# Factors associated with overweight and central adiposity in urban workers covered by the Workers´ Food Program of the Brazilian Amazon Region

*Fatores associados ao sobrepeso e adiposidade central em trabalhadores urbanos assistidos pelo Programa de Alimentação do Trabalhador da região amazônica do Brasil*

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***Abstract***

**Objective:** To investigate factors associated with overweight and abdominal obesity in male and female workers. Methods: This is a cross-sectional population-based study. A representative sample of 1,054 workers ranging from 18 to 74 years of age, selected among individuals covered by the Workers´ Food Program living in the Metropolitan region of Belém, Northern Brazil. Health-related behavior and anthropometry were assessed. Fasting blood samples were collected. Results: Overweight prevalence was 38.0% among women and 50.4% among men. Among overweight subjects, there were 6.1% obese women and 10.7% obese men. Multivariate analysis was used to identify social behavior and clinical-biochemical factors associated with increased body adiposity (BMI > 25 kg/m$^2$ and increased waist circumference: > 80 cm for women and > 94 cm for men). Variables positively and significantly associated with overweight and abdominal obesity in men according to prevalence ratio (PR) values were: age (1.02), high family income (1.05), smoking (1.36), hypertension (systolic blood pressure, 1.41; diastolic blood pressure, 1.85) and hypertriglyceridemia (2.29). In women, the PR of increased body adiposity was associated with: age (1.02), alcohol intake (1.42), hypertriglyceridemia (1.44), diastolic blood pressure (1.65) and hyperglycemia (1.71). Conclusions: The association of overweight and abdominal obesity with social behavior variables should be corrected with preventive and educational measures. Furthermore, association of overweight and abdominal obesity with clinical and biochemical variables places the urban workers from the Amazon region assisted by the Workers´ Food Program at a possible risk for morbidity and mortality from increased body adiposity.

**Keywords:** Obesity. Waist circumference. Serum lipids. Glucose. Blood pressure. PAT.

## *Resumo*

**Objetivo:** Investigar os fatores associados ao sobrepeso e a obesidade abdominal em trabalhadores de ambos os sexos. Método: Estudo transversal de base populacional, de uma amostra representativa de 1054 trabalhadores, com idade entre 18 e 74 anos, assistidos pelo Programa de Alimentação do Trabalhador na região metropolitana de Belém do Pará, na região norte do Brasil. Parâmetros relacionados à saúde e medidas antropométricas foram obtidas e amostra de sangue foram coletadas. Resultados: A prevalência de sobrepeso foi de 38% nas mulheres e 50,4% nos homens. Dentre os indivíduos com sobrepeso, 6,1% das mulheres eram obesas e 10,7% dos homens tinham obesidade. Análise multivariada foi utilizada para identificar os fatores sociocomportamentais e clínico-bioquímicos associados com o aumento da adiposidade corporal (IMC > 25kg/m2 e circunferência de cintura > 80cm para mulheres e >94cm para homens). As variáveis e a razão de prevalência (PR) associadas ao sobrepeso e adiposidade abdominal nos homens foram: idade (1,02), renda familiar alta (1,05), fumo (1,36), hipertensão (pressão arterial sistólica 1,41 e pressão arterial diastólica 1,85) e hipertrigliceridemia (2,29). Nas mulheres as razões de chance para sobrepeso e adiposidade abdominal foram: idade (1,02), consumo de álcool (1,42), hipertrigliceridemia (1,44), pressão arterial diastólilca (1,65) e hiperglicemia (1,71). Conclusão: A associação do sobrepeso e obesidade abdominal com parâmetros sociocomportamentais devem ser corrigidos com medidas educativas e preventivas. Além disso, a associação de sobrepeso e obesidade abdominal com parâmetros clínicos e bioquímicos coloca os trabalhadores de Belém do Pará, assistidos pelo Programa de Alimentação do Trabalhador, em possível risco de morbidades e mortalidade precoce pelo aumento de adiposidade corporal.



