Coffee consumption associated with physical activity, age, sex, and intake of high-energy, protein-rich foods among workers in the city of Belém, Pará, Brazil.

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Abstract

This study aims to assess associations between coffee consumption and dietary, socioeconomic-behavioral and clinical-biochemical patterns among workers from Belém, Pará, Brazil. This was a cross-sectional study with 1.054 workers of both sexes. The number of coffee drinkers grew significantly as consumption of the meat and egg (p=0.04), fat and oil (p=0.003), and snack food groups (p=0.02) increased. Physically-active individuals were 2.3 times more likely to drink 1 to 4 cups of coffee/day (p=0.003) and 1.9 times to drink more than 4 cups/day (p=0.04) than sedentary ones. Women were 2.1 times more likely to drink 1 to 4 cups/day of coffee than men (p=0.01). In addition, the likelihood of a worker drinking more than 4 cups/day of coffee increased 4.4% per year of age (p=0.004). Coffee consumption is more likely to occur among physically active individuals and women, with the advance of age, and when high-energy, protein-rich foods are consumed.

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INTRODUCTION

There are few studies in the scientific literature that assess the effects of coffee consumption on the Brazilian population health. In Brazil, the vast majority of people drink filtered or instant coffee[1]. Controversies over the association between drinking these types of preparation and the increase in the levels of serum lipids are also found, with studies in favor of[23] and others against it[45].

Relevant studies have been published in recent years, revealing that coffee has functional and nutritional properties that are beneficial to human health[6789]. The effects of bioactive compounds present in coffee, such as chlorogenic acids and caffeine, have been extensively studied. Chlorogenic acids have significant antioxidizing, antibacterial and hypoglycemic properties[1011]. Caffeine is known to have natural ergogenic effects, improving performance and readiness to perform physical activities[12].

In contrast, knowledge about the isolated effect of caffeine is mistaken for the effect of coffee itself[613].

As a result, this study aimed to verify associations between coffee consumption and dietary, socioeconomic-behavioral, and clinical-biochemical patterns among workers from companies covered by the Programa de Alimentação do Trabalhador – PAT (Workers' Food Program) in the metropolitan area of the city of Belém, state of Pará, in Northern Brazil.

METHODOLOGY

The sample of individuals analyzed by this study originated from a survey conducted among workers in the metropolitan area of the city of Belém[14]. This was a population-based, cross-sectional study with a sample of workers from companies covered by PAT. Companies analyzed were found through institutions registered with this Program, and also from a list of companies registered with the Conselho Regional de Nutricionistas/7ª Região (Regional Council of Nutritionists/7th Region).

Hierarchical clustering was the criterion used for the sampling design, and it was obtained with software developed by SAS version 9.0 (SAS Institute, Carry, NC, USA). As the area where the survey was performed did not have data on weight excess prevalence at the time, 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 reached (about 8% of all 13,337 workers). Weight excess prevalence in the city of Belém has recently been found to be 41.8%, a value below the one established for the sample calculation[15], which assured a higher sample size than actually needed.

A total of 1,111 workers participated in the survey, with a 5.1% loss of individuals who were not present for blood collection. Thus, the final sample totaled 1,054 workers. Field study was conducted between February and August 2003. Initially, an in-person interview was performed, with a standard formulary comprised of questions about socio-economic aspects (sex, age, level of education, and monthly family income), life habits (smoking, alcohol consumption, and practice of physical activity), clinical aspects, coffee consumption and dietary habits (intake from the milk and dairy, meat and egg, fat and oil, snack food, cereal and legume, and vegetable and fruit groups), using a semi-quantitative food frequency questionnaire. After the interview, each individual had their weight and height measurements taken. At the second visit, blood collection was performed and waist circumference measured.

Level of education was assessed according to the number of years of study. Family income was divided into ranges and displayed on a table where the worker indicated which one he/she belonged to (one Brazilian minimum wage was worth R$ 300 per month at the time, equivalent to about US$ 170). Systemic blood pressure was measured with a WS-500 Techline digital blood pressure monitor (from Hong Kong, China), according to recommendations previously published[16].

