IDB WORKING PAPER SERIES Nº IDB-WP-1172

# Socioeconomic Factors Associated with Being Overweight or Obese in Suriname

Jeetendra Khadan
Nekeisha Spencer
Eric Strobl
Theophiline Bose-Duker

Inter-American Development Bank
Country Caribbean Department Group

June 2021

# Socioeconomic Factors Associated with Being Overweight or Obese in Suriname

Jeetendra Khadan[1]
Nekeisha Spencer[2]
Eric Strobl[3]
Theophiline Bose-Duker[4]

[1]Inter-American Development Bank
[2]Department of Economics, University of the West Indies, Jamaica
[3]Department of Economics, University of Bern, Switzerland
[4]Department Economics, University of Birmingham, United Kingdom

Inter-American Development Bank
Country Department Caribbean Group

June 2021

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library
Socioeconomic factors associated with being overweight or obese in Suriname / Jeetendra Khadan, Nekeisha Spencer, Eric Strobl, Theophiline Bose-Duker.
p. cm. — (IDB Working Paper Series; 1172)
Includes bibliographic references.
1. Obesity-Social aspects-Suriname-Econometric models. 2. Obesity-Economic aspects-Suriname-Econometric models. I. Khadan, Jeetendra. II. Spencer, Nekeisha. III. Strobl, Eric, 1969- IV. Bose-Duker, Theophiline. V. Inter-American Development Bank. Country Office in Suriname. VI. Series.

IDB-WP-1172

http://www.iadb.org



# Socioeconomic Factors Associated with Being Overweight or Obese in Suriname

Jeetendra Khadan,[1] Nekeisha Spencer,[2] Eric Strobl,[3] and Theophiline Bose-Duker[4]

**Abstract**

This paper applies probit regression models to a nationally representative household survey dataset collected in 2016-2017 to analyze the relationships between various socio-demographic variables and adult Body Mass Index (BMI) in Suriname. Our results indicate that women, the elderly, and couples either married and/or living together are more likely to be obese or overweight. As expected, this is also true for individuals who have chronic illnesses. The analysis also finds that individuals who engage in a sport or in other forms of exercise, even if modest, have lower odds of being overweight or obese. Interestingly, the findings indicate that individuals who benefit from government social safety net programs are less likely to be associated with being overweight or obese. The results of this study have implications for the adjustment of current Surinamese nutritional guidelines as well as the design and implementation of targeted obesity-reduction policies that recognize that being overweight is influenced by various characteristics. Although the results are country-specific, they have the potential to influence action in all countries in the Caribbean that lack policies to address obesity.

**JEL Codes**: I10, I12, I15

**Keywords**: BMI, overweight, obesity, Suriname, policy

[1] Inter-American Development Bank, Washington, DC, United States
[2] Department of Economics, University of the West Indies, Jamaica
[3] Department of Economics, University of Bern, Switzerland
[4] Department of Economics, University of Birmingham, Birmingham, United Kingdom

# 1. Introduction

Being overweight is one of the leading risk factors of premature death. It is estimated to cause an average loss of 3.9 percent of years of life and 3.8 percent of disability-adjusted life years worldwide (Ng et al. 2014). Alarmingly, its prevalence appears to be rapidly rising (GBD 2017 Risk Factor Collaborators 2018). The disease was traditionally viewed as a developed-world problem because of its strong association with rising incomes, changing eating habits, and reduced physical activity in low- and middle-income countries. However, today it is a common phenomenon worldwide (Popkin, Adair, and Ng 2012; Siddiqui and Donato 2016). According to the latest figures from the World Health Organization (WHO), at least 39 percent of adults worldwide are currently overweight or obese, and that figure is 26 percent in low- and lower-middle-income countries.[5]

One region that appears to be particularly affected in the developing world is the Caribbean. Within the Caribbean Community and Common Market (CARICOM),[6] more than 60 percent of adults are overweight or obese, and this figure is as high as 80 percent in some countries such as Barbados (Foster et al. 2018). Suriname, in particular, has been noted as a high-risk obesity country given the rapid increase in adult obesity there over the two-decade period from 1995–2015. Further, Suriname has been cited as having very poor chances of meeting the 2025 United Nations adult obesity targets. In fact, obesity levels for the country by that time are predicted to be approximately 40 percent for women and 26 percent for men. Those figures were almost 10 percentage points lower in 2010 (World Obesity Federation 2020).

Signs of the consequences of the high obesity levels are already apparent in the prevalence of such illnesses as diabetes, which ranges between 10 and 15 percent of the adult population in the Caribbean as compared to averages of 9 percent and 9.5 percent for low-income and lower-middle-income countries as a whole, respectively. In addition, diabetes has been a major contributor to premature deaths in the Caribbean (Sobers-Grannum et al. 2015).[7] Similarly, Forrester et al. (2007) find that being overweight or obese can explain 26 percent of the variance in blood pressure in females and 13 percent in males in Jamaica, St. Lucia, and Barbados. Given the status quo and the future obesity outlook for Suriname, it is clear that diseases associated with being overweight will form part of the burden on the health system.[8] As a result, it is important

[5] Calculations were undertaken using the 2016 figures from the WHO Global Database on Body Mass Index (BMI), where overweight is defined as having a BMI of 25 or greater and being obese surpasses the 30 BMI threshold.
[6] CARICOM consists of 15 official members in the Caribbean.
[7] The figures for the Caribbean are from Sobers-Grannum et al. (2015), while the figures for the low- and lower-middle-income groups are from the World Bank (https://data.worldbank.org/indicator/SH.STA.DIAB.ZS).
[8] See http://www.healthdata.org/suriname for summary data on obesity in Suriname.

to understand the factors driving obesity in Suriname in order to develop appropriate policies to reduce the expected increase in obesity.

Despite the expanding literature on the determinants of obesity across the globe (Abdulai 2010; Gao and Shen 2017; Katsaiti and El Anshasy 2014; Kuku, Garasky, and Gunderson 2011; Miljkovic et al. 2018), the number of studies on the widespread weight problem in the Caribbean and what might be driving its prevalence is rather limited. For instance, Gaskin et al. (2008) find that misperceptions, inactivity, and maternal factors may drive obesity among Barbadian adolescents, while in Jackson et al. (2003) marital status and cigarette smoking factors predicted the Body Mass Index (BMI) for both male and female urban Jamaican African-origin adults. Also, for Jamaica, Francis et al. (2009) find that fast-food and sweetened beverage consumption were associated with being overweight and with high waist circumference in adolescents. For The Bahamas, Brathwaite, Brathwaite, and Taylor (2011) discovered that education was the strongest (negative) predictor of obesity prevalence. In a study of school-age children in Haiti, Morshed et al. (2016) found that always purchasing food at school, the mother's BMI, and household ownership of a bicycle were significant predictors of being overweight.

