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Factors associated with dietary patterns among low-income adults

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Abstract

Objective: To describe the association of socio-economic, demographic and life-style characteristics with three eating patterns identified among low-income adults living in the Rio de Janeiro metropolitan area, Brazil.

Design: Data were obtained in a population-based cross-sectional study. The analysed patterns were: (i) 'Mixed', in which diverse foods had similar factor loadings; (ii) 'Western', which included items with high energy density; and (iii) 'Traditional', which relied in rice and beans, traditional staple foods in Brazil. Hierarchical logistic analysis was performed to estimate the association between the independent variables and each one of the dietary patterns. The variables that presented statistical significance <0·20 in the univariate analysis (χ^2 test) were included in the multivariate models.

Setting: Duque de Caxias, a low-income area in the Rio de Janeiro metropolitan region, Brazil.

Subjects: Adults (*n* 1009) aged 20 to 65 years (339 men and 670 women).

Results: The 'Mixed' pattern was positively associated with smoking (OR = 1·58, 95 % CI 1·00, 2·48 for current smoking *v.* those who never smoked). The 'Western' pattern was positively associated with family income (OR = 3·00, 95 % CI 1·81, 4·97 for those with monthly per capita family income ≥1·0 *v.* <0·5 times the official Brazilian minimum wage) and inversely associated with family food insecurity (OR = 0·55, 95 % CI 0·36, 0·84). The 'Traditional' pattern was associated with family food insecurity (OR = 1·79, 95 % CI 1·27, 2·51).

Conclusions: The results support previous findings relating improvement in economic conditions to reduced adherence to the traditional Brazilian food consumption pattern based on the combination of rice and beans.

Keywords
Food intake
Factorial analysis
Multivariate analysis
Socio-economic factors
Hierarchical analysis

From the epidemiological point of view, diet represents a complex combination of exposures. However, epidemiological studies often fail in corroborating the effects observed experimentally for some dietary components. The conventional approach adopted in investigations on food consumption, which is centred on the evaluation of energy, nutrient or food intake as independent variables, does not allow one to consider the effect of the diet as a whole on the risk diseases, as the multicollinearity, confounding and interaction that may occur between the many dietary components are usually not appropriately taken into account[1,2]. For example, the association between the consumption of whole grains and the reduction in the risk for developing chronic diseases may be subject to confounding by the relationship between the use of unrefined products and the intakes of fruits, vegetables and fish[2–4].

The identification of dietary patterns employing statistical procedures, such as principal component analysis and cluster analysis, has been considered as an alternative to overcome these limitations. Supposedly, dietary patterns illustrate the real situations of food availability and dietary practices of the study population[5,6]. Consequently, they facilitate the identification of subgroups that adopt eating habits compatible with the risk for or protection against diseases and provide reliable empirical support to the elaboration of dietary recommendations and guidelines[7–9].

Three dietary patterns were identified among adults living in Duque de Caxias, a metropolitan area of Rio de

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Janeiro, Brazil[10]; one of these was characterized as the 'traditional' pattern which has also been identified in other studies carried out in this country[6,11,12]. In 1994–1995, Sichieri examined the association between dietary patterns and obesity in adults living in the city of Rio de Janeiro and also identified three main dietary patterns: 'mixed' (in which diverse food items showed similar factor loading), 'traditional' (characterized by the consumption of rice and beans) and 'Western' (characterized by the consumption of fats and soft drinks)[13].

The traditional Brazilian food consumption pattern, centred around the consumption of rice and beans, has been considered to be protective due to its Fe and fibre contents and low energy density[10,13,14].

The objective of the present study was to estimate the association between socio-economic, demographic and lifestyle factors and three dietary patterns in a low-income neighbourhood in the Rio de Janeiro metropolitan area.

Methods

The data refer to a population-based cross-sectional study, carried out in 2005 in the district of Campos Elíseos, in the municipality of Duque de Caxias, one of the poorest areas in the Rio de Janeiro metropolitan area, Brazil, which had 244 000 inhabitants in the 2000 population census[15].

