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Patterns of food acquisition in Brazilian households and associated factors: a population-based survey

Dirce M Marchioni[1,2,*], Rafael M Claro[1,2], Renata B Levy[1,3] and Carlos A Monteiro[1,2]
[1]Núcleo de Pesquisas Epidemiológicas em Nutrição e Saúde, Faculdade de Saúde Pública, Universidade de São Paulo, Av Dr Arnaldo 715, Cerqueira César, São Paulo, SP, Brasil, CEP 01246-904: [2]Departamento de Nutrição, Faculdade de Saúde Pública, Universidade de São Paulo, São Paulo, SP, Brasil: [3]Departamento de Medicina Preventiva, Faculdade de Medicina, Universidade de São Paulo, São Paulo, SP, Brasil

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Abstract

Objective: To identify food acquisition patterns in Brazil and relate them to the sociodemographic characteristics of the household.
Design: A cross-sectional national Household Budget Survey (HBS). Principal component factor analysis was used to derive food patterns (factors) on the basis of the acquisition of food classified into thirty-two food groups.
Setting: The source of data originates from the 2002–2003 HBS carried out by the Brazilian Institute of Geography and Statistics between June 2002 and July 2003 using a representative sample of all Brazilian households.
Subject: A total of 48 470 households allocated into 443 strata of households that were geographically and socio-economically homogeneous as a study unit.
Results: We identified two patterns of food acquisition. The first, named 'dual', was characterized by dairy, fruit, fruit juice, vegetables, processed meat, soft drinks, sweets, bread and margarine, and by inverse correlations with Brazilian staple foods. In contrast, the second pattern, named 'traditional', was characterized by rice, beans, manioc, flour, milk and sugar. The 'dual' pattern was associated with higher household educational level, income and the average age of adults on the strata, whereas the 'traditional' presented higher loadings in less-educated households and in the rural setting.
Conclusions: Dietary patterns described here suggest that policies and programmes to promote healthy eating need to consider that healthy and non-healthy foods may be integral in the same pattern.

Keywords
Dietary patterns
Household Budget Survey
Factor analysis

To cope with the increasing rates of obesity, CVD, diabetes mellitus and cancer, one of the main objectives of the Brazilian food and nutritional policy is to reduce health damages related to diet in the population[1]. To achieve this goal, there is a need to understand the main population dietary patterns. Various sociodemographic factors such as income, education, sex and ethnicity are thought to influence food choices. Traditionally, research on diet and health has focused on single nutrients or on single food items, and not on the entire diet. Since we eat food, not single nutrients or food items, the focus has recently turned more towards dietary patterns[2,3]. Thus, the study of dietary patterns using multivariate data analysis, e.g. factor analysis, is burgeoning in nutritional research. Factor analysis is a statistical method that analyses the covariate structure of a range of variables to identify a restricted number of underlying variables. When applied to the analysis of food group consumption, exploratory factor analysis reduces data into patterns based on correlation between dietary items[4].

Studies regarding food or nutrient intake have reported changes in dietary intake and food consumption in Brazil. Levy-Costa *et al.*[5], on the basis of data from Household Budget Surveys (HBS) on food, reported, in a 30-year interval: a decline in the consumption of basic, traditional foods such as rice and beans; notable increases (up to 400 %) in the consumption of processed food items, such as cookies and soft drinks; maintenance of excessive consumption of sugar; and a continuous increase in total fat and saturated fat contents in the diet. However, few studies have examined entire dietary patterns.

The aim of the present study was to identify and analyse the main dietary patterns prevailing in Brazil using data from a national HBS.

Methods

All data analysed in the present study originate from the 2002–2003 HBS carried out by the Brazilian Institute of

*Corresponding author: Email marchioni@usp.br

Geography and Statistics between June 2002 and July 2003 using a representative sample of all Brazilian households. The data collected in this survey describe in considerable detail all food purchases made by families throughout a 12-month period.

