New Evidence of the Effect of Body Weight on Labor Market Outcomes in Brazil

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Resumo

Este artigo fornece novas evidências do efeito do peso corporal sobre os sucessos no mercado de trabalho no Brasil. A metodologia usa mudanças no peso corporal devidas a fatores genéticos como uma fonte de variação exógena. Os resultados mostraram que o peso corporal tem um efeito positivo sobre os salários e a probabilidade de emprego formal. Além disso, evidenciaram-se impactos heterogêneos por sexo, raça e área de residência. A evidência sugere também que a educação é um importante mecanismo através do qual o peso corporal afeta os sucessos no mercado de trabalho.

Palavras chaves: Peso corporal, sucessos no mercado de trabalho, emprego formal.

Classificação JEL: I10, J30, J24

Abstract

This paper provides new evidence of the effect of body weight on labor market outcomes in Brazil. The methodology exploits changes in body mass index due to genetic factors as a source of exogenous variation. We found that body weight has a positive effect on wages and formal employment. Furthermore, we also find heterogeneous effects by sex, race, and residence, and area. The evidence also suggests that education is an important mechanism through which body weight affects labor market outcomes.

Keywords: Body weight, Labor market outcomes, Formal employment.

JEL classification: I10, J24, J30

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1. Introduction

This paper provides new evidence of the effect of body weight on labor market outcomes in a developing country context. Besides estimating the effects on wage, we also examine informal employment, one dimension of labor market that is prevalent in developing countries and has not previously been examined by literature. The literature has long discussed the relationship between body size, measured by body mass index (BMI), and labor market outcomes (BAUM; FORD, 2004; CAWLEY; HAN; NORTON, 2009; CAWLEY, 2004). It has been argued that obesity increases the risk of various diseases such as cancer, diabetes, depression and arthritis (ABBOTT et al., 1994; PI-SUNYER, 2002), adversely affecting labor productivity. This has been one of the main arguments in the literature to expect a negative relationship between BMI and wages, and much of the evidence, which has focused on the developed countries, is consistent with this view. However, such relationship may be different in developing countries. To the extent that the insufficient intake of nutrients is much more prevalent in developing countries, weight gains may reflect better health and nutrition, which could result in higher labor productivity. There is evidence consistent with this. Indeed, while increases on BMI lower wages in obese people, increases in BMI are associated with higher wages in non-obese individuals(SHIMOKAWA, 2008; WADA; TEKIN, 2010). This suggests that increases in BMI, on average, may lead to better labor market outcomes in developing countries.

Understanding the effects of body size on labor market outcomes is important for a number of reasons. First, an estimation of this relationship may provide relevant information on the determinants of poverty persistence due to that success in the labor market is directly related to family income and individual welfare. Second, understanding the effects of variations in the health and nutrition on labor productivity might contribute to formulation of employment benefit policies such as health insurance, health promotion programs and disease management interventions. Third, because body weight is related to health, the economic effects of events in the environment, such as environment-related disease, affecting health may be better quantified. This is particularly important in developing countries since adverse health shocks are more frequent and harder to be mitigated (CURRIE; VOGL, 2013).

Any empirical exercise that attempt to ascertain the importance of body weight in labor market outcomes must take into consideration the endogeneity of BMI. A source of endogeneity is simultaneity or reverse causality. Individuals with higher earnings may differently invest in their health. Moreover, if relevant variables, such as individual background, that are correlated with both labor productivity and BMI are omitted, the regressions will be subject to omitted variables bias, or the second source of endogeneity. Furthermore, if the anthropometric variables used to calculate the BMI are subject to measurement error, then this would lead to attenuation in the estimates. These sources of bias have been well discussed in the literature and various methods have been proposed to remedy. For developing countries, much of the existing studies have used disease environment, health infrastructure and health input prices as instruments for BMI. In the Brazilian case, Thomas and Strauss(1997)use the relative prices of food as instrumental variables for BMI and find that higher BMI leads to higher wages. The problem with using these instruments is that they could be correlated with other local characteristics (e.g. input supplies for firms) that may affect wages regardless of BMI.

