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Research Article

NUTRITIONAL DEFICIENCIES DETECTED IN POPULAR RESTAURANTS IN BRAZIL

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ABSTRACT

The Popular Restaurants Program is part of the Food and Nutrition Security System implemented by the Brazilian government to fight obesity and associated chronic diseases. The program aims to offer nutritionally balanced and safe meals at lunch hour, at a low cost. Evaluating this program is essential to establish whether the initiative is promoting food security in this population and thus contributing to decreased obesity in the country. The present study evaluated the prevalence of inadequate nutrient intake in popular restaurants in the Distrito Federal (DF), and the nutritional status of the target population. A cross-sectional study was carried out with 267 individuals who ate lunch at one of the six popular restaurants in the DF. Nutritional status of the population was evaluated by Body Mass Index (BMI) and waist circumference. Food intake at lunch was determined by dish weight and direct observation of dish composition. The assessment of nutrient intake at lunch was done according to dietary recommended intake document. According to BMI classification, 13.9% (n = 37) of individuals were obese, 36.3% (n = 97) were overweight, and 0.4% (n = 01) undernourished. The distribution of the macronutrient intake at lunch was within the acceptable macronutrient distribution ranges. Intakes of micronutrients with Estimated Average Requirement values show that more than 50% of individuals consumed inadequate amounts of B1, B2, B3, Ca, and Zn and more than 30% of individuals consumed inadequate amounts of B6 and Mg, at lunch. The mean sodium intake at lunch was at least 3 times the Adequate Intake value for this micronutrient. The results show that the Popular Restaurants Program must improve the nutritional quality of the meal being offered by increasing the intake of vitamins and minerals and decreasing the amount of sodium chloride used in meal preparation.

INTRODUCTION

The prevalence of overweight and obese individuals has increased worldwide over the last three decades from 28.8% to 36.9% in men and 29.8% to 38.0% in women. A study conducted from 1980 to 2013 reveals that the prevalence of overweight women in Brazil is 52.5% and in men is 58.4%. Excessive energy intake, physical inactivity, and low nutrient density of food have been suggested as the main factors contributing to this increase in obesity in the world population(Ng et al., 2014).

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Even though obese individuals have high energy intake, they frequently present low micronutrient intake (Markovic & Natoli, 2009; Via, 2012). Micronutrient deficiencies are associated with development of several chronic diseases, such as obesity, type 2 diabetes, cardiovascular disease, cancer, and osteoarthritis (Lu et al., 2014; Ng et al., 2014). On the other hand, Fuhrman et al. (Fuhrman, Sarter, Glaser, & Acocella, 2010) suggested that diets with high micronutrient quality significantly attenuate the perception of hunger even in conditions of low caloric intake. To fight against obesity and to prevent the development of associated chronic diseases, in 2006 the Brazilian government implemented the Food and Nutrition Security System, according to the 11.346/2006 decree (Brasil, 1996). The strategy consists of a group of social programs that include food and nutrition initiatives and other

actions that facilitate implementing these programs (Nordin, Boyle, & Kemmer, 2013; Valente, 2003). The Popular Restaurants Program is part of this strategy. The program aims to offer nutritionally balanced and safe meals at lunch hour, at a low cost. The target population is comprised of individuals who are socially vulnerable and at risk for nutritional insecurity (Brasil, 1996). The first 'popular' restaurant (i.e., belonging to the Popular Restaurants Program) was created by the Government of the Federal District (DF) in Brazil in 2001; however, the program was not regulated until 2008(Brasil, 1996). In 2009, eight popular restaurants were running, in 2012 this number had increased to 13. In 2009, the popular restaurants in DF offered an average of 23,433 meals per day. The popular restaurants offer lunch six days a week, and the daily menu consists of rice, beans, meat (beef, pork, chicken, or fish), side dishes such as pasta and potatoes, salad, processed fruit juices, and dessert(Branquinho, de Oliveira, de Cássia Akutsu, & da Silva, 2015).

However, its known that actions to combat food and nutritional insecurity go beyond ensuring access to food and may also include health-promoting dietary practices and respect for the cultural, economic, and social status of the population (Nordin et al., 2013; Valente, 2003).In this study, we aimed to investigate whether the Popular Restaurants Program is in fact ensuring a nutritionally adequate meal for the target population. Thus, we evaluated the prevalence of inadequate nutrient intake in popular restaurants in the Distrito Federal, Brazil, using the Dietary Recommended Intake assessment methodology. Evaluating this program is essential to establish whether the initiative is promoting food security in this population and thus helping to decrease obesity in the country.