This study adds to the scarce literature on the factors associated with being overweight or obese in the Caribbean by investigating obesity among Surinamese adults. As far as we are aware, there is only one other study that has examined the determinants of any weight problem in Suriname. More specifically, Baldew et al. (2019) used data from the Healthy Life in Suriname (HELISUR) study to show that the obesity prevalence ratio was significantly lower in participants meeting the WHO physical activity recommendations, particularly those regarding commuting and leisure time domains.[9,10] The authors discovered that active minutes per week and total volume of activity were negatively associated with obesity for all adults in the African-Surinamese population but not in the Asian-Surinamese population.

Our paper uses the 2016–2017 Suriname Survey of Living Conditions to examine the role of socio-demographic factors on BMI among persons living in Surname. The results using regression analysis show that females, marital status, and age are significant predictors of higher BMI among Surinamese adults. In support of the findings of Baldew et al. (2019), the analysis also finds that even modest forms of exercise can be significant in lowering one's weight. Moreover, individuals who benefit from government social safety net programs are less likely to

[9] The Baldew et al. (2019) study, which was based on data on 1,079 persons collected between February 2013 and July 2015 in Paramaribo, found that 34.4 percent of the respondents were overweight, and 36.7 percent were obese. See Baldew et al. (2019) for further details.

[10] Cycling and/or walking from one place to another were defined as activities within the commuting domain, while walking activities and/or activities that were not included within the domestic and garden domain were classified as falling within the leisure time domain.

suffer from a weight problem. A more striking result, however, is that beneficiaries of social safety net programs are less likely to be overweight. The results are key to developing a multidimensional policy to successfully address the problem of obesity in Suriname.

The next section of this paper describes the data set. Section 3 then describes the empirical modeling strategy, and Section 4 presents and discusses the results. Concluding remarks are presented in Section 5.

## 2. Data

This study uses the 2016–2017 round of the Suriname Survey of Living Conditions (SSLC). The goal of the survey is to collect data on various socio-demographic variables to assist in poverty analysis, support the policymaking process, and develop objective baseline indicators for the design of projects financed by the Inter-American Development Bank (IDB). Data was collected over a period of one year to account for seasonality using a two-stage sampling process. About 2,100 households from all 10 districts of Suriname were surveyed using extensive questionnaires on education, health, child anthropometrics, access to social services, fertility, employment, housing, emigration, income, consumption, and financial inclusion. The sample consists of 3,803 adults aged 20 and older.

Using the 2016–2017 SSLC allows for accounting for various demographic, social, and economic factors, including rurality, physical activity, socioeconomic status, labor market outcomes, income, level of education, and asset ownership (including land, television sets and desktop computers). BMI is also easily calculated for each individual surveyed based on data collected on height (in centimeters) and weight (in kilograms).

The analysis applies the standard WHO cut-off values for BMI for the Western Hemisphere (Latin America and the Caribbean are considered a part of the Americas). Individuals with BMI values below 18.5 are considered underweight, those with values between 18.5 and 24.9 are considered to be of normal weight, those with values between 25 and 29.9 are considered overweight, and those with values of 30 and above are considered obese.

In contrast, Krishnadath et al. (2018) use data on individuals aged 20 to 65 to construct optimal ethnic and sex-specific cut-off values for adult obesity in Suriname. These BMI cut-off values are derived specifically for the prediction of hypertension and cardio-metabolic risk. The results from the Krishnadath et al. study show that these cut-off values vary significantly by sex and ethnic groups. For instance, for hypertension, the optimal cut-off values for adult male obesity are 28.4, 24.8, 25.2, 25.5, 25, and 25.9 for men who are, respectively, Amerindian, Creole, East Indian,

Javanese, Maroon, and Mixed. For cardio-metabolic risk, the authors found optimal cut-off values of 26.5 (Amerindian), 25.4 (Creole), 25 (East Indian), 25.5 (Javanese), 25.5 (Maroon), and 25.1 (Mixed) men. These values are generally higher for women belonging to the respective ethnic groups. Section 4 of the present study compares our results to estimates using these cut-off values and finds that our results do not change substantially.

The variables used in this study can be put into three categories: individual characteristics, economic variables, and health and physical activity variables.

### 2.1. Individual Characteristics

For this group (age 20 and older), the 2016–2017 SSLC allows for including the person's gender, marital status, age, and level of education. The person's corresponding ethnic group is also included, since different ethnic groups may have different diets and eating habits that could have an impact on BMI.

### 2.2. Economic Variables

These variables capture the level of economic activity of each individual and/or household. To account for the labor market status of each individual, employment status and total individual income are included. We also include a variable that captures public transfers from the government for individuals who benefit from government safety net programs. The number of young children present in each household is also included, as having young children could be a barrier to labor force participation, especially for women due to domestic caring responsibilities (Klasen and Pieters 2015). To account for asset ownership and wealth, we include the ownership of arable or homestead land by each household and the number of television sets and desktop computers owned by each household. Finally, we attempt to capture rurality by including variables that indicate whether an individual lives in the capital of Paramaribo and its environs, or in the interior regions of the country.

### 2.3. Health and Physical Activity

The health status of each individual is captured using a variable that indicates whether he/she has at least one of the following chronic conditions: diabetes, high blood pressure, asthma, arthritis, or cancer. The activity levels of individuals are accounted for by using a variable that indicates whether the person engages in physical activities such as regular walking, jogging, horse riding, exercising in a gym, or any other sporting activity.

### 2.4. Summary Statistics

Table 1 presents sample statistics according to each BMI category. Of the total sample, 4 percent is underweight (BMI is less than 18.5), 38 percent is within the normal weight category (BMI between 18.5 and 25), 36 percent is overweight (BMI between 25 and 30), and 22 percent is obese (BMI is greater than 30). This is also presented graphically using a bar chart for the total sample (Figure 1) and for various subsamples (Figure 2). These statistics are worrying, since more than half of the sample is either overweight or obese.

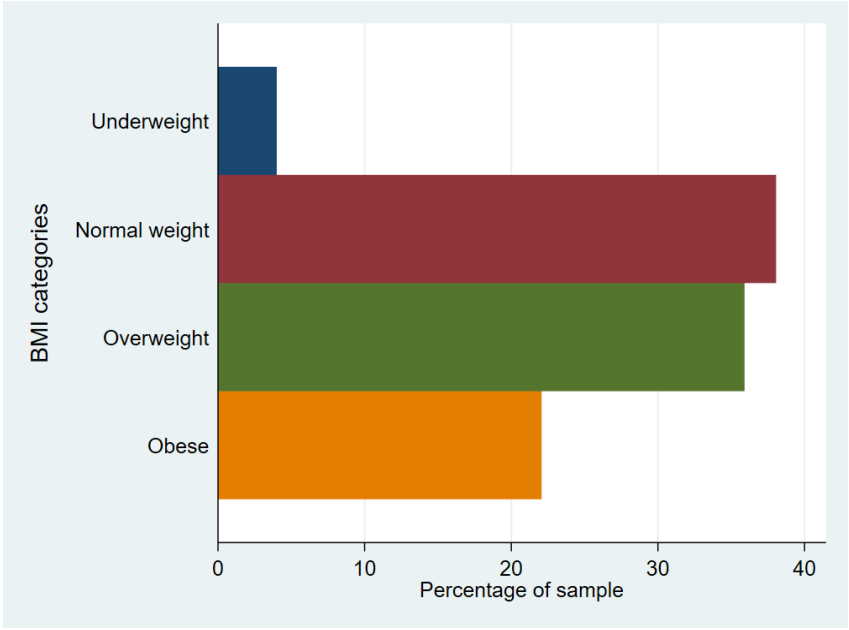
There are a few interesting patterns worth mentioning from Table 1 and the figures. First, women are more likely than men to be on the extremes of the BMI scale, that is, they are more likely to be underweight or obese, while men are more likely to be of normal weight or overweight (Figure 2). Surprisingly, Figure 2 also shows that the percentage of the sample that is overweight or obese is slightly higher for younger adults (aged 20 to 59) than for older ones (aged 60 and above). Table 1 shows that individuals who are married or living together are more likely to be overweight or obese. The same is true for individuals who have a chronic illness. On average, more than 60 percent of the individuals in the underweight category are of Asian origin. Finally, the category with the largest proportion of individuals who benefit from government social safety net programs is the underweight category.

