**	7.2976
Gnip	-7.4E-05	2.75E-05	-2.71	0.0204**	6.18585
Fprod	0.03754	0.02111	1.78	0.103*	2.44846
Labm	-0.01914	0.02025	-0.94	0.365	1.34126
Telev	0.00263	0.00099	2.66	0.0222**	2.67884
F-value	13.76	Pr > F = 0.0001			
R^2	0.8975				
Adjusted R^2	0.8323				
DW	2.343				
White test	X^2 = 12.18	Pr > X^2 = 0.9097			
Shapiro-Wilk	Pr < W = 0.7675				

Model: lnbmim = fimpc nimportd incd gnip fprod labm telev

It has been suggested that television viewing time, coupled with time spent playing video games, working on computers, and other devices, reduces caloric disbursement during free time, and boosts snacking, larger portions, and increase in the consumption of high-calorie foods [Embelling et. al., 2002].

Food imports in net food importing and other countries have a negative effect on the incidence of obesity. It seems that net food importing countries may be adding more variety to their diets [Houck, 1986] and may be importing the food products (fruits, vegetables, fish and meats) that are associated with lower obesity occurrence. It is seen in figure 1 that the importation of meat products is increasing at a faster rate than that of other foods. Income in all cases had a negative effect on obesity prevalence. This phenomenon provides further insights into the statement that LAC countries might be importing more healthy foods to supplement their diets. However, higher income LAC countries seem to have higher prevalence of obesity than lower income LAC countries. This may be so as income distribution in LAC countries are skewed [Cox, 2008] and the higher income groups may be consuming more fast foods and may be eating more away from home. The prevalence of fast food restaurants are more likely to be located in the higher income group neighborhoods whereas the lower income groups are more likely to be still consuming some of their local roots, tubers, fruits and vegetables.

The levels of television sets which mark a more inactive lifestyle are positively related to total, male and female obesity prevalence [Kain et al., 2002]. In most LAC countries urban migration is high. Urban dwellers have more television sets and spend more time watching television than rural inhabitants; therefore, urban dwellers are likely to be more obese than rural people [Uaauy et al., 2001].

The region is transformed from poor agricultural states to thriving tourist destination sites. Progress made economically has resulted in mechanization and decreased in manual labor, better road systems and improvement in transportation and low levels of physical exercise [Sinha, 1995; Henry et al., 2001]. Lifestyle has been transformed by leisure activities that now include long hours of watching television and more deskbound forms of employment. The LAC people may also be more tolerant of overweight than people from the more

developed countries. Among the English-speaking Caribbean, obesity is traditionally portrayed as healthy and economically successful, and fat women are admired and preferred [Fraser, 2003].

The study concludes that food imports, in general, have a negative influence on obesity in LAC countries. Per capita income has a negative effect on the prevalence of obesity in higher income LAC countries while television sets positively influence the prevalence of obesity. There are differences in the factors influencing the prevalence of obesity between men and women in LAC countries. Domestic food production positively influences male obesity prevalence. Food import, whether the male is from a high income or low income, a sedentary lifestyle, as noted by the number of television sets per 100 individuals, influence obesity prevalence. For women food imports, income and the number of television sets per 1000 individuals influence the prevalence of obesity.

The paper presents some insightful outcomes and in most cases in agreement with previous findings. There were some contradicting aspects in that income increases had a positive effect on obesity but the prevalence of obesity is more pronounced in higher income LAC countries. One must, however, be careful about the interpretation since the number of countries in the sample is small and the dates of measurement of overweight and obesity are not for a single year but a period. Data collected over a period of time could have helped improve the estimates.

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