



Factors Associated with Hypertension and Overweight in Metallurgical Workers: A Cross-Sectional Study

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Abstract

The prevalence of overweight and hypertension have increased among Brazilian workers. There are evidences that chronic exposure to stressful working conditions. Furthermore, it is believed that such conditions may favor the occurrence of unhealthy behaviors such as smoking, excessive alcohol consumption and hyperalimentionation, which are risk factors for hypertension and overweight. This study aims to identify factors associated with overweight and hypertension in metallurgical workers of the state of Bahia - Brazil. It's a cross-sectional study conducted with 139 workers. Sociodemographic, occupational, lifestyle, clinical, anthropometric, food intake and physical activity level data were collected. We used the prevalence ratio and the confidence interval of 95%, which were calculated by Poisson regression. It was observed, respectively, 12.9% and 50.4% prevalence of hypertension and overweight. Age greater than 45 years and lower income, represented the distal determinants for hypertension and, in the approximate level, the high waist circumference. Determinants of overweight in the distal and intermediary II levels were, respectively, having a partner and high risk food consumption for non-communicable diseases. The results reinforce the influence of age increasing, lower income and high waist circumference in the growth of hypertension prevalence, and the presence of a partner and of the high and moderate risk food consumption for non-communicable diseases as predictors of overweight.

Keywords: Overweight; Hypertension; Feeding behavior; Workers

Abbreviations:

PR: Prevalence Ratio; CI: Confidence Interval; NCD: Chronic Non-communicable Diseases; MCOHP: Medical Control and Occupational Health Program; BMI: Body Mass Index; WC: Waist Circumference; FAPESB: Foundation of Research Support of the State of Bahia; PPSUS: Research Program for then Single Health System

Introduction

Excess weight and hypertension are in the group of chronic non-communicable diseases (NCD), representing 72.0% of deaths causes in Brazil. In 2013, hypertension reached 24.1% of Brazilians and overweight struck 50.8% of them [1].

Studies have revealed a high prevalence of overweight and hypertension among groups of Brazilian workers [2-5]. There are evidences that chronic exposure to stressful working conditions - such as the increased demand for labor activity; work environments with weak organizational level and with high noise levels and high temperatures; long workday; and work per shift - may be responsible for the significant and persistent growth in blood pressure [6-9]. Furthermore, it is believed that such conditions may favor the occurrence of unhealthy behaviors such as smoking, excessive alcohol consumption and hyperalimentionation [9], which are risk factors for hypertension and overweight, and are part of the complex network of determinants of these diseases [10,11].

Based on the concept that factors associated with overweight and hypertension in workers may fall into different explanatory levels of determining events in health [2,4,11], we sought to understand the relationship of sociodemographic factors, occupational, related to lifestyle and hereditary medical conditions in the determination of overweight and hypertension, adopting a hierarchical approach.

The objective of this paper is to identify the prevalence and factors associated with overweight and hypertension among workers of a metallurgical industry of the state of Bahia, Brazil.

Methods

This study is part of a more extensive research "Identification and Analysis of Risks and Nutritional Harms in the Health of Industry Workers", coordinated by docents from Nutrition School of Federal University of the State of Bahia. This is about a cross-sectional study involving workers of a metallurgical industry located in the state of Bahia. The steelworkers were allocated in administrative or production sectors, which were exposed to elevated temperatures and high noise levels. There were two work regimes: business hours (8:00 a.m. to 5:00 p.m.); or shift (morning - 8:00 a.m. to 4:00 p.m.; afternoon - 4:00 p.m. to 0:00 a.m.; night - 0:00 a.m. to 8:00 a.m.), with break of 1 hour for feeding. The industry was registered on Workers' Food Program, with food service outsourced for distribution of three meals (breakfast, lunch and dinner) in the company refectory, being offered only one meal a day to workers.

The sample of the larger study was calculated considering 95% confidence level and an error of 8%. The bases for the sample size were 7% prevalence of hypertension and 53% prevalence of overweight observed in the same population in pilot study. It was added 10% in the previously calculated sample considering the estimated losses. The estimated sample was 141 individuals.