The current analysis includes data from adults between 19 and 65 years old. A cluster sampling design with three selection stages was adopted for the selection of subjects. Primary sampling units (census sector) were the first stage of selection, households the second and adults the third; one adult was interviewed in each household. The sample design included the procedure of ranking the households according to income inside each census tract, allowing for sampling also according to this variable. Statistical tests indicated that data as well as the sample size were adequate for performing factorial analysis in the identification of dietary patterns[10].

Data were obtained by means of interviews conducted in the households from May to December, 2005. All participants signed a free informed consent form, and the research was conducted within the standards demanded by the Declaration of Helsinki and approved by the Ethics Committee of the University of the State of Rio de Janeiro.

Food intake was estimated applying a semi-quantitative FFQ validated for the adult population of Rio de Janeiro[16]. The FFQ listed eighty-two food items, three options of portion size for each item and eight alternatives for reporting the frequency of food intake, which varied from 'never or almost never' to 'more than three times a day'.

To identify the dietary patterns, the food items listed in the FFQ were grouped into twenty-one food groups based on their nutritional characteristics and considering the reported intake frequency. Exploratory factor and principal component analysis were applied to derive dietary patterns. Orthogonal Varimax rotation of the factors was applied to improve the interpretation. Six solutions with eigenvalues $>1{\cdot}0$ were obtained, and the Cattell graph method[17] indicated that three patterns should be retained: (i) the 'Mixed' pattern, characterized by the consumption of cereals, fish and shrimp, leaves, vegetables, fruits, eggs, meats and caffeinated beverages; (ii) the 'Western' pattern, with high intakes of juices, cakes and cookies, soft drinks, milk and milk derivatives, sweets, snacks and fast foods; and (iii) the 'Traditional' pattern, characterized by the consumption of rice and beans, breads, sugar, sauces and fats. Those patterns together explained 35 % of the total data variance.

Hierarchical analysis

Hierarchical analysis models were developed separately for each dietary pattern identified in order to estimate its association with the demographic, socio-economic and lifestyle variables. The factor scores associated with each pattern were categorized as lower than or equal to the median (reference category, codified as '0') or above the median (codified as '1'). A factor score classified as 'above the median' was defined as adherence to a pattern.

In the theoretical model that oriented the hierarchical analysis, the socio-economic factors were considered as distal (group 1). In the second group were included variables related to the family characteristics (number of family members, presence of children and adolescents, sex of the household head, family food insecurity), and the third group was composed by the proximal variables related to lifestyle. The classification of the independent variables is described in Table 1.

The association between the independent and the dependent variables was tested in univariate analysis using the χ^2 test, selecting for the hierarchical analysis those with a significance level $<0{\cdot}20$ in order to avoid the exclusion of potentially important variables. The hierarchical model was then developed using logistic regression analysis, considering significance levels $<0{\cdot}10$ for the maintenance of variables in the model. Age, sex and skin colour were maintained in the models as they were considered important confounding variables.

The first hierarchical level included in the model was composed by the socio-economic factors that presented statistical significance in the univariate analysis. In the second step of the analysis, the factors referring to family and household were included and their effects verified in the presence of the remaining factors from the previous level (those that presented $P<0{\cdot}10$). The same procedure was applied for including the third group of variables (those related to lifestyle). These approaches guaranteed control by variables from the previous groups. The final estimator for the effect of distal variables was the one observed before the introduction of the proximal variables, while estimators of the effect of the

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Table 1 Variables included in the theoretical model of hierarchical analysis analysing factors associated with dietary patterns in Brazilian adults