Using Brazilian data, we explore the strategy proposed by Cawley (2004), which exploits changes in BMI due to genetic factors as a source of exogenous variation. Specifically, this author proposes the use of the BMI of a sibling as instrumental variable for BMI, arguing that the BMI between siblings is strongly correlated because they share much of the same genes. The crucial assumption of this identification strategy is that the BMI of a sibling is not correlated with unobserved determinants of labor market outcomes. The plausibility of this assumption relies on the evidence suggesting that the correlation between BMI across siblings is not explained by home environment (COMUZZIE; ALLISON, 1998; VOGLER et al., 1995).

Differently from previous studies, we extend the analysis to a measure related to employment quality. Specifically, we investigate the effect of body size on labor informality among

Brazilian workers. The literature has emphasized the potential detrimental effects of informality on well-being due to inferior working conditions. If the BMI is related to productivity, then differences in BMI could explain variations in the employment conditions because the least productive individuals may be unable to find work in the formal sector. Alternatively, less productive individuals may see the informal sector as a mechanism for receiving higher income than that they would receive in the formal sector.

Brazil is a developing country characterized by one of the highest inequalities in income. At the same time, Brazil has a high fraction of people living below the poverty line. The figures indicate that about 6.8 % of the population living on less than $2.00 a day in 2012(WORLD BANK, 2015). Not surprisingly, in many other ways Brazil is a developing country: life expectancy is 73 years, which is nearly 15 years lower than in countries such as Japan; infant mortality is 12 per hundred thousand inhabitants, a figure 150% higher than the corresponding to US; and the incidence of malnutrition is 10 times higher than in countries like Canada. Therefore, an investigation of the magnitude of the effect of body weight on labor market outcomes would provide useful information for the formulation of policies aimed at reducing inequality and poverty in the country.

To preview, we found that increases in BMI is associated with better labor market outcomes. Specifically, we found that BMI has a positive effect on wages and reduces the likelihood of informal employment (measured as lack of social security). We also find heterogeneous effects by sex, race and urban/rural status. Indeed, we find a greater impact on women, non-white people and individuals living in urban areas. We also found suggestive evidence that education is an important mechanism through which BMI affects labor market outcomes. In particular, we find that the effect of BMI on wages is reduced by about 80% when the years of schooling is included as a control variable. Education is a plausible mechanism in view of studies showing that poor health, particularly during early stages of life, may adversely affect human capital accumulation(CURRIE, 2009; JANET CURRIE; ENRICO MORETTI, 2007). Thus, one possible interpretation is that lower BMI means poorer health, which implies less human capital formation and, in turn, worse labor market outcomes. However, we recognize the possibility that our analysis underestimate or exaggerate the role of education as mechanisms since we do not solve the endogeneity of education. Therefore, we see this as an exploratory exercise and should be interpreted as suggestive.

The rest of the paper is organized as follows. The following section presents a review of the literature. The third section presents a description of the data. The fourth section presents a description of the methodology used and discusses the plausibility of using the strategy proposed by Cawley (2004) in the Brazilian context. In the fifth section, we present the results of the estimates from OLS and Instrumental Variables (IV). Finally, the sixth section concludes with a discussion of the results.

2. Literature

There is a large body of studies investigating how labor market outcomes respond to variations in body weight. Most of this empirical evidence is concentrated in developed countries[5]. In particular, the relationship between weight and wages tend to be negative in developed world, but positive in developing countries(CAWLEY; HAN; NORTON, 2009). For developing countries, it has been documented that the increase of weight (from underweight to normal) is associated with the improvement of current health status and thus with higher level of labor productivity (SCHULTZ; PETERS; HEDLEY, 1995; THOMAS; STRAUSS, 1997). Another possible explanation for the negative sign in developing economies is attributed to the fact that jobs are

[5] See, for example, Sargent and Blanchflower (1994), Baum and Ford (2004), Shimokawa (2008), Greve (2008), Kline and Tobias (2008) and Norton and Han (2008).

more exhausting in developing countries and higher body mass upgrades productivity in this way (GLICK; SAHN, 1998).