Sampling

The present study is based on the analysis of data collected from the 2002–2003 HBS on a probabilistic sample of 48 470 Brazilian households[6]. This survey used a complex clustered sampling procedure, with a random selection of Census tracts in the first stage and of households within those tracts in the second. Selection of Census tracts was preceded by an examination of the 215 790 tracts of the 2000 Demographic Census in order to obtain strata of households with high geographic and socio-economic homogeneity. For this classification, the geographical location of tracts (region, state, capital city or other, urban or rural) and, within each geographical locus, the variation in years of schooling of heads of households in the sector (obtained during the 1996 population count) were considered. Finally, 443 strata of households that were geographically and socio-economically homogeneous were constituted. The number of tracts selected from within each stratum was proportional to the total number of permanent private households in that stratum, with a minimum of two tracts selected per stratum. Next, households were selected within each tract by simple random sampling without reposition. Interviews within each selected stratum were distributed uniformly across the four trimesters of the study so as to reproduce, within each stratum, the seasonal variation in income, prices and purchase of food and other products.

Data collection

The main component of data from the 2002–2003 HBS used in the present analysis comprises the records of seven consecutive days of food purchases for consumption by the household. Purchases were recorded in a booklet by the household members under the daily supervision of the interviewer from the Brazilian Institute of Geography and Statistics. The short reference period used by the HBS for recording household food expenditures does not allow the identification of the usual food purchase patterns of each individual household. To overcome this limitation, in the present analysis we used the set of households visited within each of the 443 strata in the sample as a study unit. The mean number of households studied within each study unit was 109·4 (range: 9–804).

Variable creation and definition

In order to establish the amounts of the different foods purchased within each study unit (household stratum), we added all records for the same food by each household in the study unit. In the end, approximately 1300 different foods and beverages were computed. When appropriate, we excluded the inedible fraction of foods using the corresponding correction factors[7]. We then converted the total amount of each purchased food into energy (kJ) and selected nutrients (protein, carbohydrate, fat, retinol, fibre, vitamin C, cholesterol, Ca, Fe and saturated fat) using AQUINUT software version 1·0 (Núcleo de Pesquisas Epidemiológicas em Nutrição e Saúde – NUPENS, Sao Paulo, Brazil)[8], generated predominantly using TACO (the Brazilian food composition table)[9]. For foods not included in this table, we used the US official food composition table, version 15[10].

The food items were categorized into thirty-two food groups according to categories of foods with similar nutritional content and the frequency of purchase: sugar and sweeteners, soft drinks, biscuits, desserts and sweets, processed meat, chicken, beef meat, pork meat, fish, rice, wheat flour, pasta, corn, bread, banana, orange, other fruits (all fruits, except orange and banana), fruit juices, butter and margarine, milk, dairy products, pulses, oil, eggs, ready-to-eat meals, potatoes, manioc, manioc flour, lettuce, other green vegetables (all greens, except lettuce), tomato and other vegetables (all vegetables, except tomato).

The mean family income in the stratum, expressed in $US/person per month, was obtained by dividing the sum of the monthly incomes of all households in the stratum by the total number of persons living in these households. In a similar manner, we calculated the mean age and mean years of schooling of residents for each stratum. The geographical region where the stratum was located (north, north-east, south, south-east and mid-west) and its rural/urban status complemented the characterization of the study units.

Statistical methods

Principal component factor analysis was used to derive food patterns (factors) on the basis of the acquisition of the thirty-two food groups. The first pattern extracted accounts for the maximum possible variance in the data set. The second, independent of the first, explains the maximum possible for the remaining variance, and so on, without any correlation between the components[11,12]. A stepwise procedure was utilized to determine the number of patterns to be extracted. Initially, the patterns with eigenvalues over 1·25 were retained, resulting in six factors. In a second step, the Scree Test criterion was used, by examining the shape of the screeplot to define the cut-off point. Finally, the criterion of interpretability was considered[11,12]. After this process, labels were assigned to each pattern retained on the basis of an approximate description of the food items that were most highly represented[13,14].