**Table 1. Summary Statistics for Sample by Body Mass Index Categories, Suriname, 2016–2017**

| | Underweight (BMI<18.5) | Normal Weight (18.5<=BMI<25) | Overweight (25<=BMI<30) | Obese (BMI>=3) | Total |
|---|---|---|---|---|---|
| Female | 0.55 | 0.47 | 0.47 | 0.62 | 0.51 |
| | (0.50) | (0.50) | (0.50) | (0.48) | (0.50) |
| Married/living together | 0.39 | 0.56 | 0.64 | 0.67 | 0.61 |
| | (0.49) | (0.50) | (0.48) | (0.47) | (0.49) |
| Age | 43.30 | 46.00 | 46.40 | 46.90 | 46.20 |
| | (19.66) | (16.55) | (14.92) | (14.30) | (15.65) |
| Has completed general junior secondary education | 0.43 | 0.44 | 0.46 | 0.43 | 0.44 |
| | (0.50) | (0.50) | (0.50) | (0.49) | (0.50) |
| Lives in Paramaribo | 0.46 | 0.38 | 0.40 | 0.36 | 0.39 |
| | (0.50) | (0.49) | (0.49) | (0.48) | (0.49) |
| Asian | 0.62 | 0.55 | 0.52 | 0.48 | 0.53 |
| | (0.49) | (0.50) | (0.50) | (0.50) | (0.50) |
| African | 0.20 | 0.28 | 0.30 | 0.33 | 0.30 |
| | (0.40) | (0.45) | (0.46) | (0.47) | (0.46) |
| Indigenous | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 |
| | (0.20) | (0.16) | (0.16) | (0.15) | (0.15) |
| Mixed | 0.13 | 0.14 | 0.14 | 0.15 | 0.14 |
| | (0.34) | (0.35) | (0.34) | (0.36) | (0.35) |
| White | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | (0.00) | (0.06) | (0.05) | (0.00) | (0.05) |
| Individual is employed | 0.48 | 0.62 | 0.66 | 0.60 | 0.63 |
| | (0.50) | (0.49) | (0.47) | (0.49) | (0.48) |
| Individual is active | 0.50 | 0.53 | 0.48 | 0.49 | 0.50 |
| | (0.50) | (0.50) | (0.50) | (0.50) | (0.50) |
| Individual receives government assistance | 0.11 | 0.06 | 0.05 | 0.07 | 0.06 |
| | (0.32) | (0.24) | (0.21) | (0.25) | (0.23) |
| Individual has a chronic disease | 0.20 | 0.27 | 0.32 | 0.46 | 0.33 |
| | (0.40) | (0.45) | (0.47) | (0.50) | (0.47) |
| No. of TV sets and desktops in household | 1.09 | 1.25 | 1.27 | 1.24 | 1.25 |
| | (0.69) | (0.73) | (0.73) | (0.70) | (0.72) |
| Sample size | 152 | 1447 | 1365 | 839 | 3803 |

Source: Prepared by the authors.
Note: Standard deviations are in parentheses. BMI: Body Mass Index.

**Figure 1. Adult Body Mass Index Categories – Entire Sample**




Source: Prepared by the authors.
Note: BMI: Body mass Index.

**Figure 2. Adult Body Mass Index Categories – Subsamples**


Source: Prepared by the authors.

Note: BMI Body Mass Index.

## 3. Empirical Model

To investigate the relationship between the various socioeconomic variables and being overweight or obese, we run two probit models: a probit regression and an ordered probit regression. Both of these models are used because we investigate two dependent variables. The dependent variable for the probit model is a dummy variable that is equal to 1 if the individual's BMI is greater than or equal to 25, that is, if the individual is overweight or obese. For the ordered probit model, the dependent variable is a naturally ordered discrete variable that is equal to 1 if the individual is underweight, 2 if the individual is of normal weight, and 3 if the individual is overweight or obese. The ordered probit model is a generalization of the widely used probit model where the dependent variable has more than two outcomes (Aitchison and Silvey 1957; Aldrich and Nelson 1984).

Both models are specified as follows:

$$Y_{ij} = F\left(a + \beta_1 C_{ij} + \beta_2 H_{ij} + \beta_3 A_{ij}\right), \quad (1)$$

where *F* is the standard normal cumulative distribution function and the subscripts *i* and *j* denote individual and household, respectively. $Y_{ij}$ represents the dependent variable, which is some representation of the BMI category the individual falls within, *α* represents the constant, *Cij* is a vector of individual characteristics, *Hij* is a vector of household characteristics, and *Aij* is a vector of community characteristics. All standard errors are clustered at the household level to account for within-household correlation that may exist between individuals living in the same household.

The same set of independent variables is used for both models to facilitate easy comparison. The vector of individual characteristics (*Cij*) includes a dummy variable that is equal to 1 if the individual is female, a dummy variable equal to 1 if the individual is married or living together with his/her partner, age, age squared, and one's level of education, a dummy variable equal to 1 if the individual is employed, the log of total individual income, a dummy variable equal to 1 if the individual benefits from at least one government social safety net program, and a dummy variable equal to 1 if the individual has one of the following chronic conditions: diabetes, high blood pressure, asthma, arthritis, or cancer. We also account for the activity levels of individuals by including a dummy variable that is equal to 1 if an individual engages in at least one of the following physical activities: exercises in a gym at least once a week, engages in any sporting or physical activity at least once a week, jogs at least once a week, takes regular walks at least three times a week, or rides with a riding club at least once a week. Finally, we capture ethnicity using dummy variables that indicate whether an individual is Asian (includes East Indian, Javanese,

and Chinese), African (includes Creole and Maroon), Indigenous, White, and Mixed, with all other ethnic groups grouped together (Other) as the reference category.

The vector of household characteristics ($H_{ij}$) includes the number of television sets and desktop computers owned by the household, the number of children aged 0 to 5 within the household, and a dummy variable indicating that the household owns arable or homestead land. Finally, the vector of community characteristics ($A_{ij}$) is made up of a group of dummy variables that indicate whether an individual lives in the capital Paramaribo and its environs, or in Sipaliwini and its environs, which are mainly forest. The other districts are grouped together and act as the reference category.