Information about the practice of physical activity was obtained by adapting the short version of the International Physical Activity Questionnaire[17], comprised of questions about frequency and duration of physical activities. Physical Activity Level (PAL) was estimated according to the values proposed by FAO/WHO/UNU[18], and calculated from the sum of partial activity levels informed by each individual. Level of physical activity was classified according to four PAL categories: sedentary (≥1.0 and <1.4), light (≥1.4 and <1.6), moderate (≥1.6 and <1.9), and intense (≥1.9 and <2.5), based on what is proposed by the Institute of Medicine[19].

Classification of participants' nutritional status was performed with the body mass index (BMI in kg/m^2), following the classification proposed by the World Health Organization (WHO) [20]. Height and weight measurements to calculate the BMI were taken, according to what is proposed by Jeliffe[21]. Waist circumference (WC) measurement was based on recommendations by the WHO[22]. The cut-off points used were 94cm for men and 80cm for women, according to the WHO classification[20].

Blood collected from workers was used to determine total cholesterol (TC), HDL-cholesterol (HDL-C), triacylglycerides (TG) and serum glucose (G) levels. Collection was performed after a 10-to-12-hour fast. Serum TC, HDL-C, and TG concentrations were determined with spectrophotometric methods, using enzymatic reagents, and in accordance with the manufacturer's recommendations (Doles, Brazil). The glucose-oxidase colorimetric method was used to determine fasting blood glucose, also in accordance with the manufacturer's recommendations (Doles, Brazil).

Reference values to assess variables analyzed followed the diagnostic criteria for dyslipidemias, established by the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults[23]. Blood glucose reference values followed the criteria proposed by The Expert Committee on The Diagnosis And Classification Of Diabetes Mellitus[24].

ETHICS

This research project was approved by the Research Ethics Committee of the University of Brasília Faculty of Health Sciences (n. 020/2006) and all workers signed an informed consent form, in accordance with the norms of the Resolution 196/96 by the Brazilian Ministry of Health[24].

STATISTICAL ANALYSIS

Epi Info software, version 6.04d (CDC, USA), was used to create the database. Descriptive statistical analysis of the following variables was performed, according to coffee consumption: sex; age; family income; level of education; occupation; PAL; smoking; alcoholic beverage consumption; BMI; WC; systolic and diastolic blood pressure; and TG, TC, HDL-C, and glucose levels.

Aiming to verify the trend of coffee consumption proportion, according to the food intake frequency of the food groups researched, the Cochran-Armitage trend test was used[25]. To reach the trend of proportion, the ratio between the number of coffee drinkers and the total number of individuals from each frequency range (low, moderate, high) of every food group was obtained. Values of $p \leq 0.05$ were considered to be significant.

To obtain the odds ratio estimate of possible risk factors associated with coffee consumption, a polytomic logistic regression model[26] was adjusted, where the following independent variables were considered: TC, TG, HDL-C, and G; systolic and diastolic blood pressure; sex; age; PAL; alcoholic beverage consumption; smoking; BMI; WC; vitamin supplement intake. Coffee consumption was the dependent variable, and thus classified as follows: non-coffee drinkers, consumption of 1 to 4 cups/day, and consumption of more than 4 cups/day. In the analysis, all the independent variables were initially considered. However, with the use of the backward elimination procedure and the likelihood ratio test, all the independent variables that had a statistical significance above 5% were eliminated. The odds ratio was thus calculated in the final model. All these statistical analysis were performed by SAS version 9.0 (SAS Institute, Cary, NC, USA).

RESULTS

Of all the 1,054 individuals analyzed, 93.4% were coffee drinkers. A total of 70.5% of these drank from 1 to 4 cups/day of coffee, while 22.9% drank over 4 cups/day (a cup corresponds to a volume of 50mL). The infusion type (boiled and filtered coffee) was most frequently drank (85%), whereas the soluble type (or instant coffee) showed 14.6% of consumption in the population studied.

The majority of workers were males (69%) and 51.4% of the interviewees were younger than 35 years (18-to-74-year range). By comparing coffee consumption between age groups, it could also be observed that as age increases, the number of those who drink more than 4 cups of coffee also increases (from 0 to 31.6%). As regards level of education, the majority had up to 11 years of study (91.2%). In addition, non-coffee drinkers were found to include a higher percentage of workers with 12 years of study or more. In terms of income, about 73% of workers received less than 5 monthly minimum wages. There was also a higher percentage of non-coffee drinking workers whose income was equal to or above 5 monthly minimum wages, whereas among coffee-drinkers, the opposite was observed.