Variable	Categories
Group 1: Socio-economic factors	
Education (years of study)	≤4; 5–7; 8–10; ≥11
Working at the time of the survey?	Yes; no
Monthly per capita family income	<0·5 times minimum wage; 0·5–1·0 times minimum wage; ≥1·0 times minimum wage (note: the official Brazilian minimum wage at the time of survey was about $US 120·00)
Group 2: Factors regarding the family and the household	
Number of household members	1–2; 3–5, ≥6
Presence of children (up to 5 years) and/or adolescents (12 to 18·9 years)	Yes; no
Sex of household head	Male; female
Family food insecurity (based on the Brazilian scale of food insecurity – EBIA)[24]	Yes (any degree of family food insecurity: mild, moderate, severe); no
Marital status of respondent	Single; married; divorced or widow/widower
Group 3: Variables related to lifestyle	
Smoking habits	Current smoker; ex-smoker; never smoked
Alcoholic beverage consumption (frequency of drinking in the last year according to information reported in the FFQ)	No report; <1 time/week, 1–3 times/week; 4–5 times/week; ≥6 times/week
Physical activity (considering leisure (yes/no), working (mild, moderate, severe), domestic (yes/no) and locomotion (yes/no) physical activity)	Sedentary (reporting mild working physical activity and no leisure, domestic or locomotion physical activity); mild (reporting mild working activity and one of the other types of physical activity); moderate (reporting moderate working activity and one or two of the other types of physical activity); severe (intense working activity and including at least one type of physical activity)
Controlling variables	
Age group (years old)	19–30; 31–40; 41–50; 51–65
Skin colour (evaluated according to the interviewer)	White; black; mixed
Sex of the respondent	Male; female

proximal variables were observed after the introduction of the distal variables in the models, with the exclusion of variables with $P > 0{\cdot}10$. Odds ratios and the respective 95% confidence intervals were estimated. The data were analysed using the SPSS statistical software package version 16·0 (SPSS Inc., Chicago, IL, USA).

Results

One thousand two hundred and fifty-three individuals were interviewed, of whom 222 (17·7%) reported implausible energy intake (below 2093 kJ/d (*n* 5) or above 25 121 kJ/d (*n* 217)) and were excluded. Also excluded were twenty-two individuals with incomplete data on other variables. Analysis was done for 1009 individuals (males: 34%, *n* 339; females: 66%, *n* 670). The mean age was 39 (SD 12) years, no significant difference was observed in the mean age according to sex ($P = 0{\cdot}73$; Student's *t* test).

The results of the univariate analysis are summarized in Table 2. In short, all socio-economic variables were associated ($P < 0{\cdot}20$) with the 'Mixed' and 'Western' patterns. The sex of the household head and all lifestyle variables were also related to the 'Mixed' pattern. The number of household members, presence of children in the household and family food insecurity are the family variables that were associated with the 'Western' pattern; the only lifestyle variable associated with the 'Western' pattern was smoking. The 'Traditional' pattern was associated with the following family variables: working activity, number of household members, sex of the household head and family food insecurity; additionally, it was associated with the lifestyle variables of smoking, physical activity and alcoholic beverage consumption.

In the multivariate hierarchical analysis, it was observed that smokers presented adherence to the 'Mixed' pattern. Having a monthly per capita family income higher than 0·5 times the official Brazilian minimum wage (at the time of the study this value corresponded to $US 60·00) had a direct association with adherence to the 'Western' pattern; nevertheless, belonging to families that reported food insecurity was associated with reduced adherence to this pattern. An increased adherence to the 'Traditional' pattern was observed for those living in households with food insecurity (Table 3).

Discussion

The present analysis described the association of socio-economic, demographic and lifestyle characteristics with three eating patterns identified among low-income adults living in the Rio de Janeiro metropolitan area, Brazil. The results showed that even small increases in income are related to increased adherence to the 'Western' pattern, even though the mean income in this area is very low compared

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Table 2 Association between demographic, socio-economic and lifestyle factors and dietary patterns among adults (*n* 1009), Duque de Caxias, Rio de Janeiro, Brazil, 2005

