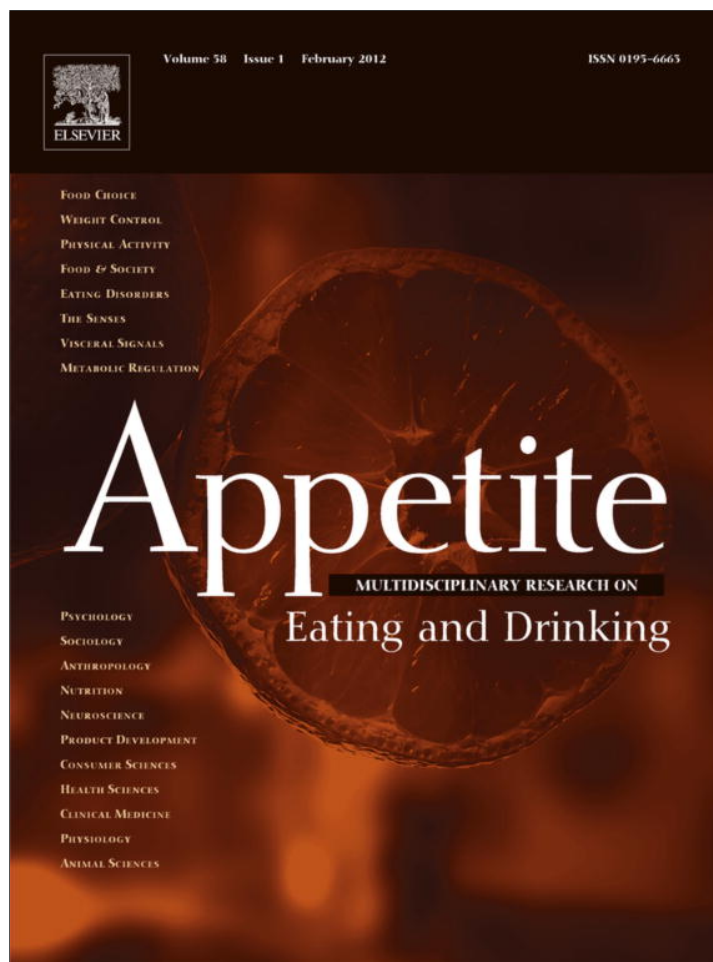


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## Research report

# Overweight/obesity is associated with food choices related to rice and beans, colors of salads, and portion size among consumers at a restaurant serving buffet-by-weight in Brazil

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## ABSTRACT

The present study investigated the prevalence of overweight/obesity and its relationship with behavioral and food choice characteristics among consumers at a restaurant serving buffet-by-weight in the city of Florianópolis, southern Brazil, during lunch time. An analytical cross-sectional survey of 675 consumers aged 16–81 years was conducted. The measures included anthropometric, socio-demographic, and behavioral characteristics, as well as portion size and a photographic record of the plate chosen by the consumer. The results indicated a prevalence of overweight/obesity in the sample of 33.8%. Overall, after an adjustment for other variables (sex, age, schooling, marital status, and food choice variables), overweight/obesity was positively associated with not choosing rice and beans (PR = 1.11) and larger portion sizes (PR = 1.08 for a portion size of 347–462 g and PR = 1.16 for a portion size of 463 g or more). Moreover, choosing 1–2 colors of salads showed a positive association when compared with choosing 3 or more colors of salads (PR = 1.06). Efforts in helping consumers make healthier food choices when eating out and thereby possibly reduce weight gain should address those aspects along with socio-demographic factors.

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## Introduction

Economic development, changes in lifestyle, and a greater concentration of people in large urban centers often result in changes in time management with respect to eating. These changes lead to modifications in the eating habits of the population. Thus, in order to gain time, consumers focus more on ready-to-eat foods and eating outside the home (Garcia, 2003).

In Brazil, changes regarding the setting for main meals are evidenced by the Household Budget Survey conducted by The Brazilian Census Bureau (IBGE). The Household Budget Survey, conducted 2002–2003, showed a weighted prevalence of out-of-home eating, in both sexes, of 40.3% (Bezerra & Sichieri, 2009; Instituto Brasileiro de Geografia e Estatística [IBGE], 2004). Between the periods 2002–2003 and 2008–2009 there was a 7% increase in the proportion of expenditure on eating out in relation to general food expenditure, with the current percentage repre-

senting 31.1% of the latter, and with marked differences in percentage between urban (33.1%) and rural (17.5%) areas (IBGE, 2010a,b).