## 4. Results

Table 2 shows the results from both the probit and ordered probit estimations in columns 2 and 4, respectively. The results are quite consistent across both models, especially regarding significance and the signs of the coefficients. The actual values of the coefficients are also reasonably similar. Column 3 presents the marginal effects of each of the variables from the probit model. The marginal effects from the ordered probit model are similar to those of the probit model. Hence, for a cleaner presentation, we present the marginal effects of only the probit model. It is worth mentioning that the results only show associations between each variable (while controlling for as many factors as possible) and the probability of being overweight or obese. They do not indicate a causal relationship.

Table 2 shows that the coefficient on females is positive and significant at 1 percent for both models. This means that women in Suriname have a higher risk of becoming overweight or obese. The marginal effect of females in the probit model (column 3) shows that, compared to men, the predicted probability of being overweight or obese for a Surinamese woman increases by 5.6 percent. Using a quantile regression analysis, Karaoglan and Tansel (2017) also find this to be true for Turkish women, especially at the highest quantiles of BMI.

The findings also indicate that the rate obesity and being overweight is much lower among single individuals, which includes persons who have never married or are widowed, separated, or divorced. This result is highly significant in both regression models. The marginal effect from the probit model shows that the predicted probability of being overweight or obese increases by 8.5 percent if an individual is married or shares a residence with his or her partner.

Similar to Costa-Font, Fabbri, and Gil (2009), Villar and Quintana-Domeque (2009), and Karaoglan and Tansel (2017), the relationship between age and individual BMI levels appears to

be concave, with a maximum turning point of 48.69 (Figure 3). This implies that the chances that an individual will become overweight or obese increases as the person gets older up until age 48. This is not surprising, as general health and physical activity levels decrease with age. After age 48, the relationship between BMI and age becomes negative. As expected the findings also indicate that chronic conditions such as diabetes, high blood pressure, and cancer are strongly associated with being overweight and obese. The predicted probability of being overweight or obese increases by 12.2 percent for adults who have at least one of these conditions. Several researchers suggest that these diseases are either caused by obesity or may result in becoming overweight or obese (Kinra et al. 2010; Martinez 2000; Nielsen et al. 2015).

The analysis also finds that active individuals are generally less likely to be overweight or obese. In particular, the predicted probability of being overweight or obese for individuals who engage in sporting activities at least once a week, work out in a gym at least once a week, or take a walk at least three times a week falls by about 3.8 percent. Although this result is not highly significant, it corroborates the results of Little et al. (2016b), who find that each hour of moderate physical activity is associated with a 0.085kg/m2 decrease in BMI among adults in rural South India. Using data from 15 member states of the European Union, Martínez-González et al. (1999) also find that obesity among adults is strongly associated with a sedentary lifestyle and physical inactivity during their leisure time. These findings are consistent with the view that even a modest level of physical activity may generate health benefits. This is especially true today, since modernization and technology have contributed to a general decline in physical activity (Little et al. 2016a; Misra et al. 2011; Ramachandran et al. 2004).

The results also show that individuals who benefit from government social safety net programs are less likely to be overweight or obese. The predicted probability of being overweight or obese for these individuals decreases by 6.8 percent. This may be a result of the fact that these individuals are usually the most vulnerable in the society and hence can barely afford to meet their basic needs. Actually, similar to Karaoglan and Tansel (2017) and Little et al. (2016b), we find some evidence that people with higher income levels tend to have higher BMI levels, although, unlike those papers, our result is not highly significant. According to the probit model, it also appears that the predicted probability of being overweight or obese falls by 13.7 percent for individuals of Asian origin.

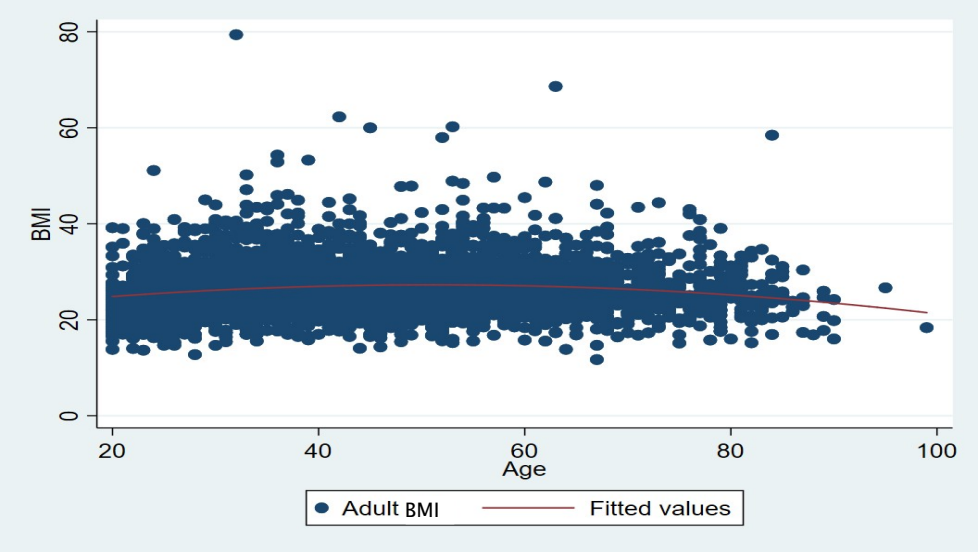
**Table 2. Factors Associated with Being Overweight/Obese – Probit Models**

| | Probit Model | | Ordered Probit |
|---|---|---|---|
| | **Estimates** | **Margins** | **Estimates** |
| Female | 0.149*** | 0.0560*** | 0.127*** |
| | (0.045) | (0.017) | (0.042) |
| Married/living together | 0.227*** | 0.0849*** | 0.241*** |
| | (0.047) | (0.018) | (0.046) |
| Age | 0.0485*** | 0.0182*** | 0.0527*** |
| | (0.008) | (0.003) | (0.008) |
| Age squared | -0.000498*** | -0.000187*** | -0.000531*** |
| | (0.000) | (0.000) | (0.000) |
| Lives in capital | -0.014 | -0.005 | -0.043 |
| | (0.049) | (0.019) | (0.048) |
| Lives in interior | 0.106 | 0.040 | 0.097 |
| | (0.128) | (0.048) | (0.131) |
| Asian | -0.364* | -0.137* | -0.273 |
| | (0.192) | (0.072) | (0.220) |
| African | -0.103 | -0.039 | 0.011 |
| | (0.194) | (0.073) | (0.221) |
| Indigenous | -0.085 | -0.032 | -0.076 |
| | (0.238) | (0.089) | (0.265) |
| Mixed | -0.188 | -0.071 | -0.083 |
| | (0.197) | (0.074) | (0.223) |
| White | -0.636 | -0.238 | -0.414 |
| | (0.484) | (0.181) | (0.412) |
| Employed | 0.023 | 0.009 | 0.054 |
| | (0.071) | (0.027) | (0.069) |
| Log of total income | 0.00481* | 0.00180* | 0.00476* |
| | (0.003) | (0.001) | (0.003) |
| Active individual | -0.103** | -0.0384** | -0.0772* |
| | (0.046) | (0.017) | (0.045) |
| No. of TV sets in household | 0.014 | 0.005 | 0.040 |
| | (0.033) | (0.012) | (0.032) |
| Level of education | -0.004 | -0.002 | -0.009 |
| | (0.022) | (0.008) | (0.022) |
| No. of 0-5 year olds in household | 0.056 | 0.021 | 0.052 |
| | (0.038) | (0.014) | (0.036) |
| Household owns agricultural land | -0.172 | -0.064 | -0.119 |
| | (0.124) | (0.046) | (0.108) |
| Receives government assistance | -0.182** | -0.0681** | -0.220** |
| | (0.091) | (0.034) | (0.087) |
| Has a chronic condition[11] | 0.325*** | 0.122*** | 0.321*** |
| | (0.050) | (0.019) | (0.048) |
| N | 3,803 | 3,803 | 3,803 |

