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Body adiposity index and associated factors in workers of the furniture sector

Índice de adiposidade corporal e fatores associados em trabalhadores do setor moveleiro

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Abstract – Obesity represents one of the main cardiovascular risk factors with high prevalence among the Brazilian population. The aim of this study was to assess body adiposity index (BAI) and associated factors in workers of the furniture sector. A descriptive study was conducted with 204 workers of the furniture sector in the city of Ubá-MG of both sexes aged 20-70 years. Working sector, economic class, level of physical activity, body mass index, waist circumference, abdominal circumference, waist-to-hip ratio, systolic and diastolic blood pressure, fasting glycemia, total cholesterol, high density lipoprotein, low density lipoprotein and triglycerides were assessed. Odds ratio (RC) was used to determine the strength of association among variables. Of the total number of individuals assessed, 50% had high BAI, presenting higher anthropometric, blood pressure, glucose and triglyceride values ($p < 0.05$). It was observed that advanced age (RC: 2.76; $p = 0.002$) and production sector (RC: 2.52; $p = 0.045$) were significantly associated with BAI. According to economic class and level of physical activity, increase in BAI was observed with reduction of economic class. It could be concluded that high percentage of increased BAI was found among workers, with association with age, working sector and economic class.

Key words: Risk factors; Obesity; Occupational health.

Resumo – *A obesidade representa um dos principais fatores de risco cardiovascular. Sendo que esta apresenta uma elevada prevalência entre a população brasileira. O objetivo do estudo foi avaliar o índice de adiposidade corporal (IAC) e os fatores associados em trabalhadores do setor moveleiro. Foi realizado um estudo descritivo com 204 trabalhadores do pólo moveleiro da cidade de Ubá-MG, de ambos os sexos, com idade entre 20 e 70 anos. Avaliou-se o setor de trabalho, classe econômica, nível de atividade física, índice de massa corporal, circunferência de cintura, circunferência abdominal, relação cintura-quadril, pressão arterial sistólica e diastólica, glicemia de jejum, colesterol total, lipoproteína de alta densidade, lipoproteína de baixa densidade e triglicerídeos. A razão de chances (RC) foi utilizada para determinar a força de associação entre as variáveis. Do total de avaliados, 50% apresentaram o IAC elevado, com estes apresentando maiores valores antropométricos, pressóricos, glicemia e triglicerídeos (p<0,05). Pode-se observar que a idade elevada (RC: 2,76; p= 0,002) e o setor de produção (RC: 2,52; p= 0,045) foram significativamente associados a mesma. Quando analisado o IAC segundo a classe econômica e nível de atividade física, foi observado um aumento do IAC com a redução da classe econômica. Conclui-se que foi encontrado um elevado percentual de IAC elevado entre os trabalhadores, com associação deste com a idade, setor de trabalho e classe econômica dos mesmos.*

Palavras-chave: *Fator de risco; Obesidade; Saúde do trabalhador.*

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INTRODUCTION

Among the major causes of death in the world, cardiovascular diseases stand out. Obesity represents one of the risk factors for such diseases, as it increases the risk of arterial hypertension, dyslipidemia, type 2 diabetes mellitus, some types of cancer, among others[1].

This risk factor deserves special attention, since the prevalence of overweight and obesity has been shown to be high, reaching 55.7% of the Brazilian population[2]. When groups of workers are evaluated, such as basic education teachers[3] and urban collective transportation workers[4], high prevalence is also observed, and. Thus, there is increase in public expenditure as the prevalence of obesity increases.

This makes excess adiposity a health problem, as it promotes a series of hormonal body imbalances. Thus, adequately assessing obesity in a quick and practical way represents an essential public health action to establish combative and especially preventive actions.

Among methods for assessing obesity, body adiposity index (BAI) stands out, which is a relatively recent method that considers hip circumference and height, and can be an alternative to body mass index (BMI); and consequently, an alternative predictor of body fat in the absence of more complex techniques[5].

BAI has already been used in population studies in Brazil, with adult individuals[6] and in groups of workers[7], presenting promising results. In addition, BAI has been used in other countries, such as Colombia[8] and China[9], allowing to easily compare transnational data, requiring further studies in Brazil including different population extracts.

When using BAI as a method to assess obesity, an expressive overweight condition was found in Brazilian adults[7]; as in adults in Colombia[9]; as well as results found using BMI, which demonstrate its potential as an anthropometric measure.