MATERIALS AND METHODS

Sample and study design

This exploratory, cross-sectional study involved the voluntary participation of customers of Popular Restaurants selected from the official listing of eight restaurants linked to the Popular Restaurants Program, which was provided by the Secretary of State for Development and Social Transfer Income of the *Distrito Federal*. Data collection was not possible in two restaurants because food preparation was performed during late night hours; therefore, the study was performed in six restaurants.The sample size was determined based on the theory of repeated measures, which used the following assumptions: the analysis included six groups (restaurants) and three repetitions (weekly follow-ups); the statistical methodology that was used for data analysis was an analysis of variance for repeated measures and included interaction terms; the significance level was 5%; the desired statistical power was 80%; the correlation between observations at two moments was 0.02 (based on the pilot study); and the hypothesized effect size on the equality of means between groups and the mean difference between groups was 0.15. The sample that was obtained was composed of 246 participants, distributed as a ratio of 41 participants/restaurant. The restaurants were denominated as A, B, C, D, E, and F. The sample size was increased by 20% to help offset potential losses to follow-up or non-response. A pilot project was conducted in two Popular Restaurants to evaluate the methodology and the instruments that were used in the present study; because no significant changes were made to the questionnaires or to the methods that were used, these data were used in the final sample. Participants who were aged ≥ 18, and who had lunch at the Popular Restaurants at least three times a week, were eligible to participate in the study. Pregnant women were excluded. The study was approved by the Human Research Ethics Committee of the University of Brasília, according to the National Health Board Decree 196/96 (Brasil, 1996), and an informed consent form was signed by all of the participants.

Variables analyzed

Socioeconomic and anthropometric data

A questionnaire was administered to collect socioeconomic and demographic data (sex, age, education, marital status, monthly income, comorbidities, and physical activity). The anthropometric data, including weight, height, and waist circumference, were collected based on Jelliffe's (Jelliffe, 1966) protocol, in a private room. The nutritional status (malnutrition, normal, overweight, and obesity) was assessed using the body mass index (BMI) as defined by the World Health Organization (Organization, 1995). The waist circumference values were compared with reference values to determine the risk of metabolic complications associated with obesity. Waist circumferences that were greater than 80 cm for women and greater than 94 cm for men were considered an indicator of an increased risk of obesity-associated metabolic complications (Organization & Organization, 1999).

Food intake during lunch

Technical cards containing information regarding caloric value and the composition of macronutrients and micronutrients of each meal were constructed according to the model described by Akutsu et al. (Akutsu, Botelho, Camargo, Sávio, & Araújo, 2005). The technical cards included noted quantities of foodstuffs, processing steps, and preparation yields, which enabled the calculation of the nutritional value of each preparation. An Excel spreadsheet, developed specifically for this research, based on the Brazilian Food Composition Table – TACO(de Estudos, 2004) was used to estimate meal nutrient composition. The nutritional composition of foods that were not in this table were taken from the Philippi (Philippi, 2002) table or from the product label. Food intake at lunch was evaluated on three non-consecutive days and was assessed by direct observation of dish composition according to the method described by Sávio et al. (Savio, Costa, Miazaki, & Schmitz, 2005). Two final dish weights were obtained: a scaled (weight of plate) and another estimated (obtained from the estimation of the portions served by the consumer). When the difference between the estimated and the scaled weight of the plate was greater than 5%, the estimated weight of each preparation was replaced by the value that was obtained from the following equations:

$$\text{Estimated percentage of the preparation} = \frac{\text{estimated weight of the preparation x 100}}{\text{estimated weight}}$$

$$\text{Real weight of the preparation} = \frac{\text{actual weight of the plate x \% estimated of the prepartion}}{100}$$