Transverse and longitudinal studies suggest a positive association between the consumption or frequency of eating away from home and weight gain or increased body mass index (BMI) (Binkley, Eales, & Jekanowski, 2000; Bowman & Vinyard, 2004; Kant & Graubard, 2004; Paeratakul, Ferdinand, Champagne, Ryan, & Bray, 2003). However, there is no agreement among the data, possibly due to the wide diversity in the characteristics of the food service sector. Thus, in some studies, these associations were not found (Burns, Jackson, Gibbons, & Stoney, 2002; Marín-Guerrero, Gutiérrez-Fisac, Guallar-Castillón, Banegas, & Rodríguez-Artalejo, 2008; Orfanos et al., 2007) or they were found only among men (Bezerra & Sichieri, 2009; Naska et al., 2011) or only among women (Kant & Graubard, 2004).

Another highlight is that the portion sizes of food away from home are usually increased and portion size is a major determinant of food consumption (Jeffery et al., 2007; Nielsen & Popkin, 2003). This relationship is independent of other factors such as sex (Rolls, Morris, & Roe, 2002), nutritional status (Rolls et al., 2002; Wansink, Painter, & North, 2005), perception of hunger and satiety (Kral, Roe,

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& Rolls, 2004; Rolls, Roe, Kral, Meengs, & Wall, 2004a; Wansink et al., 2005), and posterior compensation (Flood, Roe, & Rolls, 2006; Kral et al., 2004; Rolls, Roe, & Meengs, 2007; Rolls, Roe, Meengs, & Wall, 2004b; Wansink et al., 2005).

Nonetheless, increases in portion sizes not only increase food consumption during a meal, but also influence the total daily energy consumption, because people do not tend to compensate for higher food consumption at one meal by consuming less at subsequent meals. Moreover, research shows that the effects of portion size can persist for several days; indeed, there are experimental studies of this nature observing effects at 2 (Rolls, Roe, & Meengs, 2006), 4 (Kelly et al., 2009), and 11 days (Rolls et al., 2007).

In relation to how people tend to choose portion sizes, according to the literature, expected satiation explained 74.8% of the variance in the energy content of self-selected meals. Of this, 31% was shared with the perceived volume, indicating that the volume also influences portion-size decisions by moderating expectations around satiation (Brunstrom, Collingwood, & Rogers, 2010).

Parallel to these findings, restaurants serving buffet-style meals appear to be promoting healthy food choices in the food service sector by increasing fruit and vegetable consumption in food served away from the home (Lassen, Hansen, & Trolle, 2007). Thus, the aim of the current study was to assess the prevalence of overweight/obesity and its relationship with behavioral and food choice characteristics in a sample of consumers having lunch at a restaurant serving buffet-by-weight.

## Methods

### *Study outline and location selection*

An analytical cross-sectional study was conducted with consumers having lunch in a restaurant serving buffet-by-weight, located in the southern region of Brazil. In this type of food service, consumers serve themselves from a buffet. Then, they weigh the plate containing the chosen foods on a scale that is tared for the weight of the plate, paying only for the weight of the food chosen in relation to a kilogram price. This form of restaurant is very common in Brazil.

The selection of the location was intentional, aiming to guarantee a diverse range of dishes on the buffet and a heterogeneous clientele. The following inclusion criteria were considered: restaurants serving buffet-by-weight, location in the central area of the city, average price charged for the area, average number of dishes on the buffet, and diversified clientele. The central area of the city was chosen because of an intense circulation of people with different socio-demographic characteristics; in addition, charging a price considered average for the area was considered important because it is possible that higher prices or very low prices would attract a more homogeneous clientele.

Fifty-three self-service restaurants located in the central area of the city were identified by consulting the municipal Union of Hotels, Restaurants, Bars, and Similar Businesses, Local Business Yellow Pages, and Internet search sites. A survey of the prices charged by the establishments was carried out by telephone; 15 restaurants were excluded from the sample because they were no longer in operation or were not pay-by-weight services, resulting in a total of 38 restaurants. After separating the prices charged into quartiles, nineteen restaurants that charged prices in the intermediate quartiles (2nd and 3rd quartiles) were pre-selected for observation analyses.