However, it is important to consider that certain workers perform certain work functions with specific characteristics. Straub et al.[10] observed in office professionals that sedentary occupation was associated with higher risk of metabolic syndrome. On the other hand, firefighters, due to their active dynamics, have lower metabolic risk[10].

Therefore, it is important to know how the question of overweight in workers of the furniture industry behaves, thus expanding the documentary base on the individual, also considering regional and cultural aspects of the Minas Gerais state. Some working conditions of the furniture sector are similar to other working categories such as eight-hour fixed shift, with two hours of lunch, with functions predominantly performed in the standing position. However, workers are exposed to stressing factors such as high levels of noise and dust, requiring under certain conditions, physical effort.

The early detection of overweight among groups of workers can contribute to the creation of prevention and control strategies, which may impact on reducing future sick leaves, thus minimizing public, health care and social security spending due to chronic diseases. According to a recent study by Ramasamy et al.[11], absenteeism triggered by obesity has high costs for industries.

Therefore, in addition to the direct benefit to the worker's health by preventing excess body weight, there will be savings in public spending, considering that costs with health and social security system have increased due to the early disability and mortality of the population. Thus, the objective of the present study was to assess BAI and associated factors in workers of the furniture sector.

METHODS

A descriptive study with cross-sectional design with 204 workers aged 20-70 years of the furniture sector was carried out in the city of Ubá-MG, Brazil. Data collection was conducted from March to October 2019 in six factories in a reserved room and in the laboratory of anthropometric measurements of a local University scheduled according to the availability of participants.

Sample calculation was performed using the Epi Info software, version 7.2.1.0. Considering the size of the infinite population with expected frequency of 16.4%, which was stipulated according to the prevalence of obesity in the population of Belo Horizonte - MG[2]; with standard error of 5% and confidence interval of 90%, the value of at least 146 workers required for the study was obtained.

Initially, procedures adopted were approved by the ethics committee in research with human beings of the Federal University of Viçosa (CAAE 87704818,8,0000,5153), following Resolution number 446/12 of the National Health Council. Before starting data collection, all participants were instructed on the study's procedures and signed the Informed Consent Form.

To participate in the research, the following inclusion/exclusion criteria were adopted: 1) having minimum of two years of working experience; 2) not having more than one week of sick leave in the last year, or two months in the last three years; 3) not being in the gestational period; 4) not having orthopedic, metabolic and/or organic impairment, which would prevent them from participating in the present study.

Initially, personal data such as age, sex, and work section were collected. In addition to the application of questionnaires, anthropometric and blood pressure measurements were performed; and finally, the delivery of the request to perform the blood test in an accredited laboratory, which will be detailed below.

Participants fulfilled the Economic Classification Criterion questionnaire (CCEB) of the Brazilian Association of Research Companies (ABEP)[12]. The questionnaire gives different scores based on household characteristics, educational level of the family head and access to public services, classifying the final score into six economic categories (A, B1, B2, C1, C2, D-E).

The international physical activity questionnaire (IPAQ)[13], in its short version, was also applied to workers, which contains questions related to activities performed in a regular week associated with activities performed at work, leisure, in motion, at home, and the time spent on activities in the sitting position. This questionnaire estimates the weekly time spent in physical activities of moderate and vigorous intensity and walking. Finally, the individual is classified as “sedentary, insufficiently active A and B, active and very active”, according to IPAQ.

Anthropometric measurements were performed by a team of three qualified professionals, with participants wearing light clothes and barefoot. Height was measured using portable WCS® stadiometer (Cardiomed, Brazil), with accuracy of 1 mm and capacity of 210 cm. Body mass was obtained on portable Plenna® scale (model Acqua SIM09190, Plena, Brazil), with capacity for 150 kg and accuracy of 100 grams.

Waist, abdomen and hip circumferences were measured using Cescorf® anthropometric tape with length of 2m. Waist circumference was measured at the smallest curvature located between ribs and the iliac crest; hip circumference at the point of greatest protuberance; and abdominal circumference was obtained at the height of the umbilical scar.

BMI was calculated using the following formula: BMI = [body mass (kg) / $height^2$][14]. Waist-to-hip ratio (WtHR) was calculated using the following formula: WtHR = waist circumference (cm) / hip circumference (cm). BAI was calculated using data on hip circumference and height. For the estimation of excess body adiposity through BAI, the following cutoff point was considered: 25% for men and 35% for women, according to the World Health Organization[15].