**Palavras-chave:** Obesidade. Circunferência da cintura. Lipídios séricos. Glicose. Pressão sanguínea. PAT.


## Introduction

Increased urbanization and industrialization in recent decades are considered the main causes of diminished physical activity and increased consumption of energy-dense foods[1]. In Brazil, the demographic changes seen between the 1960s and the 1980s were concomitant with changes in occupation. At first, labor was concentrated in the primary sectors of the economy, and it eventually shifted to the secondary and tertiary sectors. These changes played a central role in transforming the Brazilian socioeconomic structure, generating new lifestyle demands and nutritional needs[2].

The population of the Amazon Region presents unique socio-cultural characteristics. In the State of Pará there is a strong influence of the peoples who began the miscegenation seen today: the indigenous people, and immigrants from European and African origin. These three different cultures determined the local eating habits that persist to this day[3]. Just like other cities in Brazil, the metropolitan region of Belém has also undergone extensive sociodemographic changes in the last decade[4].

The main consequence of this process has been the change in the epidemiologic profile of this population, with an increased prevalence of non-communicable chronic diseases, especially obesity[5,6]. In Brazil, the 2002-2003 Family Budget Survey (POF) performed by the Brazilian Institute of Geography and Statistics (IBGE)[7] shows that overweight among Brazilians is already a problem of greater magnitude than malnutrition.

This increased prevalence of overweight and obesity has been observed in distinct regions of the country and in many social strata. This situation is worrying since it is usually associated with cardiovascular complications, dyslipidemia, type 2 diabetes, osteoarticular diseases and some kinds of cancers. All these comorbidities have high treatment costs[5,6].

The distribution of body fat, especially in the abdominal region, has been associated

with the etiology of many metabolic changes among the obese[8]. In this context, many studies have demonstrated that visceral fat, characterized by the accumulation of adipose tissue in the abdominal region, is also an important risk factor for the development of cardiovascular diseases and type 2 diabetes[9,10]. Excess of visceral adipose tissue alters the glucose-insulin homeostasis, triggering insulin resistance [8]. Abdominal fat build-up also leads to hypertriglyceridemia, which is usually accompanied by a low concentration of high density lipoproteins (HDL)[10]. This set of metabolic disorders associated with arterial blood hypertension is called the metabolic syndrome. Weight maintenance, increased physical activity and decreased sodium consumption are important ways to control and prevent this syndrome[10,11].

The increased prevalence of overweight and obesity along with the increase in their associated comorbidities are responsible for an ever increasing number of debilitating diseases which may take workers away from their jobs temporarily or permanently. Bearing this in mind, the present study evaluated workers' nutritional status, identifying the association between overweight and distribution of body fat with metabolic and behavioral changes. This research was performed in a metropolitan region of the Brazilian Amazon, where diagnoses for this population are non-existent.

## Methods

### Study design and sampling

This is a cross-sectional population-based study that evaluated workers from companies located in the metropolitan region of the city of Belém, in northern Brazil. Workers were covered by the *Programa de Alimentação do Trabalhador – PAT* (Workers' Food Program) of the Brazilian Ministry of Labor and Employment. Field research was performed between February and August 2003 and included workers eating at 55 different food-service units. The sample was stratified according to the number of meals served in each unit. Hierarchical clustering was used for the sampling design, obtained with the software developed by the SAS Institute. As the area where the survey was performed did not have data on overweight prevalence, the estimated prevalence used to calculate the sample size was 50%, with a p-value < 0.05. A sample with 1,084 workers was thus calculated (about 8% of all 13,337 workers). Overweight prevalence in the city of Belém has recently been found to be 41.8%, a value below the one established for the calculation[12], which guarantees an adequate sample size.

A total of 1,111 workers participated in the survey, with a 5.1% loss of individuals who did not show for blood collection. Thus, the final sample totaled 1,054 workers. Workers were informed of the objectives and methodology of the study and those who agreed to participate signed an Informed Consent Form. This study was approved by the Research Ethics Committee of the School of Health Sciences of the University of Brasília, according to Resolution # 196/96[13].