Considering that the initial sample was not estimated to assess the relation of interest of the present study, it was decided to calculate the sampling error a posteriori. In such circumstances, based on the hypertension prevalence of 12.9% and excess weight prevalence of 50.4% observed in this study, and the confidence level of 95%, the sample size of 141 workers allowed us to identify the prevalence and factors associated with an error of 5% for hypertension and 7.6% for

overweight. The sample power was 80% ($\beta=20\%$) with a confidence level of 95% ($\alpha=5\%$) and significant level of 5% to detect the measured associations.

The selection of subjects was performed by systematic sampling from the list of effective employees provided by the industry. The interval of selection for captivation of the sample was determined by the calculation $k=904/141=6$. The first individual was selected randomly between the first and the sixth member of the list. The selected were contacted by the research team, using the communication channels of the company and letter explaining the study objectives.

Outsourced workers were not included in the sample because of the high turnover and because they are not covered by Medical Control and Occupational Health Program (MCOHP) of the industry.

The data collection was conducted between April and July of 2004, by previously trained team composed by professionals of Nutrition and Physical Education and academics of each course. Sociodemographic, occupational, lifestyle, clinical, anthropometric, food intake and physical activity level data were collected.

For anthropometric evaluation the measurements of weight and height were obtained using the criteria proposed by Lohman, Roche and Martoreli [12]. The Body Mass Index (BMI) [13] was classified according to cut-off points of WHO [14]. Waist circumference (WC) was obtained by inextensible tape measure encircling the body at the midpoint between the iliac crest and the last rib [12], classified according to cut-off points of WHO [14]. Measurements of weight, height and WC were performed in duplicate.

The evaluation of the physical activity level was performed using the International Physical Activity Questionnaire on version 8, validated in a sample of the population [15]. The physical activity levels were determined in accordance with consensus recommended by the Center for Physical Aptitude Laboratory Studies from 'São Caetano do Sul' and by the Center for Disease Control [16]. For analysis, the four physical activity levels proposed were dichotomized in very active and active, irregularly active and sedentary.

The information related to food consumption were obtained by the Food Frequency Questionnaire, adapted instrument and validated for Sichieri and Everhart [17]. The consumption pattern was designed based on the methodology proposed by Monteiro, Riether and Burini [18], which is based on the conversion of monthly consumption frequency of each food in scores. The scores established, two groups of food that reflect the consumption associated with NCD were constructed and obtained the medium score of daily consumption for each group, characterized as follows: low daily consumption (between 0.00 and 0.32), moderate daily consumption (between 0.33 and 0.65) and high daily consumption (between 0.66 and 1.00) [18,19].

Group I included the foods considered of risk to developing NCD, for example those with high saturated fat, trans fat, sweets and desserts, foods with high glycemic index, fried foods, wholefood lacteal products, sausage, preparations with high fat and highly concentrated in sodium [1,10]. The reference category (0) was represented by the low daily consumption (0.0 to 0.32), and risk (1) was interpreted as moderate/high daily consumption (0.33 to 1.00) [19].

Group II was composed of foods that are considered protective against the development of NCD, for example fiber sources food, vitamins and minerals, represented by fruits, vegetables, roots, legumes, whole grains and derivatives, those with low caloric density,

high content of monounsaturated and polyunsaturated fats and low in saturated fat and trans fat [1,20]. In this group, the reference category (0) was represented by a high daily consumption (0.66 to 1.00), and risk category (1) was interpreted as low/moderate daily consumption (0.00 to 0.65) [19].

The dependent variables were hypertension and overweight. It was considered hypertensive the workers who reported physician diagnosis from MCOHP and made use of antihypertensive medications. This indicator presents good validity when employees know their health conditions and have diagnoses given by doctors [21,22]. Overweight was defined as BMI and classified as: without overweight (BMI less than 25.0 kg/m²) and with overweight (BMI greater than or equal to 25.0 kg/m²) [14].