In an often-cited study, Cawley (2004) found that weight has negative impact on wages for white females using employs the fixed effect and IV models with the BMI of a sibling as instrument for BMI in order to deal with the endogeneity of weight. The authors pointed out that OLS estimates for those females indicate that difference in weight of two standard deviations (around 64 pounds) is associated with a difference in wages of 9 percent. This difference in wages is equivalent in absolute value to the wage effect of roughly 1.5 years of education or three years of work experience (CAWLEY, 2004, p 468). His results of other gender-ethnic groups showed a negative weight–wage relationship caused by unobserved heterogeneity. Other empirical contributions have already indicated that heavier individuals tend on average to earn less in developed countries(KLINE; TOBIAS, 2008; NORTON; HAN, 2008). For example, Conley and Glauber (2006) using data from the Panel Study of Income Dynamics (PSID), estimate sibling fixed effects models where a body mass index measure is lagged by 15 years to correct for endogeneity bias. Conley and Glauber (2006) compare OLS estimates with sibling fixed effects estimates and find that obesity is associated with an 18% reduction in women's wages and a 16% reduction in women's probability of marriage. Using data on bioelectrical impedance analysis for United States, Wada and Tekin (2010) develop measures of body composition, body fat, and fat-free mass, and analyze the relationship with wages. Their results indicate that body fat is associated with decreasing wages for both women and men, and fat free mass is associated with increased wages. Sabia and Rees (2012) used OLS and fixed effects estimates to provide evidence that overweight white women are paid substantially less per hour than their slimmer counterparts. Finally, Sabia and Rees (2012)used a model two-stage least squares (2SLS) that used sibling BMI or mother's obesity status in order to confirm and isolate exogenous variation in body weight.

Conversely to studies described above, literature in developing countries seems to show a positive sign in the correlation between weight and wage[6]. In view, Schultz (2003) found that a unit increase in BMI is associated with a 9% raise in wages for women in the Ivory Coast. His results for men suggested that an additional unit of BMI increases men's wages by 15% in the Ivory Coast and by 7% in Ghana. Schultz (2003) used instrumental variable techniques to correct for the potential endogeneity and errors in measurement of BMI. Dinda et al., (2006), using data from of Indian coalmine workers, estimate the associations between body weight and labor market outcomes. Dinda et al., (2006) found a positive effect of BMI on wage earnings. For Brazil, Thomas and Strauss (1997) examined the link of body side with wages among a sample that gathered detailed information of 53,000 households on incomes, expenditures, and socio-demographic characteristics of household members. Using relative prices of food as instrumental variables for BMI, these authors provided evidence that BMI is associated with higher wages for males after controlling for height and nutrient intakes, and these impacts are generally largest among the less educated.

3. Data

This study uses data from the last Consumer Expenditure Survey – POF (*Pesquisa de OrçamentosFamiliares*) 2008-2009 which was conducted by the Brazilian Census Bureau – IBGE (*InstitutoBrasileiro de Geografia e Estatística*) between May 2008 and May 2009 through interviews in a sample of Brazilian households. Each household was interviewed for a 7-day period through questionnaires regarding the household and its members. The survey aimed to provide information on the household budget composition and on population's life conditions as to measure the structures of consumption, expenditures and income sources. The sampling of

[6] For instance, a higher weight-for-height is associated with higher wages in Philippines (HADDAD; BOUIS, 1991) and Guinea (GLICK; SAHN, 1998).

POF is part of the group of complex surveys which involves the use of three types of probability samples (simple random sampling, stratified sampling and cluster sampling). Firstly, census sectors, which are geographical areas defined in the Brazilian 2000 Demographic Census, were selected to form a chief sample used by IBGE in all household surveys of the bureau. These sectors were then divided in strata by a geographical and statistical stratification method[7]. Secondly, census sectors were sampled from each stratum and formed a subsample used to select the 55,970 households of POF final sample. All the information is available in the form of microdata disposed in different records. Only Registers 02 and 14 were used in this study, the first is related to the people living in the household and the second has information on labor, income and income deductions. The sample of this study includes family[8] members in the household from 18 to 40 years old and was restricted to individuals that were registered as children in POF. In other words, these individuals are related to the household manager through a parental relationship. This restriction was imposed due to the estimation method chosen to test the hypothesis on how Body Mass Index (BMI) affects household members' labor market outcomes. More precisely, the estimation requires information on the individual's siblings. Furthermore, the sample excluded individuals that were not in the labor market.