Assessment of inadequate intake

The energy intake at lunch was compared with the value corresponding to 40% of the Estimated Energy Requirements (EER) for individuals of normal weight (BMI<25 kg/m^2) or

with the value corresponding to 40% of the Total Energy Expenditure (TEE) for individuals who are overweight or obese (BMI>25 kg/m2). The EER and TEE of each participant was calculated according to the equations described in the Dietary References Intake document(PANEL, 2002), using the following collected data: sex, age, weight, height, and activity level. The mean intake of macronutrients at lunch was compared to the acceptable macronutrient distribution range (AMDR) values for adults, defined as: carbohydrates 45–65%; protein 10–35%, and lipids 20–35%, of the energy intake (PANEL, 2002). Micronutrient distribution values were transformed into natural log values and were adjusted to remove within-subject variations, using the method described by Marchioni et al. (Marchioni, Slater, & Fisberg, 2004). The estimated average requirement (EAR) cut-point *method* was used to analyze the prevalence of inadequacy intake of Zn, Cu, P, Mg, and Ca, as well as of the vitamins thiamin, riboflavin, niacin, and pyridoxine(Electrolytes & Water, 2005). The prevalence of micronutrient inadequate intake corresponded to the proportion of individuals whose usual consumption at lunch was less than 40% of the Estimated Average Requirement (EAR) value established for that nutrient. For micronutrients without EAR value (fiber, K, and Na) the mean intake values were compared with 40% of the Adequate Intake (AI) values. If the mean intake at lunch was at or above these levels, a low prevalence of inadequate intake can be assumed. Because the distribution of iron requirements is not symmetrical for women of reproductive age, the prevalence of an iron deficiency was only estimated for men.

Data analysis

The data were tabulated in an Excel spreadsheet, which was designed specifically for this research, and analyzed using the SAS software (version 9.2, 2006, SAS Institute Inc, Cary, NC 27513-2414, USA). Chi-square test (χ^2) was used to analyze the association between gender and nutritional status. For the comparison between consumption and energy requirements, a paired t-test was used, and the data were described using the mean and standard deviation. Significance was defined as $p < 0.05$. The data regarding micronutrient intake were presented as the mean, standard deviation, and prevalence of inadequacy. It was not possible to calculate the prevalence of inadequacy for the micronutrients that do not have EAR value; therefore, only the proportion of participants with intake below or above the AI values was presented. Sodium consumption was compared with the *tolerable upper intake level* (UL).

RESULTS

Characteristics and nutritional status of the population eating lunch in the popular restaurants in 2012

A total of 267 individuals who ate lunch at one of the six popular restaurants in the DF completed the study. Individuals were on average 38 ± 13 years old and most were males (79.5%, n = 212). Most of the individuals (52.1%, n = 139) completed high school or had higher educational levels. The median monthly household income was three times the minimum wage (US$318.01), and the mean number of children per family of each individual was 1.6 ± 1.5. A total of 20.6% (n = 55) participants reported having been diagnosed with a chronic disease; hypertension was highly prevalent in our sample, being reported by 10.1% of the participants. According to BMI classification, 13.9% (n = 37) of individuals were obese, 36.3% (n = 97) were overweight, and 0.4% (n = 01) undernourished (Organization & Organization, 1999). The prevalence of obesity was higher (20.0%, n = 11) in females than in males (13.9%, n = 37; p = 0.0397). Pearson's correlation between age and BMI was direct and positive (r=0.3; IC95% 0.1-0.4; $p < 0.001$). Among the participants, 31.1% had a waist circumference above the normal range; being more prevalent in women (58.2%) than in men (24.1%) ($p < 0.001$).

Assessment of energy and macronutrient intake of the population eating lunch in the popular restaurants in 2012

Table 1 shows the average energy and macronutrient intake values consumed by individuals during lunch. The distribution of the macronutrient intake at lunch was within the acceptable macronutrient distribution ranges. The mean energy intake among men and women at lunch was equivalent to 37.8% and 40.6% of the daily estimated energy requirement (EER), respectively. The energy intake of men at lunch was lower than the requirement for that meal (p = 0.0043), while no significant difference was observed for women.

Prevalence of inadequate micronutrient intake of the population eating lunch in the popular restaurants in 2012

The estimated usual intake for micronutrient values and the prevalence of nutrient intake inadequacy are presented in Table 2. The assessment of intake of micronutrients with Estimated Average Requirement (EAR) values shows that more than 50% of individuals consumed inadequate amounts of B1, B2, B3, Ca, and Zn and more than 30% of individuals consumed inadequate amounts of B6 and Mg, at lunch. A low prevalence of inadequate iron intake at lunch was observed in the present study for males. The estimated usual intake for nutrients with Adequate Intake (AI) values is presented in Table 2. Over 90% of the participants had a potassium intake at lunch below the AI. The mean fiber intake of men under 50 years was below the AI value at lunch. The mean sodium intake at lunch was at least 3 times the AI value for this micronutrient.