In the observational analysis, trained observers evaluated the variety of dishes and clientele from the buffets of the nineteen pre-selected restaurants using specific forms, culminating with the selection of one restaurant. The selection considered the socio-demographic characteristics of sex and age, as well as the

number, quality, and variability of dishes on the buffet. The chosen restaurant was considered by the trained observers as being representative of the consumers and the menus offered in the other restaurants observed. The first restaurant chosen agreed to participate.

### *Participants*

The predicted sample size was calculated to be representative of consumers from the selected restaurant, on weekdays in one month (weekends excluded). According to the average production of 400 meals per day at lunch and the average of 22 weekdays in the month, the population of consumers at the restaurant consisted of 8,800 individuals.

Considering an unknown prevalence of overweight/obesity (50%), confidence interval within 4% points, design effect of 1, confidence level of 95%, and random loss of 20%, a sampling of 674 consumers was estimated.

### *Data collection*

Prior to data collection, a pilot study was conducted on two days, with 100 consumers at a similar restaurant. On the basis of the results of this study, changes were made to the questionnaire with the aim of reducing the duration of the interviews with the participants.

Data were collected on 10 non-consecutive weekdays, corresponding to two data collections for each weekday on separate occasions, during open lunch time (11:30 to 14:00), during two consecutive months in 2008.

Consumers were selected through a systematic interval of one consumer in every five after the first consumer of the collection day. This interval took into account the sample size, days of collection, and open time to enable representativeness. The participants were approached only after serving themselves from the buffet, which is a precaution that was taken in order to avoid consumers changing their food choices.

Data were collected in two stages: interviewer-administered questionnaire and direct observation. The interviewer-administered questionnaires included socio-demographic (schooling, sex, age, and marital status), anthropometric (self-reported height and weight), and behavioral characteristics (through the following questions: "how many times a week do you have lunch in a restaurant serving buffet-by-weight"? and "is this meal similar to your usual meal when you eat in this kind of restaurant?"). The direct observation included a photographic record of the plate and dishes available on the buffet and a record of the weight of the plate containing the chosen foods. When the arrangement of food on the plate did not allow for a clear view of the food in the photographs, the interviewers noted the dishes chosen. To prevent data loss, the plate was photographed at least twice. There was no repetition of consumers during the ten days of collection and only consumers 16 years of age or older were approached. The data of 678 consumers were collected by a questionnaire and direct observation.

### *Data analysis*

Those dishes that appeared on the buffets during the 10 days analyzed were classified in four groups: meat, pastry, salads, and rice/beans. Meat, rice, and beans were analyzed because their consumption is typical and common to all regions of Brazil (Brazil, 2005), and they are often consumed together and usually at lunch. Salads were analyzed because of the importance of eating fruits and vegetables for a healthy diet. It is known that different colors of fruits and vegetables are related to different nutrients and,

therefore, the variety of colors is related to the variety of nutrients. Pastry was analyzed because of its high caloric potential.

The preparations of meat were classified according to their cooking method into two categories considering the caloric potential: Group I (baked, broiled, grilled, sautéed with little fat or steamed), and Group II (with large amounts of added fat or deep fried). The pastry group included hot side dishes that had been fried or that contained large amounts of fat added to the preparation, such as pastries, lasagna, pies, and fritters.

The preparations available on the cold buffet were classified into salads or cold side dishes. Salads are preparations primarily comprising fruits, legumes, and/or vegetables, either alone or mixed. This group included both the raw and the cooked preparations. Cold side dishes consist of fruits, legumes, and/or vegetable preparations, which have other types of foods (i.e. grains, pasta, bread, animal protein) as a base ingredient or vegetables that contain approximately 20% carbohydrates in their composition (i.e. corn or tubers in general such as potatoes or cassava). Only salads were considered for analyses due to their low energy density. The colors of salads were classified according to the predominant color of the preparation in 5 colors (white, orange, green, red, or purple). The color and cooking method assessments were done by two different observers and discrepancies were subsequently reviewed and corrected.

Later, the photographs of the consumers' plates and noted dishes chosen were analyzed to identify the presence and cooking method of meats, presence of pastry, presence and colors of salads, and presence of rice and/or beans. This study analyzed the food choices of consumers, and not food consumption. Nevertheless, although we did not analyze plate waste, as this is a restaurant serving buffet-by-weight, in which the meal is self-selected, and people pay for exactly what they choose, it is perceived that people tend to consume the meal in its entirety.