### Measurement variables

Measurements, team training, adjustment of field instruments, and questionnaire pre-testing were first done in a pilot study, with a sample of workers who were not included in the research. The precision and accuracy of the anthropometric measurements were tested by the standardization method proposed by the Department of Nutrition of the School of Public Health of the University of Sao Paulo[14].

Information on socioeconomic aspects was obtained by interviews. The variables collected were: gender, age, origin, nationality, educational level, marital status, number of children, working hours, occupation, and family income.

Anthropometric evaluation included weight (kg), height (m), and waist circumference (cm). Participants were assessed in light clothing and barefoot. A digital

Plenna Lithium scale (São Paulo – Brazil), with 150kg capacity and 100g readability, was used to determine weight. A portable Alturexata stadiometer (Belo Horizonte – Brazil), with a total length of 213cm and 0.1cm grades, was used to determine height. Body mass index (BMI) was defined as the ratio between weight (kg) and height (m) squared, and values ranging from 18.5 to 25kg/m$^2$ were considered normal, according to the criteria proposed by the WHO[15]. Waist circumference was determined with an inelastic measure tape TBW (São Paulo – Brazil), 150cm, with 0.1 cm grades, positioned at the mid-point between the bottom of the rib cage and the top of the iliac crest. One anthropometrist was responsible for waist measurements. Values of < 80cm for women and < 94cm for men were considered normal, according to the WHO[15].

Systemic arterial blood pressure was determined, according to the Brazilian Guidelines for Arterial Pressure[16] criteria and technical norms. Measurements were taken in the sitting position. A digital Techline WS-500 blood pressure monitor (Hong Kong – China) was used for this purpose. Cutoff points for systemic arterial blood hypertension were: systolic arterial blood pressure (SAP) equal to or above 140mmHg and/or diastolic arterial blood pressure (DAP) equal to or above 70mmHg.

Blood was collected after 10-12h fasting to determine the following serum constituents: triacylglycerol (TAG); total cholesterol (TC); HDL cholesterol (HDL-c), and fasting glucose. TAG, TC and HDL were determined by enzymatic colorimetric methods with Doles Reagentes kits (Doles, Goiás, Brazil), and spectrophotometric readings were done according to the manufacturer's instructions. HDL-c was determined in the supernatant obtained by centrifugation after treating the sample with buffered polyethylene glycol (PEG 6000, Doles, Goiás – Brazil), which selectively precipitates low-density fractions (VLDL-c and LDL-c). Fasting glucose was determined by the colorimetric glucose oxidase method using the *Doles Reagentes* kits (Doles, Goiás – Brazil) following the manufacturer's instructions. The coefficient of variation (inter-assays CV) was determined with Qualitrol 1 CAT (Labtest Diagnóstica, Minas Gerais – Brazil) run in all determination batches. The coefficients of variation for TC, HDL-c, TAG and glucose tests were below 1.0%.

**Statistical analysis**

Data input was carried out in Epi-Info 6.04 software[17] and the statistical analysis was performed with the Statistic Analysis System software (SAS Institute Inc., Cary, NS, USA)[18]. Student's t-test was used to compare mean values for each gender. A multivariable analysis was performed to identify possible factors associated with obesity and central adiposity. At first, all variables were included in the multiple regression model. The final model was obtained by the stepwise method of variable selection. Dependent variables were BMI and waist circumference. Independent variables were: age, smoking status, alcoholic beverage consumption, systolic arterial blood pressure, diastolic arterial blood pressure, triacylglycerides, cholesterol, HDL-c, fasting glucose levels, and family income. Behavioral variables were smoking status and alcoholic beverage consumption. Age in years was treated as continuous. The cut-off points for biochemical variables and arterial blood pressure were the values determined by the Brazilian Guidelines on Dyslipidemia[19] and the Brazilian Societies of Hypertension[16] and Diabetes[20], which follow international cut-off points. Family income was stratified into five groups based on the number of Brazilian minimum monthly wages for each group (1 minimum wage corresponds to US$130.00). The medians for each group were 1, 2.5, 4, 7.5 and 15 minimum wages. Adjusted prevalence ratio (PR) estimates were calculated using Poisson regressions with robust variance to identify possible factors associated with obesity and central adiposity. The significance level adopted was of 5%.