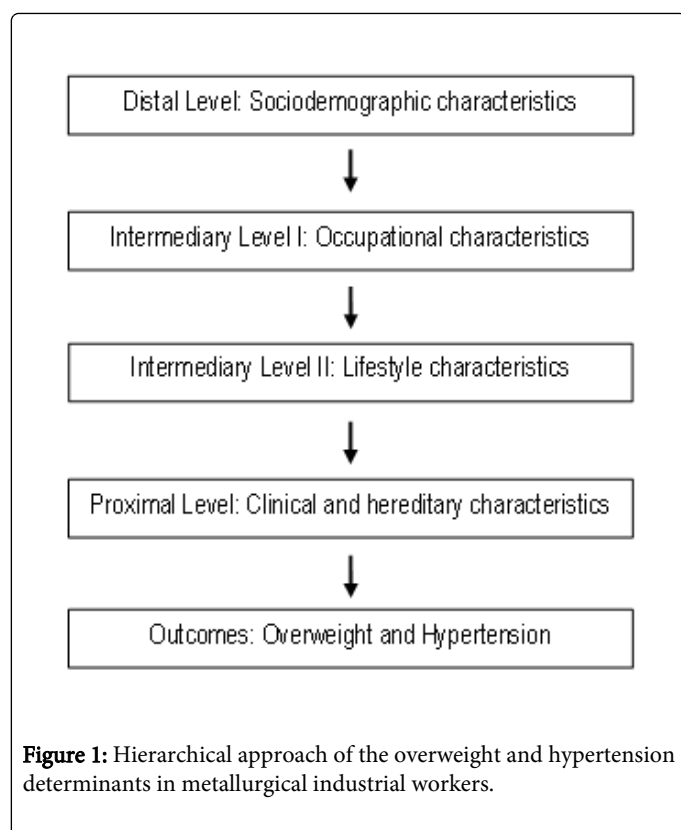
The independent variables were represented by exposure factors for high blood pressure and excess of weight, arranged in four determination levels of explanatory models described below.

The first level (distal) was represented by sociodemographic variables: sex [male (1) and female (0)], age (greater than or equal to 45 years (1); less than 45 years (0)), skin color/ethnicity referred [23] (black: black, mulattos (1), not black: white, yellow, Indian (0)), conjugal status (with a partner: married, cohabiting or in a stable union (1), without a partner: single, separated/divorced or widowed (0)), education (elementary/secondary education (1); incomplete/complete university education (0)), monthly family income (lower income: less than R\$ 1,820.00 (1), middle/higher income: greater than or equal to R\$ 1,820.00 (0)).

The intermediary level was classified into sublevels I and II. The intermediary level I integrated the models with occupational variables: type of developed activity (production (1), administrative (0)), working hours (shift: morning/afternoon/evening (1); commercial (0)), time of service in the company (greater than or equal to 8 years (1), less than 8 years of work in the company (0)). The intermediary level II understood the variables related to lifestyle: smoking [1] (smoker/ex-smoker (1); nonsmoker (0)), alcohol consumption [1] (excessive (1), none/moderate (0)), consumption of risk food for NCD (high/moderate (1), low (0)), consumption of protective foods for NCD (low/moderate (1), high (0)), physical activity level (sedentary/irregularly active (1), active/very active (0)).

And in the proximal level, were allocated the immediate determinants represented by waist circumference [14] (high: WC greater than or equal to 80 cm for women and greater than or equal to 94 cm for men (1); adequate: WC less than 80 cm for women and less than 94 cm for men (0)), by the hereditary characteristics: family history of hypertension (yes (1); no (0)), and family history of overweight (yes (1); no (0)). The WC was not adopted as immediate determinant for overweight because these indicators are collinear, being adopted only as a determinant for hypertension.

The data were entered on the software Epi Info version 6.0 and analyzed in the package STATA for Windows version 10. To describe the study population, we used the prevalence and to identify determinants of overweight and hypertension we adopted the Poisson regression analysis, with hierarchical approach, following the theoretical model presented on Figure 1. There were made two statistical models, one for overweight and another for hypertension.



For the selection of variables that integrated the multivariate models, we adopted the backward technique [24]. So, all variables potentially related to the event, were included in the models made for each hierarchy level. In each of these models the variables were eliminated step by step based on the higher value of p, until remain those with $p < 0.05$ in the final model. Thus, the significant variables at each level of the model hierarchy were preserved and entered in the adjustment of subsequent level and so on. We used the prevalence ratio (PR) as a measure of association and confidence intervals (CI) of 95% to evaluate the significance of identified association.