#### Variables

Continuous variables, including BMI, age, and plate weight, were transformed into categorical variables. Self-reported height and weight were used to calculate the BMI, with two categories being used as the dependent variable including: (a) without overweight/obesity (adolescents: BMI < 85th percentile for age/sex (World Health Organization [WHO], 2007), adults: BMI < 25 kg/m<sup>2</sup> (WHO, 1995), older adults: BMI < 27 kg/m<sup>2</sup> (The Nutrition Screening Initiative [NSI], 1994) and (b) with overweight and obesity (adolescents: BMI ≥ 85th percentile for age/sex (WHO, 2007), adults: BMI ≥ 25 kg/m<sup>2</sup> (WHO, 1995), older adults: BMI ≥ 27 kg/m<sup>2</sup> (NSI, 1994)).

The potential confounders considered in the analysis were the socio-demographic variables corresponding to sex (female/male); age (adolescents – 16–19 years/adults – 20–59 years/older adults – 60 years and older); schooling (high school or less/some college education/college or university or more), and marital status (never married/married, divorced, or widowed).

The independent variables included behavioral and food choice variables. The behavioral variables were a lunch meal similar to usual in restaurants serving buffet-by-weight (yes/no), and the frequency of eating lunch in restaurants serving buffet-by-weight (once per week or less/2–3 times per week/4 or more times per week). Food choice variables included the meat cooking method (group I/group II/both group choices); pastry (no/yes); color of salads (3 or more colors/1–2 colors/not chosen); rice and beans (rice and beans/rice or beans/not chosen); and portion size – weight of food choices in tertiles (346 g or less/347–462 g/463 g or more).

The underlined category in each variable refers to the reference category, presenting a hypothetical lower risk of overweight/obesity, while the subsequent categories refer to a hypothetical increased risk of overweight/obesity. The categories of reference

and increased risk for each variable were defined *a priori* and based on the scientific literature available.

#### Statistical analysis

Descriptive statistics were used to summarize the characteristics of the participants. Backward stepwise Poisson regression with robust variance was used in bivariate and multivariate analyses to allow for the estimation of the prevalence ratio (PR) and 95% CI for the associations between the prevalence of overweight/obesity and independent variables. All the independent variables were selected for multivariate analysis based on a conceptual framework determined *a priori*. Two levels were incorporated into the multivariable model: level I included socio-demographic variables and level II included behavioral and food choice variables. Second-level variables were adjusted for each other and potential confounders ( $P < 0.200$ ) were retained for the adjustment of the second level. Adjusted second-level variables that presented  $P \geq 0.200$  were excluded from the model, one by one.

Effect modifiers of sex were identified by examining interactions between the prevalence of overweight/obesity and independent variables by sex, using the Wald test.

Statistical analysis was carried out using the STATA statistical software package (version 11.0, StataCorp, College Station, TX, USA). The critical alpha level was set at  $P = 0.100$  for the Wald test and  $P = 0.050$  for all other tests. All  $P$  values quoted are two-tailed.

#### Ethical aspects

The Federal University of Santa Catarina Institutional Review Board approved the study protocol following the ethical principles detailed in Resolution n° 196/95 of the National Health Council – Brazil, which are in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All persons gave their informed consent prior to their inclusion in the study.

## Results

#### Description of the participants

The present study investigated 678 lunch consumers in a restaurant serving buffet-by-weight. The response rate was approximately 99.5%. The reason for non-participation ( $n = 3$ ) was due to refusal to report or ignorance of anthropometric measurements, giving a total sample of 675 lunch consumers, ranging in age from 16 to 81 years. The majority of participants did not present overweight/obesity, were adults, and had never been married (Table 1). The consumers were familiar with this type of restaurant, with 81.2% reporting eating lunch in restaurants serving buffet-by-weight at least 2 times per week and 74.7% considered the chosen meal similar to their usual meal in this type of restaurant (Table 1).

Food choices related to meat preparation by both categories of cooking methods simultaneously, rice, and salads up to 2 colors were more prevalent in the sample. Around 79.8% of consumers chose at least one salad. The majority of the participants did not choose beans or pastry. Concerning the food choice of rice and beans, 36% of consumers chose the two foods together. Due to the low prevalence of choosing only beans and the absence of significant differences between choosing only rice and choosing only beans, these two categories were merged for further analysis into the category rice or beans. The average portion sizes for each tertile were 278 g, 406 g and 556 g, respectively, which represent an average increase of approximately 46% and 100% in the portion sizes in relation to the first tertile (Table 1).