Source: Prepared by the authors.
Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

[11] It should be noted that the inclusion of chronic conditions as an explanatory variable could potentially violate the assumption of orthogonality to the error term, since being obese may or may not be a risk factor for causing these conditions, thus affecting the interpretation of our variable "Has a chronic condition."

**Figure 3. Scatter Plot – Age and Body Mass Index**




Source: Prepared by the authors.
Note: BMI: Body Mass Index.

We also carry out our regressions separately for men, women, the young (aged 20 to 59) and the old (aged 60 and above). The results from these regressions are presented in Tables 3 (men), 4 (women), 5 (the young) and 6 (the old). There are a few patterns worth mentioning from these four tables. First, Tables 3 and 4 show that women (unlike men) with higher income levels have a larger propensity to be overweight or obese. Second, Table 5 shows that the predicted probability of being overweight or obese increases by 3.11 percent for young adults who have or live with very young children. The results of a qualitative study by Alvarado, Murphy, and Guell (2015) on Afro-Caribbean women corroborate this result. That study finds that being active tends to compete with family and caring responsibilities. Hence, adults with young children tend to be less active than adults who do not have any young children and therefore have a higher propensity to be overweight or obese. This is likely to be truer for women than for men, as other previous studies confirm that the responsibility for childcare in Caribbean countries falls predominantly on women (Handa 1996a, 1996b; Wyss 1995). Third, Tables 5 and 6 show that, specifically, it is Surinamese women aged 60 and above who have a greater propensity to be overweight or obese than their male counterparts. Finally, Table 6 shows that, in addition to senior women and seniors with a chronic condition, persons who live in the capital and its environs are less likely to be overweight or obese. The predicted probability of being overweight or obese decreases by 7.11 percent for older individuals who live in Paramaribo.

Finally, as a robustness check, we also create a dummy variable indicating whether an individual is obese using the ethnic and sex-specific cut-off values from Krishnadath et al. (2018) and re-run our probit regression using this variable as the dependent variable. The results from this estimation cannot be directly compared to our previous probit models in Tables 2, 3, 4, 5, and 6 because the dependent variable used for these models is a binary variable indicating whether an individual is either overweight or obese. To make our results comparable to the estimates using cut-off values of Krishnadath et al. (2018), we construct another binary variable indicating whether an individual is obese using the standard WHO adult obesity cut-off value of 30. The results are shown in Table 7. The results using standard WHO values are presented in column 2, while those using ethnic and sex-specific cut-off values for the prediction of hypertension and cardio-metabolic risk are presented in columns 3 and 4, respectively. Apart from the estimates for the categories of females, Asian, African, indigenous, and chronic illness, which change appreciably because the optimal cut-off values from Krishnadath et al. (2018) take these factors directly into account, the qualitative conclusions from our study largely remain the same.

**Table 3. Factors Associated with Being Overweight/Obese – Males**

| | Probit-Males | Probit-Margins | Ordered Probit-Males |
|---|---|---|---|
| Married/living together | 0.238*** | 0.0909*** | 0.250*** |
| | (0.069) | (0.026) | (0.065) |
| Age | 0.0441*** | 0.0168*** | 0.0484*** |
| | (0.012) | (0.005) | (0.012) |
| Age squared | -0.000454*** | -0.000173*** | -0.000476*** |
| | (0.000) | 0.000 | (0.000) |
| Lives in capital | -0.023 | -0.009 | -0.061 |
| | (0.067) | (0.026) | (0.065) |
| Lives in interior | 0.296 | 0.113 | 0.310* |
| | (0.191) | (0.073) | (0.175) |
| Asian | -0.649** | -0.248** | -0.521 |
| | (0.320) | (0.122) | (0.365) |
| African | -0.571* | -0.218* | -0.395 |
| | (0.322) | (0.123) | (0.366) |
| Indigenous | -0.286 | -0.109 | -0.232 |
| | (0.387) | (0.147) | (0.430) |
| Mixed | -0.576* | -0.220* | -0.406 |
| | (0.325) | (0.124) | (0.369) |
| White | -1.200** | -0.458** | -0.925* |
| | (0.555) | (0.211) | (0.495) |
| Employed | 0.114 | 0.044 | 0.170 |
| | (0.108) | (0.041) | (0.104) |
| Log of total income | 0.003 | 0.001 | 0.003 |
| | (0.004) | (0.001) | (0.004) |
| Active individual | -0.108* | -0.0412* | -0.081 |
| | (0.063) | (0.024) | (0.060) |
| No. of TV sets in household | 0.037 | 0.014 | 0.053 |
| | (0.045) | (0.017) | (0.043) |
| Level of education | 0.034 | 0.013 | 0.037 |
| | (0.033) | (0.012) | (0.030) |
| No. of 0-5 year olds in household | 0.056 | 0.021 | 0.070 |
| | (0.056) | (0.021) | (0.050) |
| Household owns agricultural land | -0.170 | -0.065 | -0.116 |
| | (0.160) | (0.061) | (0.138) |
| Receives government assistance | -0.190 | -0.073 | -0.201 |
| | (0.147) | (0.056) | (0.137) |
| Has a chronic condition | 0.188*** | 0.0718*** | 0.176** |
| | (0.073) | (0.028) | (0.069) |
| N | 1,869 | 1,869 | 1,869 |

Source: Prepared by the authors.

Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

**Table 4. Factors Associated with Being Overweight/Obese – Females**

| | Probit-Females | Probit-Margins | Ordered Probit-Females |
|---|---|---|---|
| Married/living together | 0.257*** | 0.0934*** | 0.262*** |
| | (0.066) | (0.024) | (0.063) |
| Age | 0.0512*** | 0.0186*** | 0.0536*** |
| | (0.011) | (0.004) | (0.011) |
| Age squared | -0.000523*** | -0.000190*** | -0.000547*** |
| | (0.000) | (0.000) | (0.000) |
| Lives in capital | 0.001 | 0.000 | -0.024 |
| | (0.067) | (0.024) | (0.065) |
| Lives in interior | -0.065 | -0.024 | -0.080 |
| | (0.165) | (0.060) | (0.176) |
| Asian | -0.058 | -0.021 | -0.019 |
| | (0.292) | (0.106) | (0.299) |
| African | 0.415 | 0.151 | 0.447 |
| | (0.296) | (0.107) | (0.301) |
| Indigenous | 0.183 | 0.067 | 0.133 |
| | (0.341) | (0.124) | (0.348) |
| Mixed | 0.237 | 0.086 | 0.262 |
| | (0.300) | (0.109) | (0.305) |
| White | 0.286 | 0.104 | 0.420 |
| | (1.150) | (0.418) | (1.035) |
| Employed | -0.116 | -0.042 | -0.089 |
| | (0.103) | (0.038) | (0.098) |
| Log of total income | 0.00860* | 0.00312* | 0.00866* |
| | (0.005) | (0.002) | (0.005) |
| Active individual | -0.127* | -0.0461* | -0.101 |
| | (0.067) | (0.024) | (0.066) |
| No. of TV sets in household | -0.014 | -0.005 | 0.025 |
| | (0.046) | (0.017) | (0.044) |
| Level of education | -0.021 | -0.007 | -0.032 |
| | (0.030) | (0.011) | (0.030) |
| No of 0-5 year olds in household | 0.049 | 0.018 | 0.033 |
| | (0.048) | (0.018) | (0.050) |
| Household owns agricultural land | -0.149 | -0.054 | -0.105 |
| | (0.185) | (0.067) | (0.169) |
| Receives government assistance | -0.180 | -0.065 | -0.231** |
| | (0.114) | (0.041) | (0.110) |
| Has a chronic condition | 0.438*** | 0.159*** | 0.440*** |
| | (0.071) | (0.025) | (0.068) |
| N | 1,934 | 1,934 | 1,934 |

Source: Prepared by the authors.
Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

**Table 5. Factors Associated with Being Overweight/Obese – The Young**

| | Probit-Young | Probit-Margins | Ordered Probit-Young |
|---|---|---|---|
| Female | 0.075 | 0.028 | 0.063 |
| | (0.051) | (0.019) | (0.049) |
| Married/living together | 0.265*** | 0.0985*** | 0.281*** |
| | (0.054) | (0.020) | (0.052) |
| Age | 0.0968*** | 0.0359*** | 0.0907*** |
| | (0.017) | (0.006) | (0.016) |
| Age squared | -0.00113*** | -0.000419*** | -0.00104*** |
| | (0.000) | (0.000) | (0.000) |
| Lives in capital | 0.036 | 0.013 | 0.009 |
| | (0.056) | (0.021) | (0.055) |
| Lives in interior | 0.103 | 0.038 | 0.069 |
| | (0.144) | (0.054) | (0.155) |
| Asian | -0.415* | -0.154* | -0.459** |
| | (0.238) | (0.088) | (0.221) |
| African | -0.182 | -0.068 | -0.175 |
| | (0.241) | (0.089) | (0.224) |
| Indigenous | -0.084 | -0.031 | -0.228 |
| | (0.293) | (0.109) | (0.286) |
| Mixed | -0.296 | -0.110 | -0.327 |
| | (0.244) | (0.091) | (0.227) |
| White | -1.265** | -0.469** | -0.986*** |
| | (0.550) | (0.203) | (0.357) |
| Employed | 0.018 | 0.007 | 0.029 |
| | (0.082) | (0.031) | (0.079) |
| Log of total income | 0.005 | 0.002 | 0.00587* |
| | (0.003) | (0.001) | (0.003) |
| Active individual | -0.120** | -0.0444** | -0.0936* |
| | (0.051) | (0.019) | (0.051) |
| No. of TV sets in household | 0.004 | 0.001 | 0.041 |
| | (0.038) | (0.014) | (0.037) |
| Level of education | -0.008 | -0.003 | -0.016 |
| | (0.026) | (0.010) | (0.025) |
| No. of 0-5 year olds in household | 0.0839** | 0.0311** | 0.0732* |
| | (0.040) | (0.015) | (0.039) |
| Household owns agricultural land | -0.156 | -0.058 | -0.102 |
| | (0.129) | (0.048) | (0.113) |
| Receives government assistance | -0.134 | -0.050 | -0.189** |
| | (0.097) | (0.036) | (0.093) |
| Has a chronic condition | 0.366*** | 0.136*** | 0.366*** |
| | (0.060) | (0.022) | (0.057) |
| N | 3,025 | 3,025 | 3,025 |

Source: Prepared by the authors.

Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

**Table 6. Factors Associated with Being Overweight/Obese – The Old**

| | Probit-Old | Probit-Margins | Ordered Probit-The Old |
|---|---|---|---|
| Female | 0.345*** | 0.129*** | 0.283*** |
| | (0.098) | (0.036) | (0.092) |
| Married/living together | 0.088 | 0.033 | 0.102 |
| | (0.108) | (0.040) | (0.103) |
| Age | 0.061 | 0.023 | 0.133 |
| | (0.112) | (0.042) | (0.108) |
| Age squared | -0.001 | 0.000 | -0.001 |
| | (0.001) | (0.000) | (0.001) |
| Lives in capital | -0.191* | -0.0711* | -0.209** |
| | (0.101) | (0.038) | (0.097) |
| Lives in interior | -0.002 | -0.001 | 0.110 |
| | (0.246) | (0.092) | (0.226) |
| Asian | -0.468 | -0.174 | -0.087 |
| | (0.392) | (0.146) | (0.502) |
| African | -0.063 | -0.024 | 0.240 |
| | (0.400) | (0.149) | (0.511) |
| Indigenous | -0.313 | -0.117 | 0.046 |
| | (0.477) | (0.178) | (0.557) |
| Mixed | -0.033 | -0.012 | 0.366 |
| | (0.406) | (0.151) | (0.514) |
| White | 0.000 | 0.000 | 4.833*** |
| | (.) | (.) | (0.575) |
| Employed | 0.005 | 0.002 | 0.118 |
| | (0.165) | (0.061) | (0.152) |
| Log of total income | 0.000 | 0.000 | -0.004 |
| | (0.008) | (0.003) | (0.008) |
| Active individual | -0.001 | -0.001 | 0.009 |
| | (0.101) | (0.038) | (0.097) |
| No. of TV sets in household | 0.070 | 0.026 | 0.066 |
| | (0.066) | (0.025) | (0.061) |
| Level of education | 0.024 | 0.009 | 0.030 |
| | (0.046) | (0.017) | (0.045) |
| No. of 0-5 year olds in household | -0.171 | -0.064 | -0.128 |
| | (0.109) | (0.040) | (0.105) |
| Household owns agricultural land | -0.268 | -0.100 | -0.207 |
| | (0.428) | (0.160) | (0.350) |
| Receives government assistance | -0.347 | -0.129 | -0.250 |
| | (0.304) | (0.113) | (0.238) |
| Has a chronic condition | 0.311*** | 0.116*** | 0.291*** |
| | (0.096) | (0.035) | (0.090) |
| N | 776 | 776 | 778 |

Source: Prepared by the authors.
Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