Orthogonal Varimax rotation was applied to achieve a simpler structure with greater interpretability. Factor loadings of >0·25 were considered to significantly contribute to the pattern. Within each pattern, negative loadings indicate that the food group is inversely associated with the pattern, whereas positive loadings indicate a direct association. The higher the factor loading of a food group the greater the contribution of that group to the pattern, since the square of the factor loading corresponds to the percentage variance of the food group that is explained by the pattern. Factor scores – a composite measure created for each study unit on each pattern retained[11] – were used to study the relationship between patterns and the sociodemographic and socio-economic aspects of the strata. The following variables were used: urban or rural strata and average adult age, education and income. All the continuous variables used in the present analysis – representing the average values of the strata – were categorized according to tertiles of their distribution.

As orthogonal rotation of all patterns retained the guarantee that they are uncorrelated, the sum of the square correlations between absolute nutrient availability and factor scores can be interpreted as the proportion of variance of the nutrient availability that is explained by the patterns[14]. The same analysis was conducted with energy-adjusted nutrient availability, using the residual method, obtained on the basis of the residuals of linear regression models that have the acquired amount of each nutrient as the outcome variable and total energy as the explanatory variable[15]. We used Cronbach's α coefficient to evaluate internal consistency for each component. All analyses were carried out using the Stata/IC statistical software package version 9·2 for Windows (StataCorp., College Station, TX, USA). Two-sided significance was determined at $P < 0·05$.

Results

Table 1 presents the sociodemographic and socio-economic characteristics of the household strata. The vast majority lived in urban areas (85 %) and 45 % in the south-east region. Mean per capita monthly income was $US 269, and for one-third of the household strata the monthly income was $US 148 or less. The mean composition of the households was 3·6 members, aged nearly 30 years, and approximately a quarter were headed by women. Individuals under 20 years formed 38 % of the households. The mean number of years of schooling was 7.

Two patterns were retained in the factor analysis, which accounted for 42 % of the variance in food acquisition (Table 2). The first was responsible for 29 % and the second for the additional 13 % of total variance.

The factor loadings of each food group in each pattern are presented in Table 2. On the basis of the factor loadings of each food group in each of the two retained patterns, we called the first 'dual pattern' and the second 'traditional pattern'. The dual pattern had significant contributions (factor loadings > 0·25) from dairy, fruit, tomato, orange, vegetables, fruit juice, green vegetables and banana, food items that are recognized as positively related to health, and also from foods that have been associated with deleterious effects on health, such as desserts and sweets, soft drinks, processed meat, ready-to-eat meals, margarine and biscuits. Further, this pattern presented inverse correlations with Brazilian staple foods. The traditional pattern had significant contributions from

Table 1 Demographic and economic characterization of the study units, Brazil, 2002–2003

	Household strata (*n* 443)	
Indicator	*n*	%
Area		
Urban	323	84·8
Rural	120	15·2
Region		
North	95	6·5
North-east	146	25·2
South-east	93	45·1
South	52	16·0
Centre-east	57	7·2
Monthly per capita income ($US)		
34–148	169	33·3
148–240	111	34·1
≥240	163	32·6
	Mean or %	SE
Age (years)	29·1	0·29
Male	28·4	0·27
Female	29·8	0·32
Percentage of women as heads of households	26·1	0·6
Percentage of women in the stratum population	50·5	0·2
Number of householders	3·6	0·00
Percentage of individuals over 64 years	8·8	0·3
Percentage of individuals under 5 years	6·3	0·3
Average monthly per capita income ($US)	269·0	15·41
Schooling – adults (completed number of years)	6·7	0·16

Table 2 Factor loadings for the two factors found in the principal component analysis