**Table 1**  
Consumers in a restaurant serving buffet-by-weight (*n*, %, and CI) by nutritional status and socio-demographic, behavioral, and food choice characteristics (*N* = 675).

Variables	<i>n</i>	%	(95% CI)
Nutritional status			
Without overweight/obesity	447	66.2	(62.7, 69.8)
With overweight/ obesity	228	33.8	(30.2, 37.3)
Socio-demographic characteristics			
Sex			
Male	315	46.7	(42.9, 50.4)
Female	360	53.3	(49.6, 57.1)
Age			
Adolescents (16 to 19 years)	110	16.3	(13.5, 19.1)
Adults (20 to 59 years)	529	78.4	(75.3, 81.5)
Older adults (60 years and older)	36	5.3	(3.6, 7.0)
Schooling			
High school or less	258	38.2	(34.6, 41.9)
Some college education	142	21.0	(18.0, 24.1)
College or university or more	275	40.7	(37.0, 44.4)
Marital Status			
Never married	372	55.1	(51.4, 58.9)
Married, divorced, or widowed	303	44.9	(41.1, 48.6)
Behavioral characteristics			
Lunch meal similar to usual in restaurants serving buffet-by-weight			
Yes	504	74.7	(71.4, 77.9)
No	171	25.3	(22.1, 28.6)
Frequency of eating lunch in restaurants serving buffet-by-weight			
Once per week or less	127	18.8	(15.9, 21.8)
2–3 times per week	119	17.6	(14.8, 20.5)
4 or more times per week	429	63.6	(59.9, 67.2)
Food choice characteristics			
Meat cooking method			
No meat chosen	18	2.7	(1.5, 3.9)
Only group I <sup>a</sup>	106	15.7	(13.0, 18.4)
Only group II <sup>b</sup>	255	37.8	(34.1, 41.4)
Group I <sup>a</sup> and group II <sup>b</sup>	296	43.9	(40.1, 47.6)
Beans			
Yes	265	39.3	(35.6, 42.9)
No	410	60.7	(57.1, 64.4)
Rice			
Yes	503	74.5	(71.2, 77.8)
No	172	25.5	(22.2, 28.8)
Rice and beans			
Rice and beans	244	36.0	(32.4, 39.8)
Only rice	260	38.4	(34.7, 42.2)
Only beans	22	3.2	(2.1, 4.9)
Neither	152	22.4	(19.3, 25.7)
Color of salads			
No salad chosen	136	20.1	(17.1, 23.2)
1–2 colors	293	43.4	(39.7, 47.1)
3 or more colors	246	36.4	(32.8, 40.1)
Pastry			
Yes	193	28.6	(25.2, 32.0)
No	482	71.4	(68.0, 74.8)
Portion size			
346 g or less	226	33.5	(29.9, 37.0)
347–462 g	227	33.6	(30.1, 37.2)
463 g or more	222	32.9	(29.3, 36.4)

<sup>a</sup> Baked, broiled, grilled, sautéed with little fat or steamed.

<sup>b</sup> With large amounts of added fat, deep fried.

### Variables associated with overweight and obesity

The Wald test supported the homogeneity of the prevalence ratios across nutritional status and each independent variable in the analysis separated by sex (all  $P \geq 0.100$ ; *data not shown*). Therefore, all the tests were performed for all consumers.

In adjusted analyses, the variables were adjusted for variables in the same level and potential confounders (socio-demographic variables). The overall prevalence of overweight/obesity in the study sample was 33.8%. The socio-demographic characteristics of sex, age, and marital status were significantly associated with the risk of being overweight/obese in both crude and adjusted analyses, whereas schooling were significantly associated with the risk of being overweight/obese only in crude analyses. All socio-demo-

graphic variables presented a  $P \leq 0.115$  and were considered potential confounders for further analysis (Table 2).

No significant differences were found in the risk of overweight/obesity according to the behavioral characteristic of choosing a lunch meal similar to that usually eaten in restaurants serving buffet-by-weight, in both crude and adjusted analysis (*data not shown*). Crude analysis of the frequency of eating lunch in restaurants serving buffet-by-weight showed a significant difference in the risk of overweight/obesity ( $P = 0.037$ ). Eating out 2–3 times per week in this type of restaurant decreased the risk for overweight/obesity by 10% when compared to eating out once per week or less. However, when adjusted for socio-demographic, behavioral, and food choice characteristics ( $P = 0.151$ ), this relationship was not confirmed. The frequency of eating in this type

**Table 2**

Crude and adjusted analysis of the association between the prevalence of overweight/obesity and the socio-demographic characteristics of consumers in a restaurant serving buffet-by-weight (N = 675); prevalence ratios (PR), and 95% confidence intervals (CI) based on Poisson regression with robust variance.