		'Mixed' pattern		'Western' pattern		'Traditional' pattern	
	Total (%)	Adherence (%)*	*P* value (χ^2)†	Adherence (%)*	*P* value (χ^2)†	Adherence (%)*	*P* value (χ^2)†
Group 1: Socio-economic factors							
Education (years of study)			0·197		<0·005		0·345
≤4	30·9	51·0		37·3		46·8	
5–7	23·3	54·3		47·4		52·2	
8–10	21·7	50·5		52·8		53·7	
≥11	24·1	44·6		65·0		47·9	
Working activity			0·164		0·002		0·026
Yes	45·9	52·6		55·2		53·9	
No	54·1	48·2		45·2		46·7	
Monthly per capita family income (multiple of official Brazilian minimum wage)			0·080		<0·005		0·346
<0·5 (<$US 60·00)	48·9	54·0		40·9		46·0	
0·5–1·0 ($US 60·01–120·00)	30·4	49·0		61·5		43·8	
≥1·0 (≥$US 120·00)	20·7	43·0		66·9		38·7	
Group 2: Factors regarding the family and the household							
Number of household members			0·336		0·006		0·065
1–2	14·3	45·5		56·2		38·0	
3–5	68·9	49·9		53·0		49·6	
≥6	16·8	54·5		39·2		49·0	
Presence of children/adolescents			0·596		0·081		0·362
Yes	28·6	48·6		56·0		45·3	
No	71·4	50·7		49·2		48·8	
Sex of the household head			0·156		0·306		0·033
Male	74·3	48·6		52·2		50·0	
Female	25·7	54·4		47·9		41·5	
Family food insecurity			0·611		<0·005		0·002
No	31·2	50·4		63·1		42·3	
Yes	68·8	52·2		43·0		53·6	
Marital status			0·332		0·283		0·274
Single	17·6	45·5		55·1		54·0	
Married	70·9	51·5		48·5		49·9	
Divorced or widow(er)	11·5	48·7		50·4		44·3	
Group 3: Variables related to lifestyle							
Smoking habits			<0·005		<0·005		0·153
Never smoked	63·5	61·3		40·2		55·7	
Ex-smoker	17·1	55·9		43·5		45·9	
Current smoker	19·5	45·4		54·6		49·4	
Physical activity			0·009		0·346		0·174
Sedentary	3·5	48·6		37·1		57·1	
Mild	53·5	46·1		50·9		47·2	
Moderate	29·0	52·6		50·9		51·2	
Severe	13·4	61·9		46·3		56·7	
Alcoholic beverage consumption			0·038		0·871		0·007
None reported	59·6	48·6		50·7		45·4	
<1 time/week	5·2	44·2		48·1		63·5	
1–3 times/week	15·3	47·9		51·9		54·5	

Table 2 *Continued*

		'Mixed' pattern		'Western' pattern		'Traditional' pattern	
	Total (%)	Adherence (%)*	*P* value (χ^2)†	Adherence (%)*	*P* value (χ^2)†	Adherence (%)*	*P* value (χ^2)†
4–5 times/week	6·5	48·5		48·5		57·6	
≥6 times/week	13·5	62·5		46·3		56·6	
Control variables							
Age group (years old)			<0·005		<0·005		<0·005
19–30	29·3	40·5		66·9		59·8	
31–40	29·0	55·6		49·5		53·2	
41–50	22·9	56·3		42·0		43·3	
51–65	18·7	48·7		34·4		38·1	
Sex of the respondent			0·351		0·689		<0·005
Male	33·6	52·2		51·0		68·1	
Female	66·4	49·0		49·6		40·9	
Skin colour			0·018		0·001		0·087
White	31·8	50·2		57·5		45·1	
Brown	50·5	46·4		47·8		52·4	
Black	17·7	58·9		41·1		50·2	

*Individuals with factor scores above the median for the factor.
†χ^2 test for homogeneity.

with the average per capita Gross Domestic Product calculated for the country in 2005 (about $US 4400/year[15]). Individuals from families with monthly per capita income over half of the official Brazilian minimum wage presented an increment in the probability of choosing this type of dietary pattern even though processed items are more expensive than the foods included in the 'Traditional' pattern, such as rice and beans. Alves *et al.*[3] observed that women belonging to the A and B economic classes, the two most wealthy categories, living in the south of Brazil presented greater adherence to a high-cost dietary pattern that included foods related to the risk of chronic non-transmissible diseases and was based on candy, desserts, sweets, cream, ham, bologna, salami, aged pork loin, industrialized mayonnaise, cheese, fried foods, fast foods, cookies and cakes.