DISCUSSION

Evaluating the Popular Restaurants Program is essential to establish whether the initiative is contributing to promote food security in this population. Therefore, we evaluated the prevalence of inadequate nutrient intake in popular restaurants in the DF, Brazil, as well as the nutritional status of these individuals. In the present study the anthropometric data indicate a high prevalence of overweight (36.3%) and obesity (13.9%) in the population eating lunch in the popular restaurants, which reflects current Brazilian epidemiological trends. Indeed, the Brazilian Household Budgets Research 2008/2009 shows that 49.0% of Brazilians are overweight and that 14.8% of those individuals are obese (de Orçamentos Familiares, 2010). An analysis of the data collected in the survey "Vigitel Brazil: protective and risk factors for chronic diseases by telephone survey" showed that the rates of overweight and obesity in the Brazilian population increased significantly from 42.7% to 51.0%, between 2006 and 2012 (Brazil, 2010).

Table 1 Estimated macronutrients and energy intake at lunch of popular restaurants costumers compared with the Dietary Reference Intakes

	Dietary Reference Intake	Intake of macronutrients at lunch	
		Women (n=55)	Men (n=212)
% energy intake from			
Carbohydrates (AMDR)	45 - 65	60.5 ± 4.5	60.4 ± 4.5
Protein (AMDR)	10 - 35	16.7 ± 1.9	16.3 ± 1.8
Fat (AMDR)	20 - 35	22.8 ± 4.3	23.3 ± 4.4
EER women (kcal/lunch)	748 ± 167*	759 ± 262	-
EER men (kcal/lunch)	1,025 ± 132*	-	969 ± 247

Data expressed as mean ± standard deviation. EER = Estimated energy requirement. AMDR: Acceptable Macronutrient Distribution Ranges. * 40% of the daily Estimated Energy Requirement.

Table 2. Mean intake and assessment of usual intake in relation to DRIs of popular restaurant customers, according to gender, in Distrito Federal, Brazil 2008-2009[a]

	Estimated nutrient intake at lunch					
	Men			Women		
	40% EAR/AI	Mean	P. I. (%)	40% EAR/AI	Mean	P. I. (%)
Thiamin (mg)	0.4	0.3 ± 0.1	93.6	0.4	0.3 ± 0.1	95.0
Riboflavin (mg)	0.4	0.1 ± 0.1	96.3	0.4	0.1 ± 0.1	100.0
Niacin (mg)	4.8	5.0 ± 1.2	63.5	4.4	3.9 ± 1.2	80.8
Pyridoxine 19-50 years (mg)	0.4	0.6 ± 0.4	32.2	0.4	0.5 ± 0.3	40.9
Pyridoxine > 50 years (mg)	0.6	0.6 ± 0.4	54.4	0.5	0.4 ± 0.2	80.0
Calcium 19-50 years (mg)	320	96.7 ± 42.5	100.0	320	75.4 ± 44.9	100.0
Calcium > 50 years (mg)	320	96.3 ± 43.6	100.0	400	68.4 ± 26.5	100.0
Copper (µg)	0.3	0.8 ± 0.7	2.9	0.3	0.6 ± 0.5	22.2
Iron (mg)	2.4	5.2 ± 1.6	4.6	3.2	3.9 ± 1.8	ND
Phosphorus (mg)	232	362.7 ± 120.6	9.4	232	275.4 ± 110.3	44.3
Magnesium 19-30 years (mg)	132	162.1 ± 68.8	36.3	102	123.6 ± 42.3	30.5
Magnesium > 30 years (mg)	140	148.2 ± 34.8	40.6	na	117.8 ± 25.4	32.2
Zinc (mg)	3.8	4.2 ± 1.3	58.8	2.7	3.2 ± 1.2	58.3
Potassium (mg)	1880	1178.7 ± 455.9	ND	1880	920.5 ± 438.9	ND
Sodium (mg)	600	2272.6 ± 596.7	ND	600	1825.6 ± 596.7	ND
Fiber 19-50 years (g)	15.2	13.0 ± 5.4	ND	10	10.1 ± 5.1	ND
Fiber > 50 years (g)	12	13.1 ± 5.4	ND	8.4	9.1 ± 4.4	ND

Note: Data are mean ± standard deviation. PI = prevalence of inadequacy. ND: not determinable due to lack of EAR values. Estimated Average Requirement (EAR) or Adequate Intake (AI). In bold are nutrients that have AI values.