## Results

Table 1 shows the sample distribution of age, arterial blood pressure and biochemical variables by gender. Of the 1,054 workers who participated in this study, 728 (69%) were males and 326 (31%) were females. The mean age for women was 35.1 ± 9.3 years and their ages ranged from 18 to 74 years. The mean age for men was 35.1 ± 9.6 years and their ages ranged from 18 to 73 years. However, the ages of 63% of men and women in the sample ranged from 20 to 50 years.

Table 1 also shows the comparative analysis of the means by gender for the anthropometric and clinical-biochemical characteristics. The mean BMI value for men was significantly different from the one for women. The mean BMI observed for men reached the level of overweight ($p < 0.05$). This higher mean BMI for men reflected the higher prevalence of overweight and obesity among them, where 50.4% of the men presented this characteristic. Among women, 38.0% presented this characteristic. Mean waist circumference between men and women also presented a significant difference ($p < 0.05$). Mean diastolic arterial blood pressure for men was also significantly higher than for women ($p < 0.05$). Mean total cholesterol and HDL-c for men and women were similar. However, mean triacylglycerols and glucose for men were significantly higher than those for women ($p < 0.05$).

Table 2 shows the model for multiple regression analysis. This model showed that older women who consumed alcoholic beverages and who presented triacylglycerol levels ≥ 150 mg/dL, diastolic arterial blood pressure ≥ 70 mmHg and fasting glucose ≥ 110 mg/dL were significantly associated with excess adiposity.

Table 2 also shows that older men who smoke and who presented triacylglycerol levels ≥ 150 mg/dL, diastolic arterial blood pressure > 70 mmHg, systolic arterial blood pressure > 140 mmHg and higher family income were significantly associated with overweight and central obesity.

Prevalence ratio (PR) estimates seen in Table 3 show that women who presented fasting glucose levels above 110mg/dL had

**Table 1 -** Anthropometric and clinical-biochemical characteristics of workers. Belém, Brazil, 2003.
***Tabela 1 -*** *Características antropométricas e clinicas e bioquímicas de trabalhadores de Belém do Pará, Brasil, 2003.*

| Variable | Women *(n=326)* | | Men *(n=728)* | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Age (years) | 35.1 | 9.6 | 35.1 | 9.3 |
| Body mass index ($Kg/m^2$) | 24.2 | 3.5 | 25.4* | 3.7 |
| Waist circumference (cm) | 81.0 | 9.0 | 87.4* | 10.6 |
| Diastolic blood pressure (mmHg) | 69.3 | 12.0 | 76.1* | 12.9 |
| Blood Cholesterol (mg/dL) | 190.8 | 20.9 | 192.6 | 24.2 |
| HDL- c (mg/dL) | 46.9 | 20.8 | 47.3 | 24.3 |
| Triacylglycerol (mg/dL) | 103.9 | 61.8 | 146.1* | 101.0 |
| Glucose (mg/dL) | 92.9 | 18.0 | 96.0* | 20.4 |

SD= standard deviation. *mean with statistical significance by Student t test ($p<0.05$).
*SD= desvio padrão. * media e significância estatística pelo teste t de Student ($p<0,05$)*

**Table 2 -** Multivariate analysis of factors associated with overweight and abdominal obesity in workers. Belém, Brazil, 2003