Premium® aneroid sphygmomanometer and stethoscope (Wenzhou Instrument Co., China, 2014) were used to measure pressure levels, calibrated and with cuff pattern for adults. The procedure was performed at rest after five minutes of participants in the sitting position, according to rules of the Brazilian Society of Cardiology[16].

Venous blood samples were used for the collection of biochemical parameters. Collections were conducted between 07:00 am and 09:00 am by a qualified professional in the Laboratory of Clinical Analysis after a 12-hour fasting period. The biochemical parameters analyzed were glycemia, total cholesterol (TC), high density lipoprotein (HDL-C) and triglycerides, using the enzymatic calorimetric method. The apparatus used for analysis was BA 400 (BioSystems). Low-density lipoprotein (LDL-C) was calculated using Friedewald’s equation[17]. The proposal of the Brazilian Society of Cardiology[18] was considered as indicator of normality parameters.

Data analysis started with the Komolgorov-Smirnov test, with Lilliefors correction, to verify the assumption of normality of variables, with only height and HDL-C values showing normal distribution. Subsequently, data analysis constituted the descriptive exploration of study variables (mean, median, standard deviation, and maximum and minimum values) and the calculation of relative frequencies. The Student’s t-test was used to compare means between independent groups, and the Mann-Whitney test for non-parametric data. The association between BAI and BMI was assessed using simple linear regression. Pearson's chi-square test was used to verify associations between BAI and other variables. Odds ratio was used to determine the strength of association among variables, with 95% confidence interval. For all treatments, 5% significance level was adopted. All statistical analyses were performed using the SPSS software for Windows, version 20.0 (Chicago, USA).

RESULTS

Overall, 204 workers of the furniture sector were assessed, 39 female and 165 male (table 1).

Table 1. Characteristics of workers of the furniture sector, Ubá-MG, 2019.

	n (%)
Sex	
Female	39 (19.1)
Male	165 (80.9)
Age (years)	
20-39	143 (70.1)
40-70	61 (29.9)
Working sector	
Administrative	29 (14.2)
Production	175 (85.8)
Economic Class*	
A	01 (0.7)
B1	15 (10.9)
B2	42 (30.7)
C1	29 (21.2)
C2	38 (27.7)
D-E	12 (8.8)
Level of Physical Activity‡	
Very Active	35 (24.6)
Active	45 (31.7)
Insufficiently active A	16 (11.3)
Insufficiently active B	19 (13.4)
Sedentary	27 (19.0)

Note. * 137 workers fulfilled the socioeconomic questionnaire; ‡ 142 workers fulfilled the physical activity questionnaire

Of the total number of individuals assessed, 50% had high BAI ($\geq$ 25% for men and $\geq$ 35% for women). It is noteworthy that BAI obtained strong association with BMI (R^2 = 0.674; $p < 0.001$).

Table 2 shows the anthropometric, blood pressure and biochemical characteristics of the sample, according to the presence of normal and high BAI.

Table 2. Anthropometric, blood pressure and biochemical characteristics of the sample according to the body adiposity index of workers of the furniture sector, Ubá-MG, 2019.

Variables	Normal BAI (n= 102)	High BAI (n= 102)	P-value
Age (years)	34 (20-64)	36 (20-70)	0.006*
Weight (kg)	65.4 (44.7-92.9)	81.7 (49.4-155.0)	<0.001*
Height (m)	1.71±0.09	1.67±0.07	0.002ǂ
BMI (Kg/m²)	22.8 (17.8-30.7)	29.0 (19.8-50.7)	<0.001*
WC (cm)	78 (61-97)	92 (67-140)	<0.001*
HC (cm)	94 (78-119)	103 (87-160)	<0.001*
AC (cm)	82 (66-100)	97 (69-169)	<0.001*
WtHR	0.83 (0.67-1.08)	0.89 (0.70-1.04)	<0.001*
BAI	23.67 (16.28-34.82)	29.26 (25.07-54.92)	<0.001*
SBP (mmHg)	120 (90-140)	130 (100-180)	<0.001*
DBP (mmHg)	80 (60-100)	90 (60-130)	<0.001*
Glucose (mg/dL)¥	81 (67-105)	87 (73-270)	<0.001*
TC (mg/dL)¥	167 (93-320)	171 (99-266)	0.945*
HDL (mg/dL)¥	63.21±8.19	62.25±9.51	0.465ǂ
LDL (mg/dL)¥	86.4 (26.2-184.6)	84.4 (14.2-183.0)	0.604*
Triglycerides (mg/dL)¥	83 (34-462)	100 (29-469)	<0.006*

