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Workplace staff canteen is associated with lower blood pressure among industry workers

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**Workplace staff canteen is associated with lower blood pressure among industry workers**

Running title: Staff canteen at the workplace and blood pressure

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## ABSTRACT

### Purpose

A staff canteen in the workplace can offer a healthier diet, which may lower blood pressure. This study aimed to evaluate whether the presence of staff canteen in the workplace is associated with consumption of healthy food and lower systolic and diastolic blood pressure.

### Design/methodology/approach

A cross-sectional study was conducted, randomly selecting workers through a multi-stage sampling, stratified by company size in Brazil. Demographic, socioeconomic, and lifestyle characteristics were evaluated, and weight, height, and blood pressure were measured. Statistical analysis used Generalized Linear Models, controlling for design effect and confounding factors, to assess the association between blood pressure and staff canteen and the intake of food items.

### Findings

4,818 Workers, aged  $35.4 \pm 10.7$  years, 76.5% men, with  $8.7 \pm 4.1$  years of formal education were enrolled. Prevalence of hypertension was 24.7% (P value  $< 0.001$ ) among workers from industries with staff canteen versus 30.6% among those with no staff canteen. Workers of industries with staff canteen consumed higher proportion of fruits, green leafy vegetables, and milk than workers of industries without canteen, and had lower systolic and diastolic blood pressure, independently of the frequency of intake.

### Practical implications

Workers of industries with staff canteen consumed a healthier diet, and had lower systolic and diastolic blood pressure, and lower prevalence of hypertension than workers from workplaces without staff canteen.

### Originality/value

This study was the first carried out among workers of industries reporting that the presence of a staff canteen in the workplace is associated with lower systolic and diastolic blood pressure and prevalence of hypertension.

Key words: Hypertension, blood pressure, workforce, workplace, diets

## INTRODUCTION

High blood pressure has assumed a dominant role in the causation of cardiovascular disease, aligning its high risk (Lewington et al., 2002) to the high worldwide prevalence (Zhou et al., 2017). The scenario is not different in Brazil (Picon et al., 2012). Increasing blood pressure (BP) values have been associated with high cardiovascular risk (Kurioka et al., 2014) and elevated population-attributable risk for cardiovascular disease (Tajeu et al., 2017), besides the increase in medical expenditures (Mozaffarian et al., 2015; Picon et al., 2017).

The increasing of BP with age has been attributed to unhealthy dietary habits. Excess of salt intake (Geaney et al., 2011; Bazzano et al., 2013), calories (Zheng et al., 2017) and animal protein (Borgi et al., 2015; Lajous et al., 2014), as well as low intake of fruits, vegetables and dairy products (Soedamah-Muthu et al., 2012; Van Horn et al., 2016), and potassium (Aburto et al., 2013), are well-known causes of BP rising.

The recommendation to change dietary habits has been usually provided in individual basis by doctors, nutritionists, and other health professionals. The opportunity to offer healthier diets to a large number of individuals has been explored in many contexts, such as in canteens of industries, schools, universities and others (Delaney et al., 2017; Geaney et al., 2013; Roos et al., 2004). The beneficial effect of such initiatives over the prevalence of cardiovascular risk factors has been demonstrated (Rees et al., 2013). We recently showed, in a multilevel analysis, that characteristics of the workplace had an independent association with the prevalence of hypertension (Vinholes et al., 2017). In this report, we extended these observations, exploring the association between the presence of staff canteen, consumption of food items and blood pressure.

## MATERIAL AND METHODS

### Study population

This cross-sectional study was carried out among workers randomly selected by multistage sampling from the industries or companies listed in the Annual Listing of Social Information (RAIS), of the Ministry of Labor and Employment in Brazil. Workers aged 15 years or older were selected from stratum of small (20-99 employees), medium

(100-499 employees) and large ( $\geq 500$  employees) companies in each state. Details of this study have been reported elsewhere (Vinholes et al., 2012).