	Dual pattern				Traditional		
Food item	Percentage of variance	Cronbach's α	Factor loading	Food item	Percentage of variance	Cronbach's α	Factor loading
	29	0·93			13	0·78	
Dairy			0·86	Sugar			0·69
Sweets			0·85	Pork			0·69
Fruit			0·84	Wheat flour			0·69
Soft drinks			0·80	Milk			0·68
Tomato			0·75	Rice			0·63
Ready-to-eat meals			0·75	Vegetable oil			0·63
Orange			0·73	Manioc			0·59
Vegetables			0·70	Beans			0·47
Processed meat			0·70	Corn			0·36
Potatoes			0·69	Green vegetables			0·36
Fruit juices			0·68	Potatoes			0·32
Bread			0·67	Pasta			0·30
Margarine			0·64	Lettuce			0·30
Green vegetables			0·62	Eggs			0·27
Banana			0·59	Bread			−0·35
Biscuits			0·44				
Milk			0·29				
Lettuce			0·28				
Sugar			−0·28				
Rice			−0·31				
Beans			−0·39				
Corn			−0·43				
Manioc flour			−0·44				

Table 3 Mean factor score in each food acquisition pattern, by area of residence, family income, age and years of schooling

	Food acquisition pattern					
	Dual			Traditional		
Household characteristic	Mean	Tertile	*P* value	Mean	Tertile	*P* value
Area						
Urban	0·18	0·26; 0·33	<0·01	−0·20	−0·33; 0·07	<0·01
Rural	−0·99	−1·26; −0·74		1·13	0·61; 1·65	
Monthly family income ($US)						
34–148	−0·80	−0·90; −0·69	<0·01	0·00	−0·22; 0·23	0·265
148–240	−0·13	−0·25; −0·01		0·32	−0·01; 0·65	
≥240	0·88	0·71; 1·04		−0·16	−0·35; 0·02	
Adult age (years)						
19·6–27·5	−0·64	−0·81; −0·48	<0·01	−0·27	−0·45; −0·11	<0·01
27·5–30·1	−0·23	−0·36; 0·09		0·07	−1·13; 0·28	
30·1–49·3	1·00	0·81; −1·20		0·23	−0·06; 0·52	
Years of schooling among adults						
1·3–5·8	−0·83	−0·97; −0·71	<0·01	0·38	0·08; 0·68	<0·01
5·8–7·3	−0·00	−0·27; 0·26		−0·09	−0·34; 0·16	
7·3–14·3	0·86	0·68; 1·03		−0·30	−0·45; −0·14	

food groups used for domestic food preparation, such as rice, beans, pork, eggs, manioc, potato, corn, green vegetables, lettuce, vegetable oil, sugar, meat, pulses, vegetables, roots (manioc) and tubers (potato). In addition, a significant negative factor loading for bread was observed, meaning that the purchase of this food item was contrary to this pattern.

A high internal consistency of food items in each pattern was observed, according to Cronbach's α: 0·93 for the dual pattern and 0·78 for the traditional pattern.

Table 3 presents the mean household factor score in each food acquisition pattern, stratified according to household sociodemographic characteristics. Positive score means on the dual pattern were observed in urban areas, whereas these means were negative in rural areas. The inverse was observed for the traditional pattern. The dual pattern was positively associated with mean household family income ($P < 0·001$), whereas no significant association was observed for the traditional pattern. In the second tertile of income, a positive mean was observed; however, in the highest tertile this mean was negative. For educational level, a positive association emerged for the dual pattern and an inverse for the traditional pattern.