***Tabela 2 -*** *Analise multivariada dos fatores associados com o sobrepeso e a obesidade abdominal de trabalhadores de Belém do Pará, Brasil, 2003.*

| Variable | Estimate | Standard Error | Z | *P* Value |
|---|---|---|---|---|
| Men | | | | |
| Intercept | -3.459 | 0.266 | -13.00 | <0.0001 |
| Family income | 0.050 | 0.012 | 4.18 | <0.0001 |
| Age | 0.022 | 0.006 | 3.45 | 0.0006 |
| Smoking | 0.307 | 0.137 | 2.25 | 0.02 |
| Triacylglycerol | 0.828 | 0.132 | 6.26 | <0.0001 |
| Diastolic blood pressure | 0.618 | 0.197 | 3.14 | 0.002 |
| Systolic blood pressure | 0.347 | 0.128 | 2.70 | 0.007 |
| Women | | | | |
| Intercept | -2.242 | 0.287 | -7.80 | <0.0001 |
| Age | 0.018 | 0.007 | 2.50 | 0.013 |
| Alcoholic beverage intake | 0.349 | 0.139 | 2.51 | 0.012 |
| Triacylglycerol | 0.366 | 0.143 | 2.56 | 0.010 |
| Diastolic blood pressure | 0.504 | 0.168 | 2.99 | 0.003 |
| Glucose | 0.538 | 0.150 | 3.59 | 0.0003 |

the highest prevalence for overweight and increased waist circumference (central obesity). This means that a glucose level above 110mg/dL was 71% more prevalent among overweight women than among women with BMI < 25 and waist circumference under 80cm. Consumption of alcoholic beverages, increase in triacylglyceride levels and diastolic arterial blood pressure were also observed to increase the prevalence for overweight and abdominal obesity among women. Additionally, each year in a woman's life increases her prevalence of being overweight and presenting central adiposity by 2.0%.

Table 3 also shows prevalence ratio (PR) estimates for overweight and abdominal obesity for men. Among all analyzed variables, triacylglycerol levels above 150mg/dL placed men at the highest prevalence of presenting excess weight and abdominal obesity, and this occurrence was 129% greater than that for men whose triacylglycerol levels were below 150mg/dL. Smoking also increased men's prevalence of presenting excess weight and central adiposity (abdominal obesity) by roughly 36%. Diastolic and systolic arterial blood pressures above 70 and 140mmHg, respectively, were more prevalent among men with overweight and central obesity. Each year of life increased men's prevalence for increasing adiposity by 2.0%. As for each increase in family income level, there was a 5.0% increase in the prevalence of overweight and central obesity in men.

## Discussion

This study revealed a young population, with 50.8% of the adults being under 35 years of age. Data from the Monthly Employment Survey conducted by IBGE[21] showed that 82.1% of economically active

**Table 3 -** Social behavior and clinical-biochemical variables associated with overweight and abdominal obesity among workers. Belém. Brazil. 2003.
***Tabela 3 -*** *Variáveis sociocomportamentais e clínico-bioquímicas associadas com o sobrepeso e a obesidade abdominal de trabalhadores de Belém do Pará. Brasil. 2003.*

| Variable | PR | 95% CI |
|---|---|---|
| Men | | |
| Age | 1.02 | 1.009 – 1.035 |
| Family income | 1.05 | 1.027 – 1.077 |
| Smoking | 1.36 | 1.040 – 1.777 |
| Systolic blood pressure | 1.41 | 1.100 – 1.820 |
| Diastolic blood pressure | 1.85 | 1.262 – 2.729 |
| Triacylglycerol | 2.29 | 1.767 – 2.967 |
| Women | | |
| Age | 1.02 | 1.004 – 1.033 |
| Alcoholic beverage intake | 1.42 | 1.079 – 1.862 |
| Triacylglycerol | 1.44 | 1.090 – 1.908 |
| Diastolic blood pressure | 1.65 | 1.190 – 2.302 |
| Glucose | 1.71 | 1.277 – 2.299 |

*PR– prevalence ratio. CI – confidence interval.
**PR – razão de prevalência. CI – intervalo de confiança*

Brazilians are less than 50 years old, and the results obtained in this study confirm this trend, with 92.5% of the workers being under 50 years of age.