#### Sampling and sample size calculation

The first stage was a stratum of with regions of the country, including one state per region, selected through simple random sampling. The second stage was based on the size of the company, composed by small, medium and large companies. A stratified random sample, proportional to the stratum size, was used to establish the number of small, medium and large companies per state, and accordingly the number of workers. Companies, ordered by city, were thereafter selected by systematic random sampling at each stratum. Prior to the data collection, the companies were visited by the supervisors in order to inform managers about the project, to obtain consent from the participating company, and to verify the structure of the company to generate the systematic random sample of workers. In each company, a random systematic sampling was used to select workers. All sampling frames were developed in details before the data collection start by an epidemiologist and a statistician, and during the field work two supervisors reassure that the steps have been followed.

The sample size calculation for this analysis was based on an estimate of prevalence of hypertension of 25% among workers of companies with staff canteen vs. 30% for companies with no staff canteen, with a ratio 2:1, totalizing 2880 participants to provide 80% of statistical power. The sample size was enlarged to test other hypothesis and to be representative of 5.453.439 workers registered in the RAIS. Epi Info 2000 (Centers for Disease Control and Prevention, Atlanta, USA, version 3.5.3), was used for sample size calculation.

#### Studied variables

Participants were interviewed at the workplace using a standardized questionnaire, which included assessment of demographic (gender and age), socioeconomic (education - years of schooling), staff canteen, and life style characteristics (abusive alcohol consumption, physical activity, and diet). A staff canteen was characterized as a place where hot meals were provided to workers in the workplace at no cost or at subsidized cost. In Brazil, a staff canteen is required by law in industries with 300

workers or more and must have a nutritionist as responsible (a requirement of the professional nutrition council).

The intake of 37 food items was investigated using a food frequency questionnaire (FFQ), which included questions about the consumption of unhealthy food - high content of sodium, or fat - and healthy food, such as dairy products, vegetables, and fruits - high content of potassium, calcium, and fiber - based on the guidelines to prevent hypertension and cardiovascular diseases. The FFQ was developed based on the guidelines to prevent hypertension and cardiovascular diseases (The JNC 7 Hypertension Guidelines, 2003; Van Horn et al., 2016). It was tested in companies not selected for the study, in order to verify whether the wording was appropriate to the whole country. More details were provided elsewhere (Vinholes et al., 2012). The food items assessed were grouped in dairy products (whole milk, skim milk, yogurt and cheese, labeled as milk), meats (red meat, sausages and salty meat – the latter refers to a specific processing method through salt addition), fruits, vegetables, and green leafy vegetables. Food intake was categorized as four or more servings per week, one to three, and less than one per week or, additionally, categorized as 4 or more and less than four. Abusive consumption of alcohol was determined by the daily intake of 30 grams or more of ethanol by men and 15 grams or more by women, using a standardized questionnaire (Moreira et al., 1996).

Age was calculated subtracting birth from interview date, and categorized into 15-29, 30-39, 40-49 and 50-76 years. Years of formal education were categorized into 0-4, 5-8, 9-11, and 12 or over.

Physical activity was assessed by the International Physical Activity Questionnaire (IPAQ), short form, analyzed according to the protocol, and categorized by the frequency and intensity in high, moderate, and, by exclusion, low physical activity.

Weight (kg) was measured (with subject dressed in light clothing and barefoot) to the nearest 100g with an electronic scale (Plenna, model Mea - 07400), and height (cm) was measured with barefoot participants positioned with heels, buttocks, back and head against the wall, and the head aligned in the horizontal plane, to the nearest 0.1 cm using a stadiometer (Tonelli, vertical model). Body mass index BMI = weight (kg)/height

(m<sup>2</sup>) was calculated and categorized in <18.5, 18.5-24.9, 25.0-29.9 (overweight) and ≥30 kg/m<sup>2</sup> (obesity).

Blood pressure was measured twice during the interview, with an automatic oscillometric device (OMRON, model HEM-705 CP), using standardized techniques. Hypertension was diagnosed by the average of two blood pressure measurements equal or higher than 140/90 mmHg or use of blood pressure-lowering medication. The data analysis was conducted using the Statistical Package for Social Sciences (SPSS, version 18.0, Chicago, Illinois, USA). All analyses were weighted by the sampling effect. The description of mean and standard deviation or n (%) corresponded to means or proportions calculated using the effect design.