The study was conducted according with the determinations of Resolution nº 196/1996 of National Health Council, been approved by the Research Ethics Committee of University Hospital Complex Prof. Edgard Santos and adjusted to the Ethical Principles for Medical Research Involving Human Subjects of the Declaration of Helsinki. The participants signed the consent form.

This study financed by FAPESB and PPSUS. Data collection completed, all participants received a thanking letter with the results of anthropometric evaluation. Those who presented any health problems were conduct to the medical department of the company.

Results

Characterization of the workers

In a total of 141 workers initially selected, 2 refused to participate in the study (1.42%). Therefore, the population effectively studied consisted of 139 workers. The results of the descriptive analysis indicated that the sample was composed by 87.1% men and 64.0% with age lower than 45 years, average of 38.9 years (DP=10.2 years). Skin

color not white (74.1%) and not having conjugal commitment (64.0%) were the information most cited by the investigated. The elementary and secondary schooling was reported by 56.8% of them, and complete or incomplete university education by 43.2% of the workers. The family income in the middle and higher range were reported by 64.0% of them (Table 1).

Variables	N	%
Group 1: Distal Determinants		
Sex		
Men	121	87.1
Women	18	12.9
Age (years)*		
> 45 years	50	36.0
< 45 years	89	64.0
Skin Color		
Not white	103	74.1
White	36	25.9
Conjugal Situation		
With partner	50	36.0
Without partner	89	64.0
Educational Level		
Elementary / Secondary	79	56.8
University incomplete / complete	60	43.2
Family income		
Lower	50	36.0
Middle / Higher	89	64.0
Group 2: Intermediary		
Determinants I		
Type of Activity		
Production	86	61.9
Administrative	53	38.1
Working Hours		
Shift	65	46.8
Commercial	74	53.2
Time of Service		
> 8 years	88	63.3
< 8 years	51	36.7
* Average age = 38.9 years (DP = 10.2).		

Table 1: Sociodemographic and occupational characteristics of metallurgical industry workers, according to levels of hierarchy.

As for occupational characteristics, members of the intermediary level I, it was observed that the activity of production was exercised by 61.9% of the workers, and most workers had insertion of more than eight years (63.3%) in the studied industry. The regime of work during business hours (53.2%) was more frequent than the one per shift (Table 1).

Regarding the variables of lifestyle, allocated in the intermediary level II, the habit of smoking or the condition of ex-smokers and excessive alcohol consumption was reported by 30.2% and 18.0% of the interviewee, respectively. The high consumption of risk foods for NCD had a prevalence of 66.9% and low and moderate consumption of protective foods of 64.7%. The physical activity level active and very active was observed in 84.3% of the workers (Table 2).

Variables	N	%
Group 3: Intermediary Determinants II		
Smoking Habits		
Smoker / Ex-smoker	42	30.2
Nonsmoker	97	69.8
Alcohol Consumption		
Excessive	25	18.0
None / Moderate	114	82.0
Consumption of Risk Food		
High / Moderate	93	66.9
Low	46	33.1
Consumption of Protective Food		
Low / Moderate	90	64.7
High	49	35.3
Physical Activity Level		
Sedentary / Irregularly Active	11	15.7
Active / Very Active	59	84.3
Group 4: Proximal Determinants		
Waist Circumference		
High	36	25.9
Adequate	103	74.1
Family History of Hypertension		
Yes	83	59.7
No	56	40.3
Family History of Overweight		
Yes	61	43.9
No	78	56.1
Outcomes: Dependents Variables		
Arterial Hypertension		

Yes	18	12.9
No	121	87.1
Overweight		
Yes	70	50.4
No	69	49.6

Table 2: Distribution of variables related to lifestyle, medical conditions, hereditary characteristics and prevalence of hypertension and overweight in workers of a metallurgical industry.

At the proximal level, the high prevalence of high WC was 25.9%. Regarding hereditary characteristics, the prevalence of hypertension and overweight in family history was 59.7% and 43.9% respectively (Table 2).

We identified prevalence rates of 12.9% for hypertension and 50.4% for overweight (Table 2).