In Brazil, country-representative household budget surveys have been conducted since the seventies' decade and more recently information on anthropometric measures was collected from each member in the household during the period of the interview. These measures contain information such as body weight and height which made possible to calculate the BMI. This index was then estimated for each individual by dividing weight (kilos) by the square of height (meters).

In order to establish a relationship between BMI and labor market outcomes the variables considered were people's hourly wages and a proxy created to measure informality in the labor market. The hourly wage variable is simply the division of the individual's monthly labor income by the number of monthly hours worked. We only considered in the analysis the main job declared by the respondent and jobs of only four groups: private sector, public sector, domestic and temporary (rural areas). In addition, we only considered monthly wages above 100.00 Brazilian *Reais* to generate the hourly wage variable. To create the proxy for informality, we used one of the indexes presented Henley, Arabsheibani, and Carneiro (2009). These authors define informality as the number of people in the labor market that do not contribute to any form of social security. We created a binary variable as a measure of the informal labor market; this variable is equal to 1 if the individual did not contribute to a public social security system, and 0, otherwise. The other variables included were the individual's social and demographic characteristics such as age, month of birth, sex, race, education years, area of residence and region. These are considered control variables that could also affect labor market outcomes.

Table 1 presents the summary statistics for all the variables discussed. It is interesting to notice the high participation of informal labor market at 42%. The maximum hourly wage observed was 116.79 Brazilian *Reais*. The level of BMI is on average 23.67 which is considered normal weight according to World Health Organization classification[9] (WHO, 1995). The age is on average 26 years and the years of education is on average 10 years. About 58% of the individuals are male and 52% declared themselves as whites. Only 9% of the individuals live in rural areas while 41% belong to cities in the metropolitan area. Most of the individuals live in the Southeast of Brazil (53%) followed by Northeast (21%) and South (14%).

[7] For more details on POF stratification method see the publication "*Despesas, rendimentos e condições de vida*" of IBGE.

[8] The definition of family differs from the definition of household in POF. One household is composed by people who live under the same roof and share food and living expenses while families are blood-related individuals or individuals connected by domestic dependence or living rules. This implies that one household can have more than one family. Particularly, this condition was observed in only 5.34% of the 55.970 sampled households.

[9] The WHO classification of body weight is: underweight if BMI < 18.5 kg/m², normal if 18.5 kg/m² $\geq$ BMI < 25 kg/m², overweight if 25 kg/m² $\leq$ BMI < 30 kg/m² and obese if BMI ≥ 30 kg/m².

4. Empirical Strategy

We use the technique of instrumental variables to estimate the effect of BMI on labor market outcomes as follows:

First stage:

$$\mathrm{BMI}_i = \theta\, \mathrm{BMI}_i^{\mathrm{sibling}} + X'\beta + \xi_i \qquad (1)$$

Second stage:

$$y_i = \delta \widehat{\mathrm{BMI}}_i + X'\pi + \eta_i \qquad (2)$$

BMI is the body mass index of the individual i and $\mathrm{BMI}_i^{\mathrm{sibling}}$ is the body mass index sibling. $y$represents different measures of labor market outcomes. The *X* vector includes a set of specific individual characteristics such as sex, race, and civil status. The terms ξandη are idiosyncratic errors. The standard errors are clustered at States level.

The final coefficient of interest is δ, which represents the effect of BMI on a given labor market outcome measure. The model essentially follows the same strategy of identifying of Cawley(2004). The assumptions behind the identification strategy are: i) the sibling BMI has a significant correlation with the BMI; and ii) the sibling BMI is properly excluded from the equation (2), or equivalently is uncorrelated with η. The validity of the first assumption is expected due to the sibling of same parents share half of their genes. This would ensure a strong correlation between BMI and sibling BMI.