#### Statistical analysis

All analyses were weighted by the sampling effect. Bivariate analysis was performed using t-test for independent samples or Pearson chi-square test. Poisson Regression model, with robust estimator, was used to calculate prevalence ratio (PR) and 95% confidence interval (95%CI) for the association between staff canteen and hypertension, adjusted for age, gender, years at school, physical activity, alcohol intake, and body mass index. The association between the presence of staff canteen and blood pressure was further investigated by analysis of mediation using the four steps approach, in which several regression analyses are conducted and significance of the coefficients is examined at each step (Baron and Kenny, 1986). Calculations were based on the Process procedure for SPSS (Hayes, 2017) in the PASW Statistics (SPSS Inc., 2009, version 18.0, Chicago, IL., USA). Total, direct, and indirect effect were calculated using the bootstrapping samples and the statistically significant mediations (boot strapping upper and lower CI did not include zero) were highlighted in bold in the figure.

Multivariate analysis was also carried out using Generalized Linear Model, with the model based on Gama distribution, and robust estimator through maximum likelihood ratio. Test of interactions were used to evaluate the effect of a staff canteen and the intake of food items (predictors) on systolic and diastolic blood pressure (clinical outcomes), controlling for age, gender, years at school, body mass index, physical activity, and alcohol consumption. Multiple comparisons were adjusted by Bonferroni method. The model diagnosis was based on Akaike's information criterion. The



Institutional Review Board and the Ethics Committee of the University Federal do Rio Grande do Sul, which is accredited by the Office of Human Research Protections as an Institutional Review Board, approved the protocol, and all participants provided informed consent.

## RESULTS

In the total, 4818 individuals were interviewed; most workers were men (76.5%), the mean age was 35.4 (SD=10.7) years old, and they attended to 8.7 (SD=4.1) years at school; 12% were obese and 37.9% had overweight. Most workers had high level of physical activity and 15.8% were smokers. A total of 68.3% of companies had staff canteen, and approximately 70% of large companies had staff canteen. Hypertension was 26.2%, more prevalent among men (30.4% vs. 12.4%;  $P \leq 0.001$ ) and among workers of companies with no staff canteen (30.6% vs. 24.7%;  $P \leq 0.001$ ). Workers characteristic's according to the presence of staff canteen in the industries are presented in Table 1.

### TABLE 1 HERE

Workers of industries with staff canteen were predominantly males, aged 30 years or beneath, had high education level, and had lower prevalence of smoking and abusive alcohol consumption. Blood pressure was lower in workers with staff canteen, both for systolic ( $125.9 \pm 19.3$  vs.  $129.6 \pm 20.4$  mmHg;  $P < 0.001$ ) and diastolic blood pressure ( $77.5 \pm 12.4$  vs.  $76.2 \pm 12.3$  mmHg;  $P = 0.001$ ), respectively (Table 1). Lack of a staff canteen at the workplace was also associated with higher prevalence of hypertension (PR: 1.23 (95%CI: 1.10-1.37);  $P < 0.001$ , independently of age, gender, years at school, alcohol intake, physical activity, and body mass index).

Figure 1 shows that workers who had a staff canteen in the workplace had higher intake of milk, green leafy vegetables, and vegetables and lower consumption of red meat. There was no association with intake of fruits.

### FIGURE 1 HERE

Table 2 shows that workers who had higher intake of red meat and do not have a staff canteen at the workplace had, on average, higher systolic and diastolic blood pressure than those who have a staff canteen at the workplace, independently of age, gender, education, and body mass index. There was an interaction between the frequency of sausage meat intake, presence of a canteen at the workplace, and systolic and diastolic blood pressure. Although no linear trend was observed, at each category of intake workers who did not have a staff canteen had higher blood pressure.

TABLE 2 HERE

Figure 2 shows the association of systolic and diastolic blood pressure with frequency of consumption of fruits. The fruit intake, which was lower among workers who had staff canteen at the workplace and had an intake of at least once a week, in comparison to those who did not have. In companies with staff canteen, the intake of fruits 4 times per week or more was associated with lower levels of systolic and diastolic blood pressure in comparison to the consumption less than weekly.