Variables	n	Crude analysis				Adjusted analysis		
		% Overweight /obesity <sup>a</sup>	PR	(95% CI)	P value <sup>c</sup>	PR	(95% CI)	P value <sup>c</sup>
Sex					<0.001			<0.001 <sup>b</sup>
Female	360	20.6	<b>1.00</b>	(reference)		<b>1.00</b>	(reference)	
Male	315	48.9	<b>1.24</b>	(1.17, 1.30)		<b>1.21</b>	(1.15, 1.28)	
Age					<0.001			0.006 <sup>b</sup>
Adolescents (16 to 19 years)	110	12.7	<b>1.00</b>	(reference)		<b>1.00</b>	(reference)	
Adults (20 to 59 years)	529	37.6	<b>1.22</b>	(1.15, 1.30)		<b>1.14</b>	(1.05, 1.23)	
Older adults (60 years and older)	36	41.7	<b>1.26</b>	(1.11, 1.43)		<b>1.12</b>	(0.97, 1.29)	
Schooling					<0.001			0.115 <sup>b</sup>
High school or less	258	31.0	<b>1.00</b>	(reference)		<b>1.00</b>	(reference)	
Some college education	142	23.2	<b>0.94</b>	(0.88, 1.01)		<b>0.93</b>	(0.87, 1.00)	
College/university or more	275	41.8	<b>1.08</b>	(1.02, 1.15)		<b>1.00</b>	(0.94, 1.06)	
Marital Status					<0.001			0.005 <sup>b</sup>
Never married	372	25.5	<b>1.00</b>	(reference)		<b>1.00</b>	(reference)	
Married, divorced, or widowed	303	43.9	<b>1.15</b>	(1.09, 1.21)		<b>1.09</b>	(1.03, 1.15)	
Total	<b>675</b>	<b>33.8</b>						

<sup>c</sup> P value for heterogeneity.

<sup>a</sup> Adolescents: BMI ≥ 85th percentile for age/sex, adults: BMI ≥ 25 kg/m<sup>2</sup>, older adults: BMI ≥ 27 kg/m<sup>2</sup>.

<sup>b</sup> Adjusted models from backward stepwise Poisson regression with robust variance: Sex + age + schooling + marital status.

of restaurant does not exclude the hypothesis that the consumer may present a different frequency of eating out, due to attending other types of restaurants (Table 3).

Concerning the characteristics of food choices, no significant differences in the risk of overweight/obesity were found by food choice related to the methods of cooking meat or the choice of pastry, in both crude and adjusted analyses (*data not shown*). The color of salads was associated with the prevalence of overweight/obesity only in the crude analysis. However, although the variable color of salads was not associated with overweight/obesity in the adjusted analysis, an association between two categories was found. Choosing 1–2 colors of salads showed a 6% increase in the risk of overweight/obesity when compared with choosing 3 or more colors of salads (Table 3).

A significant difference in the risk of overweight/obesity was found for food choice related to rice and beans only after the

adjustment of the model to include sex, age, schooling, marital status, and frequency of eating out in restaurants serving buffet-by-weight, a lunch meal similar to usual in restaurants serving buffet-by-weight, and food choices related to pastry, color of salads, and portion size. In the adjusted analysis, the risk of being overweight/obese was 11% greater in consumers who did not choose rice and beans than in consumers who chose rice and beans (Table 3). The majority of the overweight/obese consumers who did not choose rice and beans chose pastry (64.7%), one or two colors of salads (51.3%), both groups of meat concomitantly (50.0%), and larger portion sizes (46.7%).

The portion size, defined by the weight of the food choices of consumers, divided into tertiles showed a linear association with the increase in the risk of overweight/obesity, even when adjusted for socio-demographic characteristics and other variables analyzed. As a result, the portion sizes that were increased,

**Table 3**

Crude and adjusted analysis of the association between the prevalence of overweight/obesity and the behavioral and food choice characteristics of consumers in a restaurant serving buffet-by-weight (N = 675); prevalence ratios (PR), and 95% confidence intervals (CI) based on Poisson regression with robust variance.