In our study, the distribution of carbohydrates, proteins, and lipids were all within the AMDRs (Table 1). This finding agrees with other Brazilian studies. Maihara et al. (Maihara, Silva, Baldini, Miguel, & Fávaro, 2006) analyzed the amount of nutrients in the diets of male workers of different factories in São Paulo, and found that 100% and 96% of the workers met the carbohydrate and protein requirements. According to the Brazilian Household Budgets Research (de Orçamentos Familiares, 2010; Levy-Costa, Sichieri, Pontes, & Monteiro, 2005), the decrease in the consumption of basic and traditional foods (rice, beans, and vegetables) paired with the increase in consumption of processed foods (cookies and soft drinks) associated to the maintenance of excessive intake of sugar, illustrates the high percentages of macronutrient adequacy intake in the whole population. Few Brazilian studies have evaluated inadequate intake using the DRI methodology as the present study did, making it difficult to compare our results with others. A cross-sectional study by Morimoto, Marchioni, & Fisberg (Morimoto, Marchioni, & Fisberg, 2006), evaluated the consumption of 119 young female university students in São Paulo and found a prevalence of inadequate dietary intake lower (around 15%) than that obtained in the present study for thiamin, riboflavin, niacin and pyridoxine. On the other hand, the prevalence of inadequate intake of phosphorus, copper and zinc was higher than that observed in the present study. The fact that the population analyzed in the study of Morimoto, Marchioni, & Fisberg (Morimoto et al., 2006), had higher socioeconomic and educational levels than our population may explain these opposite findings.

The inadequate intake of vitamins, minerals, and fiber is strongly related to the development of non-communicable diseases, including obesity, hypertension, cardiovascular disease, osteoporosis, and cancer (Fairfield & Fletcher, 2002; Staff, Food, & Staff, 2000). The low prevalence of adequate vitamin, mineral, and fiber intake might be associated with the low consumption of whole grains, fruits, vegetables, and dairy products (Electrolytes & Water, 2005; Sacks et al., 2001). These data highlight the importance of establishing strategies to increase the consumption of vitamins, calcium, potassium, and fiber by the target population. Some strategies to improve the nutritional quality of the meals that are served in the Popular Restaurants Program include increasing the supply of brown rice, reducing the supply of side-dishes that are rich in carbohydrates, such as potatoes and pasta, and replacing them with cooked vegetables, increasing the supply of fruit for dessert, and replacing artificial juice with natural juice.

NHANES III (Third National Health and Nutrition Examination Survey) data showed that the tolerable upper intake level (UL) of sodium is exceeded for over 95% and 75% of men and women in the USA (Doyle & Glass, 2010). Due to several adverse effects on health that are associated with high intake of sodium, such as hypertension, health organizations recommend a reduction in sodium intake. The Brazilian Household Budgets Research 2008/2009 data showed that 89% of men and 70% of women aged between 19 and 59 years had daily sodium intake above the tolerable upper intake level(de Orçamentos Familiares, 2010) (UL = 2.3 g / day).

In our study, the mean sodium intake at lunch was closer to the UL value (2,272.64 mg for men and 1,825.63 mg for women), suggesting an overuse of table salt in the preparation of the food served at lunch in the Popular Restaurants Program. In general, the levels of sodium naturally present in foods account for 10% of the daily dietary intake of sodium, while 90% is consumed in the form of added sodium chloride (Doyle & Glass, 2010). The analysis of the technical cards of the preparations served at lunch in the Popular Restaurants Program show that most sodium in these preparations comes from the overuse of table salt, industrialized seasonings, and processed foods. These results suggest that the use of technical cards is an important quality instrument to control and therefore lower the quantity of sodium offered and consumed in these popular restaurants. Our data show the need for a collective effort by managers and the nutritionists involved with the Popular Restaurants Program to solve the nutritional deficiencies detected in the meals served by the restaurants evaluated in our study. In short, the micronutrient density of the meals must be higher, under penalty of exacerbating the already increasing incidence of overweight in the country.

Conclusion

In conclusion, our findings show that the lunch offered by the Popular Restaurants Program must improve the nutritional quality of the meal being offered by increasing the intake of vitamins and minerals and decreasing the amount of sodium chloride used in meal preparations. Considering that the meal eaten at the popular restaurant can be the main daily meal for these individuals, these recommendations should be followed in order to improve the nutritional security of this socially vulnerable population. In addition, the Popular Restaurants Program must include health-promoting dietary practices aiming at increasing micronutrient density per energy intake. These practices should be combined with other strategies that encourage physical activity in order to combat the prevalence of overweight and obese individuals in Brazil.

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