Figures 3 and 4 show that workers who had higher consumption of vegetables and green leafy vegetables, in a staff canteen at the workplace, had lower systolic and diastolic blood pressure in comparison to those who did not have a staff canteen. There was a statistically significant interaction between frequency of food intake and blood pressure.

Figure 5 shows that workers who had higher consumption of milk in a staff canteen in the workplace had lower systolic and diastolic blood pressure independently of age, gender, education, body mass index, and abusive intake of alcohol.

FIGURES 2, 3, 4 AND 5 HERE

Workers with a staff canteen in the workplace have lower systolic and diastolic blood pressure, which was directly associated with higher intake of milk, vegetables, and green leafy vegetables (Figure 6). A mediation analysis showed that the effect of a staff canteen was partially mediated by intake of some food items, such as milk. For some food items, not only the frequency of intake, but the specific type of meat (salty,

sausage) might be involved as mediator. The total effect of a canteen on lowering systolic and diastolic blood pressure was observed for all green leafy vegetables, vegetables, fruits, and milk (Figure 6).

HERE FIGURE 6

## DISCUSSION

This study was the first study conducted in a representative sample of workers from Brazilian industries investigating risks for high blood pressure. It showed that the presence of a staff canteen in the workplace was associated with higher intake of milk and vegetables servings and lower systolic and diastolic blood pressure. Moreover, there were interactions of systolic and diastolic blood pressure with having a staff canteen in the workplace and intake of different types of meat, milk, fruits, vegetables, and green leafy vegetables. Although a staff canteen in the workplace provides food availability, workers had lower systolic and diastolic blood pressure, even with high intake of red and sausage meats, compared with those who did work in non-canteen industries. Workers are a distinct group of the general population, since to be admitted to a job and in order to maintain it, it is necessary to be healthy. Despite of this, Asay et al. (2016) reported high prevalence of risk factors for cardiovascular disease in workers, and the presence of hypertension may result in absenteeism at high costs.

The results of this large cross-sectional study confirms previous findings of an inverse association between hypertension and total dairy (Soedamah-Muthu et al., 2012), fruits and vegetables (Thorsen et al., 2010), and a direct association with meat intake (Borgi et al., 2015; Lajous et al., 2014). The presence of canteen at the workplace was associated with the type of food intake as well. This study did not investigate the association between a staff canteen and blood pressure. A government of Australia report (Health.vic.gov.au, 2017) showed that the use of catering services has been associated with healthy eating habits and employees who eat lunch at the worksite canteens tend to make similar food choices to the nutritional recommendations. The existence of staff canteen at workplace varies across countries (Kjollesdal et al., 2010). In Brazil, approximately 70% of workers have a canteen in the workplace. Workers can choose food from a limited range of healthy options rather than consuming packed

lunch from home or buying food from vending machines. In Norway, Kjollesdal et al. (2010) reported that the presence of a canteen was related to the availability of a place to buy food items at the customer's free choice, and that at about a third of employees ate in the workplace every day. Differently from our findings, the presence of staff canteens in Norway was inversely associated with socioeconomic status and positively associated with unhealthy dietary habits and higher prevalence of obesity.

The differences between Brazil and other countries regarding the canteen of employees in the workplace involve public policies. Availability of staff canteen in the workplace is required by law for companies with more than 300 employees. Companies with fewer employees are allowed to having a canteen. Even so, it has been shown that the frequency of a canteen use is largely determined by the size of the company, gender, and education of employees (Raulio et al., 2008; Thorsen et al., 2009). Even when a canteen is available, people with lower education level or in a lower occupational class preferred packed lunches (Raulio and Prättälä, 2012). On the other hand, in Finland, higher vegetable intake was associated with regular meals in a staff canteen (Raulio, 2011).

The analysis of mediation was an attempt to better interpret our findings about the association of a staff canteen and lower blood pressure. The lack of mediation for individual food items as green leafy vegetables, vegetable, and fruits was unexpected, since these food items have been associated with lower BP (Soedamah-Muthu et al., 2012; Van Horn et al., 2016). On the other hand, the mediator effect of milk intake confirmed the association with hypertension control and lower blood pressure observed in previous studies (Appel et al., 1997; Park and Cifelli, 2013; Engberink et al., 2009).