Variables	n	Crude analysis				Adjusted analysis		
		% Overweight /obesity <sup>a</sup>	PR	(95% CI)	P value <sup>c</sup>	PR	(95% CI)	P value <sup>c</sup>
Behavioral characteristic								
Frequency of eating lunch in restaurants serving buffet-by-weight								0.164 <sup>b</sup>
Once per week or less	127	37.8	<b>1.00</b>	(reference)		<b>1.00</b>	(reference)	
2–3 times per week	119	24.4	<b>0.90</b>	(0.83, 0.98)	0.037	<b>0.93</b>	(0.86, 1.01)	
4 or more times per week	429	35.2	<b>0.98</b>	(0.92, 1.05)		<b>0.99</b>	(0.93, 1.05)	
Food choice characteristics								
Color of salads								0.085 <sup>b</sup>
3 or more colors	246	29.3	<b>1.00</b>	(reference)	0.045	<b>1.00</b>	(reference)	
1–2 colors	293	38.9	<b>1.07</b>	(1.01, 1.14)		<b>1.06</b>	(1.01, 1.12)	
No salad chosen	136	30.9	<b>1.01</b>	(0.94, 1.09)		<b>1.06</b>	(0.99, 1.13)	
Rice/beans								0.004 <sup>b</sup>
Rice and beans	244	32.1	<b>1.00</b>	(reference)	0.123	<b>1.00</b>	(reference)	
Rice or beans	282	31.6	<b>1.00</b>	(0.94, 1.06)		<b>1.03</b>	(0.97, 1.09)	
Neither	152	40.7	<b>1.06</b>	(0.99, 1.14)		<b>1.11</b>	(1.04, 1.19)	
Portion size					<0.001			<0.001 <sup>b</sup>
346 g or less	226	17.3	<b>1.00</b>	(reference)		<b>1.00</b>	(reference)	
347–462 g	227	34.8	<b>1.15</b>	(1.08, 1.22)		<b>1.08</b>	(1.02, 1.15)	
463 g or more	222	49.5	<b>1.28</b>	(1.20, 1.36)		<b>1.16</b>	(1.09, 1.24)	
Total	<b>675</b>	<b>33.8</b>						

<sup>c</sup> Portion size variable shows a P value for linear trend. All other variables show a P value for heterogeneity.

<sup>a</sup> Adolescents: BMI ≥ 85th percentile for age/sex, adults: BMI ≥ 25 kg/m<sup>2</sup>, older adults: BMI ≥ 27 kg/m<sup>2</sup>.

<sup>b</sup> Adjusted models from backward stepwise Poisson regression with robust variance: sex + age + schooling + marital status + frequency of eating out in restaurants serving buffet-by-weight + lunch meal similar to usual in restaurants serving buffet-by-weight + pastry + color of salads + rice/beans + portion size. The meat cooking method variable presented P ≥ 0.20 after adjustment and was excluded from the model.

on average, by 46% (2nd tertile) and 100% (3rd tertile) when compared to the portion sizes of the 1st tertile, indicated an increase in the risk of overweight/obesity of 8% and 16%, respectively (Table 3).

## Discussion

The present study reveals that, in adjusted analysis, overweight/obesity was associated with not choosing rice and beans, bigger portion sizes, and less colorful salads in a sample of consumers in a restaurant serving buffet-by-weight in Brazil.

The associations found between not choosing rice and beans and higher risks of overweight and obesity were possibly due to changes in traditional dietary habits. In Brazil, a study showed that a dietary pattern that relied mainly on rice and beans, which is also a low-fat diet, was associated with lower risk of overweight/obesity (13% reduction in men and 14% reduction in women) (Sichieri, 2002). Another research also indicated an association between the consumption of rice and beans and a lower risk of overweight/obesity in females from a low-income neighborhood in Brazil (Cunha, Almeida, Sichieri, & Pereira, 2010).

A cross-sectional study, based on young adults, found that this common Brazilian dietary pattern was more likely to be followed by subjects who had low personal or maternal educational levels, were of low social class, or who had always been poor. Conversely, the processed food pattern was more likely to be followed by wealthier subjects (Olinto, Willett, Gigante, & Victora, 2011).

Rice and beans used to be staple foods in Brazil, but data show a decrease in their intake between 1974 and 2003. During the same period there were increases of up to 400% in the consumption of industrialized products, excessive consumption of sugar, and a systematic increase in total and saturated fat content (Levy-Costa, Sichieri, Pontes, & Monteiro, 2005). Meanwhile, between 1974 and 2009, the prevalence of overweight/obesity in Brazil rose from 21.3% to 62.5% among men, and from 36.7% to 64.9% among women for adults 20 years of age or older (IBGE, 2010a,b).