**Table 7. Factors Associated with Being Obese – Robustness Checks**

| | World Health Organization | Krishnadath et al. (2018) | |
|---|---|---|---|
| | | Hypertension | Cardio-metabolic Risk |
| Female | 0.331*** | -0.499*** | -0.369*** |
| | (0.050) | (0.045) | (0.045) |
| Married/living together | 0.205*** | 0.245*** | 0.265*** |
| | (0.055) | (0.049) | (0.049) |
| Age | 0.0345*** | 0.0346*** | 0.0419*** |
| | (0.010) | (0.009) | (0.009) |
| Age squared | -0.000391*** | -0.000381*** | -0.000473*** |
| | (0.000) | (0.000) | (0.000) |
| Lives in capital | -0.100* | -0.079 | -0.048 |
| | (0.057) | (0.050) | (0.050) |
| Lives in interior | 0.005 | 0.043 | 0.116 |
| | (0.134) | (0.126) | (0.126) |
| Asian | -0.235 | -0.215*** | -0.091 |
| | (0.230) | (0.072) | (0.071) |
| African | 0.029 | -0.058 | 0.069 |
| | (0.230) | (0.076) | (0.074) |
| Indigenous | -0.078 | -0.504*** | -0.028 |
| | (0.275) | (0.177) | (0.161) |
| Mixed | 0.036 | 0.000 | 0.000 |
| | (0.232) | (.) | (.) |
| Employed | -0.166** | -0.105 | -0.112 |
| | (0.081) | (0.072) | (0.072) |
| Log of total income | 0.0115*** | 0.00873*** | 0.00844*** |
| | (0.004) | (0.003) | (0.003) |
| Individual is active | -0.048 | -0.066 | -0.055 |
| | (0.051) | (0.046) | (0.046) |
| No. of TV sets in household | 0.003 | 0.015 | 0.029 |
| | (0.039) | (0.035) | (0.033) |
| Level of education | -0.023 | -0.017 | -0.0426* |
| | (0.025) | (0.022) | (0.023) |
| No. of 0-5 year olds in household | 0.014 | 0.048 | 0.043 |
| | (0.043) | (0.041) | (0.039) |
| Household owns agricultural land | -0.231 | -0.187 | -0.129 |
| | (0.161) | (0.139) | (0.129) |
| Receives government assistance | -0.019 | -0.148 | -0.121 |
| | (0.101) | (0.095) | (0.094) |
| Has a chronic condition | 0.447*** | 0.348*** | 0.395*** |
| | (0.054) | (0.051) | (0.051) |
| N | 3793 | 3758 | 3758 |

Source: Prepared by the authors.

Note: Standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

## 5. Conclusion

The high prevalence of obesity and being overweight in the Caribbean could cause serious public health issues if not addressed appropriately. Using Surinamese data, this study has found that almost 60 percent of the sample is either overweight or obese. It is therefore prudent for policymakers in Suriname and other Caribbean countries to develop national strategies to help healthcare systems cope with the outcomes of this phenomenon and tackle the risk factors that have the greatest impacts on individual BMI.

The goal of this paper has been to identify some of these risk factors by applying micro-econometric techniques to available data. To this end, we applied probit and ordered probit models to a sample of 3,803 adults aged 20 and above from the 2016–2017 round of the Suriname Survey of Living Conditions. We applied the standard WHO cut-off values for BMI: individuals with BMI values below 18.5 are considered underweight, those with values between 18.5 and 24.9 are considered to be of normal weight, those with values between 25 and 29.9 are considered overweight, and those with values of 30 and above are considered obese. We also looked at specific sub-groups in the population, including men, women, the younger population (aged 20 to 59), and more senior individuals (aged 60 and above).

The findings show that women, especially senior women and women who earn relatively higher incomes, are more at risk than their male counterparts of being obese or overweight. The results also indicate that the marital status of an individual can be strongly associated with his or her BMI. In particular, especially among the younger adult population, individuals who are married or living together are more likely to be obese. We also find that the propensity to be overweight or obese increases up to age 48, after which time the relationship becomes negative. We also show that having a chronic illness such as diabetes and high blood pressure is strongly associated with being overweight or obese. In addition, although the findings are not highly significant, we do find some evidence that active individuals are generally less likely to be overweight or obese. Finally, young adults (especially women of reproductive age) with young children aged 0 to 5 are more likely to be overweight or obese, as family caring responsibilities could compete with being active.

Although the results do not indicate a causal relationship, they nevertheless highlight the need in Suriname to design and implement pointed policies aimed at reducing obesity. However, the success of such policies is likely to hinge on taking into account the factors that are associated with being overweight. The results of this study can also be used to adjust current nutritional guidelines. Further, given the noted prevalence of obesity in other Caribbean countries, these results can influence action in countries where obesity policies do not exist.

## References


Abdulai, A. 2010. “Socio-economic Characteristics and Obesity in Underdeveloped Economies: Does Income Really Matter?” *Applied Economics* 42(2): 157–69.

Aitchison, J. and S. Silvey. 1957. “The Generalization of Probit Analysis to the Case of Multiple Responses.” *Biometrika* 44: 131–40.

Aldrich, J.H., and F.O. Nelson. 1984. “Linear Probability, Logit and Probit Models.” Sage University Paper Series on Quarantine Applications in the Social Sciences No.7–45.

Alvarado, M., M. Murphy, and C. Guell. 2015. “Barriers and Facilitators to Physical Activity amongst Overweight and Obese Women in an Afro-Caribbean Population: A Qualitative Study.” *The International Journal of Behavioral Nutrition and Physical Activity* 12(97).

Baldew, S.-S. M., F.S. Diemer, V. Cornelissen, G.P. Oehlers, L.M. Brewster, J.R. Toelsie, and L. Vanhees. 2019. “Physical Activity and Obesity: Is There a Difference in Association between the Asian-and African- Surinamese Adult Population?” *Ethnicity & Health* 24(4): 365–77.

Brathwaite, N., A. Brathwaite, and M. Taylor. 2011. “The Socio-economic Determinants of Obesity in Adults in The Bahamas.” *West Indian Medical Journal* 60(4): 434–41.

Costa-Font, J., D. Fabbri, and J. Gil. 2009. “Decomposing Body Mass Index Gaps between Mediterranean Countries: A Counterfactual Quantile Regression Analysis.” *Economics & Human Biology* 7(3): 351–65.

Forrester, T., R. Wilks, F. Bennett, N. McFarlane-Anderson, D. McGee, R. Cooper, and H. Fraser. 2007. “Obesity in the Caribbean.” In *The Origins and Consequences of Obesity: The Origins and Consequences of Obesity: Ciba Foundation Symposium 201,* edited by Derek J. Chadwick and Gail Cardew. Wiley.

Foster, N., A.M. Thow, N. Unwin, M. Alvarado, and T.A. Samuels. 2018. “Regulatory Measures to Fight Obesity in Small Island Developing States of the Caribbean and Pacific, 2015–2017.” *Pan American Journal of Public Health* 42.

Francis, D.K., J. Van den Broeck, N. Younger, S. McFarlane, K. Rudder, G. Gordon-Strachan, A. Grant, A. Johnson, M. Tulloch-Reid, and R. Wilks. 2009. “Fast-food and Sweetened Beverage Consumption: Association with Overweight and High Waist Circumference in Adolescents.” *Public Health Nutrition* 12(8): 1106–114.