Factors associated to hypertension

The final model of the determinants of hypertension is presented in (Table 3). In the distal level of determination, we found that the prevalence of this harm was 2.84 (95% CI=1.05 - 7.71) times higher among workers with age greater than or equal to 45 years than the prevalence found among workers with age less than 45 years.

Variables	Adjusted PR (95% CI)	P
Group 1: Distal Determinants		
Age (years)		
> 45 years	2.84 (1.05 – 7.71)	0.040
< 45 years	1	
Family income		
Lower	3.97 (1.08 – 14.64)	0.038
Middle / Higher	1	
Group 4: Proximal Determinants		
Waist Circumference		
High	2.77 (1.05 – 7.34)	0.040
Adequate	1	

Table 3: Adjusted prevalence ratios (PR), and confidence intervals of 95% (95% CI), the association between hypertension and its determinants in workers of a metallurgical industry.

Still related to the distal determinants, workers with lower family income presented a prevalence of hypertension 3.97 (95% CI=1.08 to 14.64) times higher than those with middle and higher family income. The variables of intermediary levels I and II, occupational and lifestyle factors, respectively, adjusted by the set of sociodemographic variables, did not presented association with hypertension. While the high WC, which composes the proximal determinants, after adjustment with the other variables of the previous levels, increased by 2.77 (95% CI=1.05-7.34) times the prevalence of hypertension when compared

with the one that workers who had this parameter within appropriate standard (Table 3).

Factors associated to overweight

The results of multivariate analysis indicated that living with a partner increases the prevalence of overweight in 85% (95% CI=1.02-3.36) compared to the prevalence observed among workers without a partner. After the adjustments by the variables in the levels distal and intermediary I, the high and moderate consumption of risk foods for NCD increased the prevalence of overweight in 2.47 (95% CI=1.04 to 5.85) times when compared to the prevalence of those with low consumption of these foods. The other variables entered in the levels intermediary I and proximal were not associated with overweight (Table 4).

Variables	Adjusted PR (95% CI)	P
Group 1: Distal Determinants		
Conjugal Situation		
With partner	1.85 (1.02 – 3.36)	0.046
Without partner	1	
Group 3: Intermediary Determinants II		
Consumption of Risk Food		
High / Moderate	2.47 (1.04 – 5.85)	0.046
Low	1	

Table 4: Adjusted prevalence ratios (PR), and confidence intervals of 95% (95% CI) by Poisson regression, of the association between overweight and its determinants in workers of a metallurgical industry.

Discussion

The prevalence of hypertension (12.9%) and overweight (50.4%) indicates that the two comorbidities consist in relevant health problems among the investigated metalworkers. Retrospective cohort study conducted in Bahia identified prevalence of overweight (41.4%) lower than the prevalence registered in this study and equal prevalence of systolic hypertension (12.9%) [3].

However, the prevalence of these events is distributed differently among Brazilian workers. There are records in industry workers in Sao Paulo of higher prevalence of overweight (56.0%) and hypertension (38.0%) [4]. Results of a study with workers of a metallurgical industry, with units in different cities of the states of Rio de Janeiro and São Paulo, reported prevalence of hypertension (24.7%) higher than the one identified in this study [2]. Among metalworkers of Santa Catarina was observed a lower prevalence of hypertension (6.1%) and higher of overweight (53.0%) [5]. The variability observed in relation to hypertension may be related to the different criteria used for its diagnosis, complicating the comparisons [2].

The factors associated with these comorbidities have been studied and appears to be similarity among populations from different parts of the world. However, the search for differentiated factors into specific groups - in which work-related factors interact with other risk factors,

unleashing a complex network of causes for hypertension and overweight - is strongly recommended.

In this investigation, we identified the lower family income as a determinant of the distal level of hypertension. The arterial hypertension is more common in workers from social classes economically lower [4,5,25] and in the general population there is a higher incidence of hypertension among individuals with low-income [1]. This relation can be explained by the fact that the high socioeconomic level provides access to healthy food, adequate health care and adoption of healthy lifestyles [10,20], while people with lower incomes may find it difficult of accessing quality health services [1,10].