Individuals from families with food insecurity were associated with reduced adherence to the 'Western' pattern, but demonstrated adherence to the 'Traditional' pattern. Additionally, a previous study with this same population observed an inverse association between adoption of the 'Traditional' pattern and BMI (weight/height^2; $P<0{\cdot}01$) and waist circumference ($P<0{\cdot}01$)[10]. The adherence to the 'Traditional' pattern is considered positive due to the low energy density, the reduced glycaemic index and the good nutritional quality of the rice-and-beans combination, which is also a good source of fibre and Fe. This positive effect reaffirmed findings from a previous study with 2589 adults between 20 and 60 years old residing in the city of Rio de Janeiro, which showed an inverse association between rice-and-beans consumption and the risk of overweight/obesity in both men and women after adjusting for age, physical activity, diet and occupation[13].

Smoking was positively associated with the 'Mixed' dietary pattern, although subjects with college education rejected this eating pattern. Similar results were observed by Pryer *et al.*[18]. Alternatively, McNaughton *et al.*[19] observed among males that ex-smokers preferred 'Ethnic foods and alcohol' and 'Mixed' patterns and Mishra *et al.*[20] observed among males that non-smokers also recorded higher scores for the 'Mixed' pattern compared with smokers.

The association between college education and adherence to the 'Mixed' pattern was also observed in previous studies. Lower education was associated with unhealthy eating patterns and high income and education were associated with high scores for healthy patterns[21–23]. One analysis conducted among 1026 adult women from southern Brazil found that a lower-cost and high-risk diet was more frequent among women with low educational level[21].

Our sample included a larger proportion of females, which can be partially explained by the great number of households headed by females. Data from the Brazilian Institute of Geography and Statistics indicate that, in the country, 30 % of households are headed by a woman[15],

Table 3 Hierarchical logistic regression models and dietary patterns in adults (*n* 1009) of Duque de Caxias, Rio de Janeiro, Brazil, 2005

	OR	95 % CI
	'Mixed' pattern*	
Group 3: Variables related to lifestyle		
Smoking habits		
Never smoked	1·00	–
Ex-smoker	1·04	0·66, 1·63
Current smoker	1·58	1·00, 2·48
	'Western' pattern†	
Group 1: Socio-economic factors		
Monthly per capita family income (multiple of official Brazilian minimum wage)		
<0·5 (<$US 60·00)	1·00	–
0·5–1·0 ($US 60·01–120·00)	2·31	1·54, 3·48
≥1·0 (≥$US 120·00)	3·00	1·81, 4·97
Group 2: Factors regarding the family and the household		
Family food insecurity		
No	1·00	–
Yes	0·55	0·36, 0·84
	'Traditional' pattern‡	
Group 2: Factors regarding the family and the household		
Family food insecurity		
No	1·00	–
Yes	1·79	1·27, 2·51

*Controlling for monthly per capita family income, smoking habits, physical activity, alcoholic beverage consumption, age group, sex of the respondent and skin colour.
†Controlling for monthly per capita family income, number of household members, presence of children/adolescents, family food insecurity, education, working activity, age group, sex of the respondent and skin colour.
‡Controlling for monthly per capita family income, family food insecurity, presence of children/adolescents, smoking habits, physical activity, alcoholic beverage consumption, age group, sex of the respondent and skin colour.

which is more frequent among those families living in the poorest areas. Since prior analysis showed that there were no variations in dietary patterns according to sex[10], it is unexpected that these differences could bias our results.

The adoption of an unhealthy eating pattern by economically deprived individuals may be related to the cultural devaluation of foods that compose the traditional Brazilian diet. In contrast, the improvement in purchasing power could signify the possibility of acquiring foods that are socially valued, such as highly processed foods. Unfortunately, some of those items, e.g. sugar-added beverages and cookies, are considered to present risk for the development of non-transmissible chronic diseases.

The epidemiological importance of these findings resides in their contribution to the rationale of intervention programmes and strategies, especially considering the limiting factors to the adoption of healthier eating patterns, such as the high cost of foods like vegetables, fruits, and milk and dairy. Another factor is the need to rescue the cultural and social status of the traditional Brazilian diet and incentivize inclusion of the rice-and-beans combination in the diet of all socio-economic groups.

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