Note. * Data are presented as median, minimum and maximum values. Mann-Whitney test; ǂ Data are presented as mean and standard deviation. Student's t-test; ¥ 183 blood tests were performed, 90 with normal BAI and 93 with high BAI; BMI: body mass index; WC: waist circumference; HC: hip circumference; AC: abdominal circumference; WtHR: waist-to-hip ratio; BAI: body adiposity index; SBP: systolic blood pressure; DBP: diastolic blood pressure; TC: total cholesterol; HDL: high density lipoprotein; LDL: low density lipoprotein

Table 3 shows the percentage of individuals with profile above the proposed normality range, according to the sex factor. It is noteworthy that of the 102 individuals with high BAI, 53.9% had high blood pressure.

Table 3. Percentage of male and female workers of the furniture sector, Ubá-MG with indicators outside the normality range

Variables	Normality criterion	Female n (%)	Male n (%)	Total n (%)
BMI (Kg/m²)*				
Overweight	≥ 25 kg/m²	11 (28.2)	60 (36.4)	71 (34.8)
Obesity	≥ 30 kg/m²	11 (28.2)	32 (19.4)	43 (21.1)
WC (cm)ǂ	F: ≥ 80 cm M: ≥ 94 cm	19 (48.7)	37 (22.4)	56 (27.4)
BAI¥	F: ≥ 35% M: ≥ 25%	14 (35.9)	88 (53.3)	102 (50.0)
SBP (mmHg)†	≥ 140 mmHg	5 (12.8)	33 (20.0)	38 (18.2)
DBP (mmHg)†	≥ 90 mmHg	9 (23.1)	60 (36.4)	69 (33.8)
Glucose (mg/dL)€	≥ 126 mg/dL	1 (2.77)	1 (0.68)	2 (1.1)
TC (mg/dL)§	≥ 240 mg/dL	1 (2.77)	10 (6.8)	11 (6.0)
HDL (mg/dL)§	< 40 mg/dL	0 (0.0)	2 (1.4)	2 (1.1)
LDL (mg/dL)§	≥ 160 mg/dL	1 (2.77)	8 (5.4)	9 (4.9)
Triglycerides (mg/dL)§	≥ 200 mg/dL	3 (8.33)	9 (2.1)	12 (6.6)

Note. BMI: body mass index; WC: waist circumference; BAI: body adiposity index; SBP: systolic blood pressure; DBP: diastolic blood pressure; TC: total cholesterol; HDL: high density lipoprotein; LDL: low density lipoprotein; *Data according to WHO14; ǂ According to the Brazilian Society of Endocrinology and Metabology19; ¥According to WHO15; †Data according to SBC16; €According to ADA20; §According to SBC18.

Table 4 shows factors associated with the presence of high BAI. It is possible to observe that age and working sector were significantly associated with BAI.

Table 4. Analysis of factors associated with high body adiposity index in workers, Ubá-MG, 2019

Variables	Odds Ratio (IC95%)	P-value*
Sex		0.075
Female	1	
Male	2.04 (0.99-4.20)	
Age (years)		0.002
25-44	1	
45-68	2.76 (1.47-5.17)	
Working sector		0.045
Administrative	1	
Production	2.52 (1.09-5.84)	

Note. * Pearson's chi-square test with continuity correction

When analyzing BAI according to economic class and level of physical activity, increased BAI was observed with reduction of economic class (Figure 1).