Among non-coffee drinkers and those who drink from 1 to 4 cups/day there is a higher percentage of non-smokers (7.5% and 72.3%, respectively), when compared to those of smokers (4.3% and 67.3%, respectively). The opposite is observed among those who drink more than 4 cups/day (20.2% never smoked, while 28.4% smoked). In contrast, heavy alcoholic beverage consumption was reported by only 4.7% of workers. As regards PAL, non-coffee drinkers show a higher percentage of sedentary individuals (8.4% against 5.2% of active ones), whereas the group who drinks from 1 to 4 cups/day shows a higher percentage of active individuals (72.8% against 68.3% of sedentary ones). In terms of physical activity, the majority of workers did not exercise (60%).

Mean BMIs were equal among the groups and reveal that the population studied is overweight ($25 \pm 3.7 mg/kg^2$). Mean waist circumference in the coffee-drinking women group was above 80cm, the risk cut-off value for females. The mean biochemical and clinical parameters were also found to be similar among coffee consumption groups and had no statistically significant difference (results not shown). In terms of food intake from the milk and dairy, cereal and legume, and vegetable and fruit groups, there was no significant trend in relation to the coffee consumption proportion. However, the proportion of coffee drinkers showed a significant growing trend as consumption of the meat and egg, oil and fat, and snack food groups increased (Table 1).

Figure 1

Table 1: Coffee consumption proportion trend, according to the frequency of food group intake by workers from companies of the metropolitan area of the city of Belém, state of Pará, Brazil.

Frequency of food group intake	Coffee consumption (n)			Coffee consumption	P
	No	Yes	Total	proportion[a]	value
Milk and dairy: High	44	724	768	0.94	0.11
Moderate	11	111	122	0.91	
Low	11	115	126	0.91	
Meat and eggs: High	17	368	385	0.96	0.044
Moderate	47	553	600	0.92	
Low	5	57	62	0.92	
Snack foods[b]: High	2	76	78	0.97	0.026
Moderate	7	150	157	0.96	
Low	5	581	632	0.92	
Cereals and legumes: High	62	950	1,012	0.94	
Moderate	6	11	17	0.65	0.07
Low	0	11	11	1	
Fruits/leafy vegetables: High	35	491	526	0.93	
Moderate	26	288	314	0.92	0.271
Low	5	162	167	0.97	
Oils and fats: High	41	716	757	0.95	
Moderate	8	128	136	0.94	0.003
Low	17	115	132	0.87	

Note: [a] Cochran-Armitage trend test; [b] Snack foods included pizzas, sandwiches, French fries, crisps, and deep fries. High intake means daily consumption, moderate means weekly consumption and low means monthly consumption.

Table 2 shows the results from the polytomic logistic regression analysis. A direct linear relationship between the age (in years), sex (female x male) and PAL (active and sedentary individuals) variables and the logits 1 (1 to 4 cups/day) and 2 (≥4 cups/day) was found. As a result, the following was observed: active individuals are 2.3 times more likely to drink 1 to 4 cups/day of coffee than those who are sedentary; women are 2.1 times more likely to drink 1 to 4 cups/day of coffee than men. In addition, the likelihood of a worker's drinking more than 4 cups/day of coffee increases 4.4% per year of age; active individuals are 1.9 times more likely to drink more than 4 cups/day of coffee than those who are sedentary.

Figure 2

Table 2: Polytomic logistic regression and odds ratio estimate of risk factors associated with coffee consumption of workers from companies of the metropolitan area of the city of Belém, state of Pará, Brazil.

Variables	Coffee consumption					
	1 to 4 cups/day [a]			≥ 4 cups/day [b]		
	OD	95% CI	P value[c]	OD	95% CI	P value[c]
Age (years) [d]	1.02	(0.989 – 1.045)	0.23	1.04	(1.014 – 1.076)	0.004
PAL [e]	2.3	(1.324 – 3.897)	0.003	1.9	(1.018 – 3.349)	0.04
Sex [f]	2.1	(1.158 – 3.913)	0.01	1.2	(0.601 – 2.343)	0.62

Note: OD=odds ratio. CI= confidence interval. [a] logito1 = 1.1958 + 0.0166Age + 0.8205PAL + 0.7556Sex; [b] logito2 = 0.7845 + 0.0434Age + 0.6132PAL + 0.1715Sex; [c] Obtained by means of multivariate analysis, and resulting from the backward elimination procedure. [d] Age in years. [e] PAL (Physical activity level): active individuals x sedentary individuals. [f] Sex – female x male.