The anthropometric data obtained in this study show a high prevalence of overweight among the studied population, reflecting the current scenario reported in other studies performed in Brazil. The 2002-2003 Family Budget Survey (POF)[7], also conducted by IBGE, shows that excess weight among Brazilians is now more prevalent than malnutrition. Regarding workers, Sávio et al.[22] found a similar overweight prevalence in the Federal District, Brazil, in which overweight was also more prevalent in men than in women.

It is possible to predict cardiovascular diseases with reasonable accuracy by combining BMI and body fat distribution[8,11]. For this reason, the results found here indicate an unfavorable cardiovascular profile for workers who are overweight and present increased waist circumference.

The results of this study revealed that, for both genders, age was significantly associated with the dependent variables of the model, BMI and waist circumference. This same trend was observed by Pereira, who verified that BMI increases with age regardless of gender, while evaluating the prevalence of overweight among adults living in the city of Rio de Janeiro[25]. In addition to age, income was also associated with obesity in men, where those with a higher income also present a high prevalence. A similar result was found by Castanheira et al. in a sample of 3,464 adults living in the urban area of Pelotas, Rio Grande do Sul, Brazil, where they found that older men with higher family income presented higher means of abdominal circumference[9].

However, the findings of this study differ in some points from one of the few studies evaluating the Workers' Food Program nutritional status. The study of Veloso & Santana[26], with a retrospective cohort, showed that workers who were well nourished or pre-obese and belonged to a low socioeconomic class faced a greater risk of gaining weight[26].

Alcoholic beverage consumption was significantly associated with weight gain

and central adiposity among women and this fact is corroborated by the results obtained by Feinman and Lieber, who state that alcoholic beverage consumption and a sedentary lifestyle favor the development of obesity, especially among women[27].

The results of this study also show that men who smoke had a high prevalence of being obese. Wang et al. have verified a high prevalence of smoking associated with overweight among individuals with coronary artery disease in a rural area of China[28].

The increased prevalence of overweight and central obesity among women with glucose levels above 110mg/dL shows that effective actions to promote weight loss or even reduce the rate of weight gain in this population will have a very good repercussion. However, if no measure is taken, the maintenance or increase in body fat can lead to a higher incidence of type 2 diabetes in this group. Sartorelli and Franco consider that obesity and aging of the population are currently regarded as the main risk factors for type 2 diabetes in Brazil[29].

According to data from the 2002-2003 POF, the great nutritional challenge in Brazil is to control and prevent excess weight in the population[7]. After the publication of these national data and assessment of workers' nutritional status[22,26] a review of the Workers' Food Program parameters was implemented which reduced in half, the main (from 1,400kcal to 700 kcal) and small meal energy content, as a measure to protect against overweight[30]. Additionally, further actions must also be taken in order to ameliorate this scenario, such as: controlling the marketing and advertising of unhealthy foods, strategies to promote healthier eating habits with special emphasis on the consumption of fruits and vegetables, and encouraging workers to engage in more physical and leisure activities by creating areas and conditions for this purpose[15].

The results obtained in this study are in agreement with those found among workers of other Brazilian cities[22,26]. It is possible that, because of socio-cultural characteristics unique to the Amazon population, this situation may have further deleterious consequences. These individuals are exposed to changes in lifestyle and westernization of dietary habits; while at the same time maintain the traditional dietary practices of the various peoples who influenced their eating habits. Furthermore, the publication of these data is of interest in order to assess the impact of changes approved to the Workers' Food Program since 2005 and to further our understanding of how health-related programs developed by companies or government agencies in Belém affects workers nutritional status.

In conclusion, the association between anthropometric parameters (BMI and waist circumference), serum levels of lipid fractions and glucose, and arterial blood pressure are a strong sign of the need to adopt programs that promote health in the work environment.

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