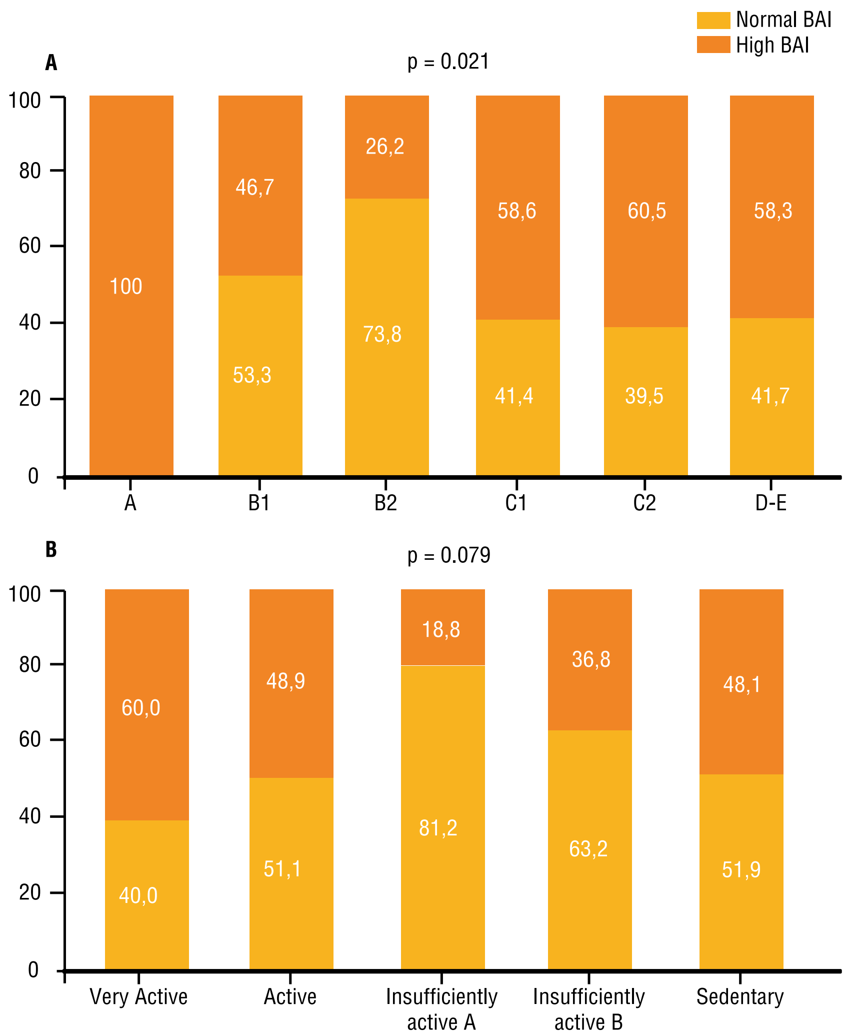

Figure 1. Prevalence of high body adiposity index according to: a) economic class and, b) level of physical activity of workers, Ubá-MG, 2019. Pearson's chi-square test. BAI: body adiposity index.

DISCUSSION

The results found revealed high prevalence of BAI among workers of the furniture sector (50%). When compared with other studies that used BAI as anthropometric measure, the percentage found was higher than that observed in adults in Brazil, with value of 36.89%[6]; 33.9% in Colombian adults[8]; and 32.1% in Brazilian teachers[7].

However, once BAI is a new method, information on the adiposity issue is not available on a national basis. Although not being the same method, which would be ideal, values obtained for overweight are similar to those observed in national data, which used a different method. In Brazilian capitals and Federal District, overweight reached frequency of 55.7%; achieving 53.3% in the population of Belo Horizonte[2].

The results are also similar to studies conducted with other groups of workers, such as basic education teachers[3] and urban collective transportation workers[4], who used BMI as anthropometric measure. It is noteworthy that in the present study, BAI showed strong correlation with BMI, so that, even using different methods, it seems to be clear that overweight is a public health problem in the Brazilian society. This condition deserves special attention, as obesity acts as a "trigger" mechanism for the appearance of other diseases, harming workers' health and increasing government costs even more.

Therefore, the need to modify this situation is emphasized, as obesity increases the risk of mortality from all cardiovascular diseases[1]. Accordingly, workers in the present study with high BAI obtained higher mean anthropometric, blood pressure, glucose and triglyceride values; with 53.9% of them having high blood pressure.

These data are consistent with studies by Oliveira et al.[21] and Almeida et al.[22] who found that BAI can be a useful tool in estimating the risk of developing diabetes mellitus and coronary artery disease in the Brazilian population. Thus, this situation indicates that, if not reversed, there will be a tendency to increase the incidence of diabetes mellitus, hypertension and coronary diseases, which reduce work capacity, in addition to compromising quality of life.