DISCUSSION

The polytomic logistic regression analysis revealed a significant association between coffee consumption and age, sex and PAL variables. As regards the age group, coffee consumption grew significantly as age increased. These findings corroborate those by Kleemola et al.[27], who observed an increase in coffee consumption with the increase in age in the Finnish population.

In term of sex, female workers were more likely to be in the group who drinks 1 to 4 cups/day of coffee than men. The same was found by Mennen et al.[28], who verified that the average coffee consumption of French female participants was higher than that of the French men. Nonetheless, in the group who drinks over 4 cups/day of coffee, no significant association with sex was observed.

In terms of PAL, physically active individuals were more likely to be coffee drinkers than those who were sedentary. Among coffee constituents, caffeine is the most well-known and researched. One study performed by Sesso et al.[29] verified that individuals who drank coffee with caffeine were more physically active. Kromhout et al.[30] also found a positive association between coffee consumption and physical activity. However, the majority of studies published were performed with athletes and/or the use of isolated caffeine capsules[123132].

Coffee-drinking groups were not significantly associated with the anthropometric parameters of the workers studied.

Both the mean BMIs and WC were similar in these groups. However, the population studied is, in general, overweight and women are above the risk cut-off point for WC[19]. This finding is in accordance with Sesso et al.[29], who found mean BMI values that point to American coffee drinkers being overweight.

Among workers studied, there was no association between coffee consumption and smoking. Schwarz et al.[33], however, found a significant association between smoking and coffee consumption. The fact that smoking is more prevalent among coffee drinkers must be viewed with caution, once it may lead to a mistaken association with health risks, originating from smoking and lifestyle, rather than coffee consumption[33]. Moreover, due to the presence of antioxidizing substances in coffee, this association can be seen as positive for smokers, thus requiring further analysis[6]. There was no association between coffee consumption and alcohol drinking.

In the sample of workers studied, it could be verified that there was no significant association between coffee consumption and systemic blood pressure. Conversely, some studies found a positive relationship between coffee consumption and higher blood pressure levels, especially among younger individuals[3427]. Cavalcante et al.[35], however, suggest that these effects of hypertension disappear with regular coffee consumption. It is believed that this is due to the caffeine tolerance developed by the organism[36]. Factors related to lifestyle are also important to maintain these levels within normal range. To be overweight or sedentary, and to eat great amounts of salt in the diet are factors associated with the development of hypertension in western populations[37], and they are frequently present among heavy coffee drinkers.

Coffee consumption was not significantly associated with the biochemical parameters analyzed. This can be partly explained by the ways the population studied usually prepares this drink, namely infusion and/or instant coffee. These types of preparation are known to have almost no diterpenes[3].

As regards consumption of food groups, the proportion of coffee drinkers showed a significant growing trend as intake of the meat and egg, oil and fat, and snack food groups increased. This is partly in accordance with Van Dam and Feskens[38], who found that coffee consumption is usually associated with less healthy diets (growing red meat and fatty food intake).

Consensus about coffee consumption, as recommended by doctors and popular belief, is that this is a health risk factor. This means that people who are not concerned about keeping adequate food habits and lifestyle are those who comprise a great portion of the coffee-drinking group. However, findings from new studies show the potential benefits that this drink has for health, slowly changing this perspective[6789]. Thus, it is important to follow the characteristics of the population who drinks coffee after these new findings are published.

CONCLUSIONS

The majority of the workers drank infused coffee. There was no association between coffee consumption and smoking, alcohol consumption, blood pressure, or serum lipid and glucose levels, nor with anthropometric parameters. In addition, the likelihood of a worker's drinking more than 4 cups/day of coffee increased with the advance of age.

Finally, as regards food groups, the proportion of coffee drinkers showed a significant growing trend as consumption of the meat and egg, oil and fat, and snack food groups increased. Moreover, active people were found to be more likely to drink coffee than those who were sedentary. As large amounts of coffee are consumed worldwide, knowledge about its associations and effects is relevant in terms of public health.

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DEDICATION

This study is dedicated to the memory of Professor Luiz Carlos Trugo, mentor and well-known investigator in the area of coffee research.

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