Also in relation to the distal determinants of hierarchy, age was also a factor associated with hypertension. Higher prevalence of hypertension was found among workers with age greater than or equal to 45 years, reflecting the knowledge that the prevalence of this harm increases with age [27], explained by a succession of pathophysiological events that accumulates and (or) occur with the aging process, for example the accumulation of visceral fat [13,28] and hardening of the arteries [27]. Moreover, the low prevalence of hypertension observed (12.9%) can be attributed to the greater number of younger individuals in the sample. This result is similar to the one reported by Martinez and Latorre [2], who also noted a raise of risk for hypertension with the increase of age. Relation also observed in the general population [26,28].

The significant association between hypertension and high WC, part of the proximal level of determination, considers the action of visceral fat and explains the interface of hypertension with the lifestyle. From the physiopathological point of view, this association emphasizes the relation between the amount of visceral adipose tissue and high levels of blood pressure [13,26,29]. This association was identified in this study, even when used the most restrictive cutoff point to classify the waist circumference representing risk for NCD.

For the overweight, the observed relation turned to two indicators, located in distal and intermediary II levels. In this context, the relation between conjugal situation and health conditions, especially the overweight, has been delineated as a disadvantage situation for those who have a partner or stable union, determinant of the distal level, results reported by other authors [30,31], although this relation is not well established yet.

The high and moderate consumption of risk food for NCD is significantly related with overweight after the adjustment with the distal determinants and the occupational variables. Results supported by consistent evidence that high consumption of foods with high saturated fat and trans fat and simple sugars, of high calorie density, low in fiber, vitamins and minerals increases the risk of NCD, including overweight [1,32]. The evidence on this relation were established from studies conducted in various parts of the world, with different population segments, which has provided the biological plausibility that supports the conclusion of this research [32]. It is highlighted that no other exposure factor was associated with overweight in this study.

There was no record of hypertension among the women, which made it not viable the evaluation of the association of this variable with the comorbidity by gender. This result is understandable since only 12.9% (n=18) of the sample of this study were integrated by women. However, the results do not change if women were excluded from this database (results not shown).

No associations were identified between overweight and hypertension with determinants related to occupational conditions or insertion in the production process of the company, although recorded by other investigators [6-9].

We must take into account that the workers of this investigation were accompanied by MCOHP, which favors early diagnosis and appropriate treatment of harms and, therefore, may present better health conditions compared to workers not assisted by similar programs or even with the general population. This way, we can speculate that the actions turned to workers' health may have controlled some of the occupational risk factors that determine them, and the adherence by the cross-sectional study design did not allow capture such relations, if they really existed. There are limitations inherent to cross-sectional design because it estimated relationships between outcome and exposure in a single moment.

These actions may also reflect to amplification of the access to health services, qualifying health care coverage for workers of some companies. It is also need to consider in this analysis, the "healthy worker effect" which consists in the progressive selection of healthy workers by the labor market, which culminates with the removal of those who are not in good health conditions [2].

Considering the relations of determination observed in this study, it is opportune to point to possible limitations, as the adoption of the reported hypertension. However the validity of this indicator is attested [21,22] when the information is provided by the individual himself from the knowledge of the diagnosis of hypertension issued in recent medical appointment in relation to the moment of the interview, conditions observed in this study. Furthermore, we sought to confirm the diagnosis of this morbidity through the use of antihypertensive medication. Thus, the possibility of bias occurrence of classification is remote.

The use and application of the evaluation methods of the food consumption frequency is still a subject of discussion and controversy [33]. However, this method has been adopted in epidemiological studies, for presenting acceptable validity, good reproducibility, practicality, easy application and low cost [33,34]. These features add up to the fact of the team, with extensive experience in this instrument's application, have been trained and the method has been already validated for similar population. It is worth to highlight that the inclusion of the evaluation of the food consumption pattern as an associated factor to the events is a positive aspect of this study, once it allowed us to identify the relation between the feed habits and overweight.

It is also to emphasize that the losses of the study were inexpressive; the data collection was performed by trained personnel and the use of robust statistical technique, with the adoption of two-tailed tests, guarding the internal validity and making the results of this study more reliable and able to be perceived to the other workers of the evaluated industry.

Conclusion

The results of this study reinforce the influence of age increasing, lower family income, and high WC in the increase of hypertension prevalence, and the presence of a partner and the high and moderate consumption of risk food for NCD as predictors of overweight.

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