Some limitations of our study deserve to be mentioned. The cross-sectional design precludes inference of causality. Reverse causality is a potential explanation for workers with hypertension eating healthier choices. Among the strengths of our study are its representativeness of Brazilian workers, rigorous data collection, and the analysis taking into account the design effect.

Our findings show that staff canteens should be provided for workers of all companies, regardless of the number of employees. Consumption of milk, vegetables, and green leafy vegetables was associated with lower blood pressure levels, while consumption of red meat was associated with higher blood pressure. Because not all studies report

better eating habits associated with canteens at the workplace, the type of foods provided by canteens should be further investigated. Studies of cost-effectiveness to implement staff canteen in small and middle size industries or its alternatives are lacking.

In conclusion, the presence of canteen in the workplace is associated with intake of healthier food items and lower blood pressure levels of the employees, in comparison with employees of industries without canteen.

**Conflict of interest**

The authors declare no conflict of interest.

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Figure 1. Food items intake according to the presence of a canteen in the workplace

Figure 2. Systolic and diastolic blood pressure according to the presence of staff canteen associated to the consumption of fruits

Figure 3. Systolic and diastolic blood pressure according to the presence of staff canteen associated to the consumption of vegetables

Figure 4. Systolic and diastolic blood pressure according to the presence of staff canteen associated to the consumption of green leafy vegetables

Figure 5. Systolic and diastolic blood pressure according to the presence of staff canteen associated to the consumption of whole milk

Figure 6. Food intake as mediators of the association between staff canteen and systolic and diastolic blood pressure

Footnote: Statistically significant associations were reported in bold

Table 1.Characteristics of workers according to presence of staff canteen in the workplace – the SESI study \*

|   | Total<br>(n= 4818) | Staff canteen (%) |                 | P value |
|---|--------------------|-------------------|-----------------|---------|
|   |                    | No<br>(n=1448)    | Yes<br>(n=3129) |         |
| Male gender                                   | 76.5               | 79.6              | 75.6            | 0.003   |
| Age (years)                                   |                    |                   |                 | ≤0.001  |
| 15-29   | 35.0               | 38.5              | 32.9            |         |
| 30-39   | 29.7               | 26.2              | 31.0            |         |
| 40-49   | 24.6               | 22.0              | 26.5            |         |
| 50-76   | 10.7               | 13.4              | 9.6             |         |
| Years at school                               |                    |                   |                 | ≤0.001  |
| 0-4   | 18.6               | 22.2              | 16.4            |         |
| 5-8   | 31.8               | 32.8              | 30.8            |         |
| 9-11  | 33.0               | 30.4              | 35.3            |         |
| ≥12   | 16.6               | 14.6              | 17.5            |         |
| Smoking                                       | 16.1               | 18.6              | 14.9            | 0.002   |
| Body mass index (kg/m <sup>2</sup> )          |                    |                   |                 | 0.8     |
| <18.5   | 1.7                | 1.5               | 1.8             |         |
| 18.5-24.9                                     | 48.4               | 48.6              | 47.4            |         |
| 25.0-29.9                                     | 37.9               | 38.2              | 38.5            |         |
| ≥30   | 12.0               | 11.7              | 12.3            |         |
| International physical activity questionnaire |                    |                   |                 | 0.3     |
| High  | 50.8               | 49.8              | 51.9            |         |
| Moderate                                      | 34.8               | 34.6              | 34.1            |         |
| Low   | 14.4               | 15.6              | 14.0            |         |
| Abusive alcohol consumption                   | 6.7                | 68.7              | 62.2            | 0.02    |
| Systolic blood pressure (mmHg)                | 129.0 ±19.7        | 129.6 ±20.4       | 125.9 ±19.3     | <0.001  |
| Diastolic blood pressure (mmHg)               | 76.6 ±12.5         | 77.5 ±12.4        | 76.2 ±12.3      | 0.001   |
| Hypertension                                  | 26.6               | 30.6              | 24.7            | <0.001  |

\* Data was analyzed using Pearson chi-square test or t-test for independent samples