Gao, P., and J. Shen 2017. “An Empirical Analysis on the Determinants of Overweight and Obesity in China.” *Applied Economics* 49(20): 1923–936.

Gaskin, P.S., H. Broome, C. Alert, and H. Fraser. 2008. ”Misperceptions, Inactivity, and Maternal Factors May Drive Obesity among Barbadian Adolescents.” *Public Health Nutrition* 11(1): 41–48.

GBD 2017 Risk Factor Collaborators. 2018. “Global, Regional, and National Comparative Risk Assessment of 84 Behavioral, Environmental, and Occupational, and Metabolic Risks or Clusters of Risks for 195 Countries and Territories, 1990–2017: A Systematic Analysis for the Global Burden of Disease Study 2017.” *Lancet* 392(10159): 1923–994.

Handa, S. 1996a. “The Determinants of Female Headship in Jamaica: Results from a Structural Model. *Economic Development and Cultural Change* 44(4): 793.

Handa, S. 1996b. Maternal Education and Child Attainment in Jamaica: Testing the Bargaining Power Hypothesis.” *Oxford Bulletin of Economics and Statistics* 58(1): 119–37.

Jackson, M., S. Walker, T. Forrester, J. Cruickshank, and R. Wilks. 2003. “Social and Dietary Determinants of Body Mass Index of Adult Jamaicans of African Origin.” *European Journal of Clinical Nutrition* 57(4): 621–27.

Karaoglan, D., and A. Tansel. 2017. :Determinants of Obesity in Turkey: A Quantile Regression Analysis from a Developing Country.” IZA Discussion Paper No. 10491, Bonn.

Katsaiti, M.-S. and A.A. El Anshasy. 2014. “On the Determinants of Obesity: Evidence from the UAE.” *Applied Economics* 46(30): 3649–658.

Kinra, S., L. Bowen, T. Lyngdoh, P. Dorairaj, K. Reddy, L. Ramakrishnan, R. Gupta, A. Bharathi, M. Vaz, A. Kurpad, G. Davey Smith, Y. Ben-Shlomo, and S. Ebrahim. 2010. “Sociodemographic Patterning of Non-communicable Disease Risk Factors in Rural India: A Cross-sectional Study.” *BMJ* 341, c4974.

Klasen, S., and J. Pieters. 2015. “What Explains the Stagnation of Female Labor Force Participation in Urban India?” *World Bank Economic Review* 29(3): 449–78.

Krishnadath, I.S., J.R. Toelsie, L.N. van Venrooij], A. Hofman, and V.W. Jaddoe. 2018. “Ethnic and Sex-specific Cut-off Values for Adult Obesity in the Suriname Health Study.” *Obesity Research & Clinical Practice* 12(4): 336–45.

Kuku, O., S. Garasky, and C. Gundersen. 2011. “The Relationship between Childhood Obesity and Food Insecurity: A Nonparametric Analysis.” *Applied Economics* 44(21): 2667–677.

Little, M., S. Humphries, K. Patel, and C. Dewey. 2016a. “Decoding the Type 2 Diabetes Epidemic in Rural India.” *Medical Anthropology* 36.

Little, M., S. Humphries, K. Patel, and C. Dewey. 2016b. “Factors Associated with BMI, Underweight, Overweight, and Obesity among Adults in a Population of Rural South India: A Cross-sectional Study.” *BMC Obesity* 3(12).

Martinez, J.A. 2000. “Body-weight Regulation Causes of Obesity.” *Proceedings of the Nutrition Society* 59(3): 337–45.

Martínez-González, M., M. Alfredo, F. Hu, M. Gibney, and J. Kearney. 1999. “Physical Inactivity, Sedentary Lifestyle and Obesity in the European Union.” *International Journal of Obesity and Related Metabolic Disorders* 23: 1192–201.

Miljkovic, D., S.H. de Miranda, A.L. Kassouf, and F.C. Oliveira. 2018. “Determinants of Obesity in Brazil: The Effects of Trade Liberalization and Socio-economic Variables.” *Applied Economics* 50(28): 3076–088.

Misra, A., N. Singhal, B. Sivakumar, N. Bhagat, A. Jaiswal, and L. Khurana. 2011. “Nutrition Transition in India: Secular Trends in Dietary Intake and Their Relationship to Diet-related Non-communicable Disease.” *Journal of Diabetes* 3: 278–92.

Morshed, A.B., H.V. Becker, J.R. Delnatus, P.B. Wolff, and L.L. Iannotti. 2016. “Early Nutrition Transition in Haiti: Linking Food Purchasing and Availability to Overweight Status in School-aged Children.” *Public Health Nutrition* 19(18): 3378–385.

Ng, M., T. Fleming, M. Robinson, B. Thomson, N. Graetz, C. Margono, E.C. Mullany, S. Biryukov, C. Abbafati, S.F. Abera, et al. 2014. “Global, Regional, and National Prevalence of Overweight and Obesity in Children and Adults during 1980–2013: A Systematic Analysis for the Global Burden of Disease Study 2013.” *The Lancet* 38(9945): 766–81.

Nielsen, M., M. Pareek, O. Gerke, M. Leosdottir, P. Nilsson, and M. Olsen. 2015. “Greater Body Mass Index Is a Better Predictor of Subclinical Cardiac Damage at Long-term Follow-up in Men than Is Insulin Sensitivity: A Prospective, Population-based Cohort Study.” *BMC Cardiovascular Disorders* 15.

Popkin, B.M., L.S. Adair, and S.W. Ng. 2012. “Global Nutrition Transition and the Pandemic of Obesity in Developing Countries.” *Nutrition Reviews* 70(1): 3–21.

Ramachandran, A., C. Snehalatha, A.D.S. Baskar, S. Mary, C.K. Sathish Kumar, S. Selvam, S. Catherine, and V. Vijay. 2004. “Temporal Changes in Prevalence of Diabetes and

Impaired Glucose Tolerance Associated with Lifestyle Transition Occurring in the Rural Population in India." *Diabetologia* 47(5): 860–65.

Siddiqui, M.Z., and R. Donato. 2016. "Overweight and Obesity in India: Policy Issues from an Exploratory Multi-level Analysis." *Health Policy and Planning* 31(5): 582–91.

Sobers-Grannum, N., M.M. Murphy, A. Nielsen, C. Guell, T.A. Samuels, L. Bishop, and N. Unwin. 2015. "Female Gender is a Social Determinant of Diabetes in the Caribbean: A Systematic Review and Meta-analysis." *PloS One* 10(5).

Villar, J.G., and C. Quintana-Domeque. 2009. "Income and Body Mass Index in Europe." *Economics & Human Biology* 7(1): 73–83.

World Obesity Federation. 2020. *Obesity: Missing the 2025 Global Targets - Trends, Costs and Country Reports.* London: World Obesity Federation.

Wyss, B. 1995. "Gender and the Economic Support of Jamaican Households: Implications for Children's Living Standards." Ph. D. thesis, University of Massachusetts, Amherst.