The second assumption is more challenging since we have no way to test their validity in the data. However, there is indirect evidence for this assumption, as discussed by Cawley (2004). However, it could be argued that non-genetic variation in BMI could be correlated with the error term of the second-stage. In particular, a possibility is that learning habits at home are correlated with BMI and wages. Nevertheless, there is no evidence finding that a significant effect of common environment within the home on BMI (COMUZZIE; ALLISON, 1998; VOGLER et al., 1995). On the other hand, there is evidence shown, for example, that the BMI between adopted siblings are significantly correlated. This suggests that most of the BMI correlation between siblings is mainly explained by genetic factors. These facts make plausible the main assumption of the identification strategy.

5. Results

5.1. OLS and IV Estimates

The first procedure to analyze the relationship between BMI and labor market outcomes was to estimate OLS regressions (See Table 2).Panel A shows the results for wage while panel B shows the results for informal employment. Column (1) is based on a specification that includes State and Cohort fixed effects (dummies controlling for the individual's birth year) and a dummy for male individuals as control variables. The other columns correspond to different specifications that include additional groups of controls. At the bottom of the table, the number of observations presented.

The BMI parameter varies from a significant effect on the logarithm of hourly wages in the first specification to insignificant estimates in the remaining ones. In terms of magnitude, the parameter of interest suffered a substantial decrease when more control variables were included. When the controls related to the area of residence are added the coefficient of interest is reduced by 32%, and now is not significant. Indeed, when all the control variables are added (column 4), the coefficient of interest is reduced by 223%.

On the other hand, the relationship between BMI and informal employment is never statistically significant. As more groups of controls are included, the parameter became larger. It is also important to note that the sign of the coefficients is positive; it suggests that higher BMI increases the likelihood of informal employment. This is counterintuitive.

In general, there is little evidence of a systematic association between BMI and labor market outcomes. In addition, the results are very sensitive to control variables included in the regressions. This suggests that the measurement error in BMI and omitted variable bias could play an important role.

The second approach to estimate the relationship between BMI and labor market outcomes in Brazil was carried out by making use of instrumental variables. All the estimates are from two-stage least squares estimation. We opted to use as instrument the BMI of the individual's sibling. Table 3 presents evidence that the sibling's BMI is strongly correlated with BMI. Specifically, the estimates shown are for the equation that relates the individual's BMI to his/her sibling's BMI. The sign of the coefficient is positive and statistically significant in all regressions, as expected. Also, the F-statistics for instrument exclusion above 10 indicates that the sibling's BMI has sufficient predictive power on BMI. Importantly, the parameter of interest does not change significantly, as different controls were included in the regression. For example, the coefficient of interest changes from 0.17 to 0.168.This can be interpreted as evidence favorable to the fundamental assumption of the identification strategy.

Table 4 presents instrumental variables estimates of the association between BMI and labor market outcomes. In this regression the individual's own BMI was instrumented by his/her sibling's BMI and the same controls included in the previous regressions were used as shown in Columns from (1) to (4). In contrast to OLS estimates, the instrumental variables results are all significant. The addition of more sets of controls caused a decrease in the parameters magnitude in both the hourly wage and the informal employment equations. However, it seems to stay more stable in comparison to OLS estimates. The results indicate that increases in BMI are associated with increases in wages. An important difference with the OLS results is that now the effect on informal employment BMI is negative and statistically significant, suggesting that increases in BMI reduces the likelihood of informal employment.

The BMI effect on labor market outcome was also evaluated in different subsamples to capture the heterogeneity of this effect among different groups of the society. Table 5 illustrates how BMI may affect hourly wages and informal employment according to the individuals' sex, race and residence area. It was used instrumental variables estimation considering all the group of controls. Interestingly, the positive impact on wages and the negative impact on informal employment were also observed in all subsamples. Nevertheless, BMI may not affect labor market outcomes of some groups separately.

The parameters were significant only for female individuals, non-white individuals and for people living in urban areas in the hourly wages equation. On the informal employment equation, the significant parameters were also for female individuals and in contrast to the hourly wage equation, informal employment seems to be affected by BMI only for people in rural areas. These results indicate that BMI is positively related to women's hourly wages and it has no influence on male individuals' labor market outcome.