In fact, obesity can contribute to increase blood pressure through several mechanisms, such as higher leptin, insulin resistance and hyperinsulinemia levels, activation of the sympathetic nervous system and renin-angiotensin-aldosterone system, and hormonal changes[23]. It can also be observed that obesity contributes to reduce triglyceride oxidation, and insulin resistance can be an important factor that contributes to hypertriglyceridemia[24].

Moreover, it is suggested that adipocytes secrete higher concentrations of tumoral necrosis factor α and interleukin 6, which are antagonistic to the action of insulin, in addition to secreting leptin, resistin and plasminogemic activation inhibitor-1 (PAI-1), which cause insulin resistance[25].

When analyzed in relation to sex (table 3), it is clear that men had greater prevalence of high BAI, high blood pressure, increased TC and LDL-C, and reduced HDL-C. Therefore, educational measures should be emphasized for this specific group in order to reduce this condition, since it is known that men have higher cardiovascular risk compared to women. In addition, women tend to have longer life expectancy[26], which may be due to the lower concern of men about preventive health behaviors.

Although most individuals included in this research were under 40 years of age, association between age over 40 years and risk of high BAI was observed. In fact, national data have shown increase in obesity with advancing age[2]. Thus, as Brazil has shown increase in the life expectancy of its population[26], prevention campaigns for healthy aging should be encouraged, aiming at reducing the risk of the appearance of cardiovascular risk factors.

A situation that attracts attention is the fact that workers of the production sector are at greater risk of presenting high BAI, compared to those of the administrative sector (Table 3). This result may be consistent with recent studies, which showed that physical activities at work may not provide health benefits, and may even harm the health of workers[27]. Therefore, this is a factor that deserves further studies to confirm the results found, as there are studies demonstrating benefits of physical activities at work[28].

Regarding the socioeconomic level of workers of the furniture sector, most are of economic class C. It is noteworthy that there was increase of BAI with reduction of the economic class of participants. In fact, studies have shown that the lower the socioeconomic class, the greater the anthropometric indicators[29]. People with higher income have more access to private spaces for physical activity such as gyms, personal studios, or clubs. Thus, the need for public policy measures is reinforced, considering groups of lower economic classes, who are more likely of developing obesity.

The absence of association between level of physical activity and high BAI is surprising, as it is expected that inactive individuals are more likely of having overweight and consequently other pathologies[30]. In a study conducted with basic education teachers, association was found between level of physical activity and overweight/obesity[3].

Finally, when analyzing the results of the present study, some limitations should be considered, such as: 1) the cross-sectional design, which allows the occurrence of reverse causality and can interfere in the interpretation of results; 2) the lack of assessment of the nutritional pattern, which could contribute to the occurrence of factors associated with BAI. In addition, due to the fact that it is a relatively new method, is also necessary to expand studies on its validity, reliability and specificity, especially in different populations, in order to make it a reference in the overweight diagnosis, as it is not yet a fully established method.

The following preventive measures are suggested for these workers: organization f information campaigns, with lectures on worker's health, and the incorporation of healthy habits, such as the implementation of labor gymnastics at work.

Thus, the need for control measures among this group of workers is emphasized, so that the prevalence of obesity decreases, and consequently the risk of the appearance of other associated chronic diseases. Nutritional education actions to change eating habits, associated with awareness of more active lifestyle with the incorporation of regular and supervised physical activities, in addition to recreational activities, are urgent measures. As it is a medium-sized city, active commuting to work can also have positive impact.

CONCLUSIONS

Workers of the furniture sector in Ubá-MG presented high obesity indicators using the BAI method, similar to the general Brazilian population. On the other hand, workers with high BAI had higher anthropometric, blood pressure and biochemical values, which can increase the risk of cardiovascular diseases.

When analyzing factors associated with the risk of higher adiposity values using BAI, it was found that advanced age and the production sector showed positive association. However, lower social classes were associated with increased BAI.

COMPLIANCE WITH ETHICAL STANDARDS

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Ethical approval

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Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed experiments: RARO, PRSA and JCBM. Performed experiments: RARO, BPB, PVRSO and JCBM. Analyzed data: RARO, BPB, PVRSO and JCBM. Contributed with reagents/materials/analysis tools: RARO, PRSA and JCBM. Wrote the paper: RARO, PRSA and JCBM. All authors read and approved the final version of the manuscript.

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