The size of portions chosen by the consumers in this study suggests that as the portion size increases there is also an increase in the risk of overweight/obesity. Thus, increases of 46% and 100% in the portion sizes were associated with an increase of 8% and 16% in the risk of overweight/obesity, respectively. Several experimental studies conducted in the United States of America and the United Kingdom show the influence of increased portion sizes on food intake (Flood et al., 2006; Kral et al., 2004; Rolls et al., 2002; Rolls et al., 2004a; Rolls et al., 2004b; Rolls et al., 2007; Wansink & Kim, 2005; Wansink et al., 2005). In general, the authors investigated portion sizes between 100% and 500% of the standard portion size, and demonstrated food intake increases of at least 30%. Studies using larger portion sizes had an effect of greater intensity in the increase in food intake. Furthermore, larger portion size is often accompanied by a higher total energy content and, thus, could contribute to weight gain. This is especially critical in the cases studied here because self-selected meals tend to be consumed in their entirety (Brunstrom et al., 2010).

In the present study, choosing 1–2 colors of salads was positively associated with overweight/obesity when compared to choosing 3 or more colors of salads. This could have occurred due to diversification in the fruits and vegetables choices, which plays an important role in providing a varied and nutritious diet and is also linked with a decreased risk of diabetes and obesity (WHO, 2003). The colors of foods included on the menu, particularly salads, are used to verify the nutritional quality of menus as a qualitative assessment method, because of the importance of the visual aspect and the relationship with the nutritional aspects of foods (Veiros, Proença, Kent-Smith, Hering, & Sousa, 2006). The studied buffet offered 5 colors of salads on each day analyzed and

most consumers chose at least 1 color of salad. A study in the United States of America exploring the availability at home and consumption in common settings of fruits and vegetables among non-Hispanic black and non-Hispanic white adolescents and their parents showed that eating in non-fast-food restaurants was a stronger predictor than home availability for vegetable intake among both groups. This suggests that intake may be increased if people eat at restaurants where fruits and vegetables are available and visible (Befort et al., 2006).

The present investigation has some methodological limitations. First, the study was restricted to a single restaurant. However, as the restaurant chosen was considered to be representative of the other restaurants surveyed, possibly their consumers also represent the characteristics of the population of interest, indicating data generalizability. Second, only the food choices of a single meal were analyzed, which may not coincide with consumption or dietary habits. However, considering that the food choices were self-selected by the consumers who were familiar with this type of restaurant, the meals analyzed are likely to represent the usual intake in such a situation. Finally, the BMI classification relies on self-reported data, which could be influenced by reporting biases, such as a tendency to overestimate height or underestimate weight (Kovalchik, 2009; Spencer, Appleby, Davey, & Key, 2002). This could lead to an attenuated relationship between BMI and the analyzed outcomes.

A positive highlight of this study is the fact that the data concerning food choices are related to direct observation and were not based on self-reported information. The analysis of actual eating behavior is considered to ensure more accurate data (Ngo et al., 2009; Poulain & Proença, 2003; Williamson et al., 2003). Furthermore, the consumers were approached only after having made their food choices to minimize the possibility of them changing food choices after learning of the research. Photographs, a quickly applied questionnaire, and self-reported measures are easily applicable, cost-effective, and cause low interference with the consumer's mealtime. This less burdensome and less time consuming method of data collection increases the chance of consumers consenting to participate in the study.

Lastly, overweight/obesity was significantly associated with the color of the chosen salads, rice and beans, and portion size. Such factors may be related to an increased risk of overweight/obesity because they indicate a monotony of choices and changes in Brazilian dietary habits. This effect may be exacerbated by the simultaneous choice of larger portions of food.

The restaurant serving buffet-by-weight appears to be capable of uniting the convenience of eating out with health promotion in the same place because of the diverse range of dishes on the buffet and the possibility of self-limitation of portion size. However, considering these characteristics, it should be emphasized that health promotion still depends on individual food choices. Therefore, given the substantial and increasing proportion of people eating outside the home together with the wide variety in the characteristics of the food service sector, the results of the present study highlight a need for a public and private focus on improving dietary choices and food availability in order to reduce overweight/obesity concomitantly with the promotion of healthier food choices when eating out.

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