The significant relationship between BMI effect and hourly wages of non-white individuals indicates that race is a relevant aspect on this subject as a higher body weight or a better sign of nutritional condition may enhance higher wages in this specific group. It makes sense that only individuals in urban areas may present a positive response on hourly wages by an increase on BMI. Labor markets in urban areas tend to be more competitive and individuals with a higher body mass may more productive and therefore better compensated.

5.2. Does Education Matter?

Our final effort is to present evidence on a potential channel through which BMI may affect labor market outcomes. In particular, we investigate if education plays a role. In order to address this issue directly, Table 6 present an exercise in where we run the benchmark specification controlling for years of education (Column 2).The education could be a mechanism give that human capital accumulation is directly affected by individual's health conditions, as suggested by the literature (CURRIE, 2009; JANET CURRIE; ENRICO MORETTI, 2007). For comparison proposal, the column (1) of Table 6 presents the results of the column (4) of Table 4. The results in panel A in the table show that the effect of BMI on wages are reduced and no longer statistically significant when education years is included as a control variable. In fact, the effect of BMI on hourly wages is reduced by about 80%. Panel B results indicate that the effect of BMI on informal employment is also reduced (in absolute value) and no longer statistically significant. These results suggest that education may be an important mechanism through which the BMI affects labor market outcomes. However, we emphasize that this exercise can be considered as suggestive and demands further investigation.

5.3. Robustness of Findings

Our strategy to test the validity of the results was to analyze the changes on BMI parameters by performing two different specifications. One consisted in the exclusion of outliers in BMI and the other in the inclusion of extreme low values in wages. Table 7 presents the results of the alternative specifications in comparison to the baseline model in Column 1. The results in the table show that the estimates are not sensible to outliers both in BMI and wage.

6. Final Remarks

Analyzing the relationship between Body weight and labor market outcomes has been the main subject of this study. To deal with the potential endogeneity of body weight, we use instrumental variable technique. Our findings suggest that higher BMI is associated with higher wages and reductions in the probability of informal employment. In addition, we found that the effects are greater in women, the nonwhite people and individuals living in urban areas. These results contrast with those of developed countries where a negative relationship is found between BMI and labor market outcomes. One potential explanation is that increments in BMI mean improvements in the health and nutrition due to that of nutrient intake is lower in developing countries. This interpretation is also consistent with studies that show a nonlinear association between BMI and wages. Specifically, these studies show that BMI follow an inverse-U-shaped pattern relative to wages, being the turning point a BMI of 29(SHIMOKAWA, 2008; WADA; TEKIN, 2010).

Our results also suggest that education may be an important mechanism through which the BMI affects the results of the labor market. This is plausible in view of studies showing that early nutrition is an important determinant for formation of human capital. Therefore, our results could represent the long-term relationship between BMI and labor market outcomes. Nonetheless, evidence of this study is essentially suggestive and requests further research.

We are aware that there are several limitations. The use sibling's BMI as an instrument implies that our sample is based on individuals who have at least one sibling. Therefore, our results may not be generalized to the entire population. Furthermore, the use of that instrument necessarily implies a reduction in the number of observations which could affect the precision of estimates. Setting aside the issue of generalizability, the fact that the performance in the labor market is directly related to poverty and individual welfare, estimating the causal effect of malleable variables in terms of policy as the BMI is an important question *per se*.

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Tables

Tables

Table 1. Summary Statistics

	N	Mean	Standard Deviation	Min	Max
Labor Market Outcomes:					
Hourly wage	8,831	4.83	5.60	0.47	116.79
Informal employment	8,461	0.42	0.49	0	1
Socioeconomic and Demographic Characteristics					
Body Mass Index (BMI)	8,831	23.67	4.32	13.80	150
Age (in years)	8,831	26.06	7.57	18	60
Male	8,831	0.58	0.49	0	1
White	8,831	0.52	0.50	0	1
Education years	8,770	10.48	3.14	0	15
Area residence :					
Rural	8,831	0.09	0.28	0	1
Metropolitan City	8,831	0.41	0.49	0	1
Region:					
North	8,831	0.05	0.21	0	1
Northeast	8,831	0.21	0.41	0	1
Southeast	8,831	0.53	0.50	0	1
South	8,831	0.14	0.35	0	1
Midwestern	8,831	0.07	0.25	0	1

Source: Research results.

Notes: All statistics were obtained using sample weights.

Table 2. OLS Estimates of the Relationship between BMI and Labor Market Outcomes

	(1)	(2)	(3)	(4)
		Panel A: Log of Hourly Wage		
Body Mass Index	0.00356	0.00268	0.00240	0.00110
	[0.00192]*	[0.00184]	[0.00196]	[0.00175]
Number of observations	8,815	8,815	8,815	8,754
		Panel B: Informal Employment		
Body Mass Index	0.000635	0.000880	0.00112	0.00149
	[0.00179]	[0.00174]	[0.00175]	[0.00183]
Number of observations	8,446	8,446	8,446	8,386
State Fixed Effects	Yes	Yes	Yes	Yes
Cohort Fixed Effects	Yes	Yes	Yes	Yes
Male Dummy	Yes	Yes	Yes	Yes
Residence Area	No	Yes	Yes	Yes
Other Demographic Characteristics	No	No	Yes	Yes
Household Head Characteristics	No	No	No	Yes

Source: Research results.

Notes: Standard errors (in brackets) are robust to heteroskedasticity. State fixed effects include dummies of State of residence. Cohort fixed effects include birth year dummies. Residence area includes dummies indicating metropolitan city and rural residence status. Other demographic characteristics contain dummies indicating birth month and white race. Household head characteristics are education years, age, and sex. All estimations use sample weights. * p<0.1.

Table 3.First Stage Results: Relationship between BMI and Sibling BMI

	Dependentvariableis BMI			
	(1)	(2)	(3)	(4)
Sibling Body Mass Index	0.17	0.17	0.169	0.168
	[0.0240]***	[0.0243]***	[0.0244]***	[0.0249]***
Exc. instruments F-stat.	50.11	48.84	48.18	45.5
Kleibergen and Paap test (p-value)	0.00	0.00	0.00	0.00
Number of observations	8,781	8,781	8,781	8,725
Basic Controls	Yes	Yes	Yes	Yes
Residence Area	No	Yes	Yes	Yes
Other Demographic Characteristics	No	No	Yes	Yes
Household Head Characteristics	No	No	No	Yes

Source: Research results.

Notes: Standard errors (in brackets) are robust to heteroskedasticity. Basic controls include State and cohort fixed effects, sex and dummies for sibling's birth year and sex. Residence area contains dummies indicating metropolitan city and rural residence status. Other demographic characteristics contain dummies for birth month and white race, and sibling's month birth and white race. Household head characteristics are education years, age, and sex. All estimations use sample weights. *** p<0.01.

Table 4. Instrumental Variables Estimates of the Relationship between BMI and Labor Market Outcomes

	(1)	(2)	(3)	(4)
	Panel A: Log of Hourly Wage			
Body Mass Index	0.0342	0.0318	0.0264	0.0248
	[0.0141]**	[0.0132]**	[0.0130]**	[0.0116]**
Number of observations	8,781	8,781	8,781	8,725
	Panel B: Informal Employment			
Body Mass Index	-0.0180	-0.0165	-0.0161	-0.0161
	[0.00943]*	[0.00947]*	[0.00908]*	[0.00912]*
Number of observations	8,413	8,413	8,413	8,359
Basic controls	Yes	Yes	Yes	Yes
Residence Area	No	Yes	Yes	Yes
Other Demographic Characteristics	No	No	Yes	Yes
Household Head Characteristics	No	No	No	Yes

Source: Research results.

Notes: Standard errors (in brackets) are robust to heteroskedasticity. Basic controls include State and cohort fixed effects, sex and dummies for sibling's birth year and sex. Residence area contain dummies indicating metropolitan city and rural residence status. Other demographic characteristics contain dummies for birth month and white race, and sibling's month birth and white race. Household head characteristics are education years, age, and sex. All estimations use sample weights. * p<0.1, ** p<0.05, *** p<0.01.

Table 5. Instrumental Variables Estimates of the Relationship between BMI and Labor Market Outcomes by Sex, Race and Residence Area

	Male	Female	White	Non-White	Urban	Rural
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Log of Hourly Wage					
Body Mass Index	0.0159	0.0326	0.0182	0.0381	0.0262	0.00384
	[0.0145]	[0.0178]*	[0.0202]	[0.0179]**	[0.0125]**	[0.0275]
Number of observations	5,133	3,592	3,779	4,946	7,485	1,240
	Panel B: Informal Employment					
Body Mass Index	-0.000759	-0.0434	-0.0168	-0.0179	-0.0123	-0.0459
	[0.0120]	[0.0157]***	[0.0137]	[0.0141]	[0.00930]	[0.0212]**
Number of observations	4,901	3,458	3,619	4,740	7,151	1,208
Basic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Residence Area	Yes	Yes	Yes	Yes	Yes	Yes
Other Demographic Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Household Head Characteristics	Yes	Yes	Yes	Yes	Yes	Yes

Source: Research results.

Notes: Standard errors (in brackets) are robust to heteroskedasticity. Basic controls include State and cohort fixed effects, sex and dummies for sibling's birth year and sex (columns 1 and 2 do not include sex, while columns 3 and 4 do not include white dummy). Residence area contain dummies indicating metropolitan city and rural residence status (columns 5 and 6 do not include rural dummy). Other demographic characteristics contain dummies for birth month and white race, and sibling's month birth and white race. Household head characteristics are education years, age, and sex. All estimations use sample weights. * p<0.1, ** p<0.05, *** p<0.01.

Table 6. Instrumental Variables Estimates of the Relationship between BMI and Labor Market Outcomes (Controlling by Education Years)

	Baseline (1)	Contollingby Educationyears (2)
	Panel A: Log of Hourly Wage	
Body Mass Index	0.0248	0.0137
	[0.0116]**	[0.0106]
Education Years		0.0798
		[0.00361]***
Number of observations	8725	8668
	Panel B: Informal Employment	
Body Mass Index	-0.0161	-0.0121
	[0.00912]*	[0.00877]
Education Years		-0.0318
		[0.00286]***
Number of observations	8359	8302
Basic Controls	Yes	Yes
Residence Area	Yes	Yes
Other Demographic Characteristics	Yes	Yes
Household Head Characteristics	Yes	Yes

Source: research results.

Notes: standard errors (in brackets) are robust to heteroskedasticity. Basic controls include State and cohort fixed effects, sex and dummies for sibling's birth year and sex. Residence area contain dummies indicating metropolitan city and rural residence status. Other demographic characteristics contain dummies for birth month and white race, and sibling's month birth and white race. Household head characteristics are education years, age, and sex. All estimations use sample weights. * p<0.1, ** p<0.05, *** p<0.01.

Table 7. Instrumental Variables Estimates of the Relationship between BMI and Labor Market Outcomes (Robustness of Findings)

	Baseline (1)	Excluding Outliers in BMI (2)	Including extreme low wages (3)
		Panel A: Log of Hourly Wage	
Body Mass Index	0.0248	0.0359	0.0298
	[0.0116]**	[0.0151]**	[0.0119]**
Number of observations	8,725	8,565	9,072
		Panel B: Informal Employment	
Body Mass Index	-0.0161	-0.0219	-0.0177
	[0.00912]*	[0.0118]*	[0.00915]*
Number of observations	8,359	8,208	8,727
Basic controls	Yes	Yes	Yes
Residence Area	Yes	Yes	Yes
Other Demographic Characteristics	Yes	Yes	Yes
Household Head Characteristics	Yes	Yes	Yes

Source: Research results.

Notes: Standard errors (in brackets) are robust to heteroskedasticity. Column 2 eliminates potential outliers by restricting our sample to include only individuals with a BMI above 15 and lower than 35. Column 3 includes individuals with a wage lower than 100.00BrazilianReais in our sample. Basic controls include State and cohort fixed effects, sex and dummies for sibling's birth year and sex. Residence area contain dummies indicating metropolitan city and rural residence status. Other demographic characteristics contain dummies for birth month and white race, and sibling's month birth and white race. Household head characteristics are education years, age, and sex. All estimations use sample weights. * p<0.1, ** p<0.05, *** p<0.01.