Table 4 Pearson's correlation coefficients between household factor score in each pattern and energy and nutrient availability and percentage of explained variance of energy and nutrient availability in the study sample

	Dietary pattern				
	Dual		Traditional		
	Crude	Energy adjusted	Crude	Energy adjusted	Total R^2 (percentage of variance)†
Energy (kJ)	0·10	–	0·80*	–	65
Protein (g/d)	0·10*	0·28*	0·74*	0·29	56
Carbohydrate (g/d)	−0·30*	−0·24*	0·72*	−0·28	61
Fat (g/d)	0·39*	0·52*	0·73*	0·56	69
Retinol (μg)	0·52	0·85	−0·13*	−0·91*	29
Fibre (g)	0·08*	0·42*	0·52*	0·42*	28
Vitamin C (mg)	0·77*	0·40*	0·20	0·52	63
Cholesterol (mg)	0·37*	0·33*	0·46*	0·36	35
Ca (mg)	0·43*	0·31*	0·69*	0·37*	66
Fe (mg)	0·43*	0·52*	0·48*	0·58	42
Saturated fat (g)	0·57*	0·49*	0·67*	0·62	77
Added sugar (g)	0·02*	0·48*	0·74*	0·48*	55

*$P < 0·05$.
†From crude Pearson's coefficient.

The two retained patterns accounted for a relatively large proportion of variance (>50 %) of the following nutrients: energy, protein, carbohydrate, fat, fibre, vitamin C, Ca and saturated fat and added sugar (Table 4). The correlations between the score of household dual pattern and selected nutrients after adjustment for energy were positive for protein, fat, cholesterol, saturated fat and added sugar, and also for fibre, vitamin C, Ca and Fe. Related to the traditional pattern, after adjustment for energy, there were positive associations only for fibre, Ca and sugar addition, whereas the pattern was negative for retinol. Despite the significant association observed with the traditional pattern, the percentage of variance explained for fibre and retinol was relatively low compared with the other nutrients: <30 %.

Discussion

The present analysis identified two food acquisition patterns in Brazil and explored their relationship with household sociodemographic characteristics and nutrient availability. The first pattern, named 'dual', was characterized by dairy, fruit, fruit juice, vegetables, processed meat, soft drinks, sweets and bread and margarine, and by inverse correlations with Brazilian staple foods. In contrast, the second 'traditional' pattern was characterized by food groups usually used in domestic preparation and cooking of Brazilian traditional dishes, such as rice, beans, manioc, flour, milk and sugar.

Although several dietary patterns have been reported in the literature, two patterns were relatively dominant and were first introduced by Slattery *et al.*[13] in 1998. The first, a pattern characterized by high intakes of vegetables and fruit, and also of whole grains and white meat or fish, was frequently named as a 'prudent', 'health' or 'health conscious' pattern[16]. The other is a culturally dependent 'traditional' pattern, reflecting ethnic differences in food preferences, as reported in North America[17–19], Europe[20–22], Asia[23–26] and Latin America[27–30]. Our study has also identified one traditional pattern composed of foods that are Brazilian staple foods, such as rice and beans.

A traditional pattern was also reported in previous studies conducted in Brazilian regions[27,28,30,31]. However, what merits attention in our study is the presence of a dual pattern characterized by the simultaneous presence of healthy and unhealthy foods. A similar pattern was found by a longitudinal study conducted in the USA[32], which reported a pattern rich in components that are considered as having the potential capacity to lower the risk of CVD, but it was not considered as exclusively health promoting. The absence of a coherent health conscious pattern in our study may indicate that the choices of food selection in Brazil are being driven not by health concerns but by tradition, cost, palatability and even food advertisement.

In our study, the traditional pattern was likely to be stronger in the rural setting, similar to the results reported in the USA[33]. The dual pattern was typical in the urban area, in families with monthly income higher than $US 240 and mean adult age above 30 years. Dietary patterns are likely to vary according to sex, socio-economic status and ethnicity[34–37]. In our study, the dual pattern was associated with higher educational level and higher income. Fan *et al.*[38], using data from the Consumer Expenditure Survey conducted in the USA, described eight food expenditure patterns that were affected by age, ethnicity, education, gender or family type. Hu *et al.*[36] in a large study in US men reported that individuals who had higher scores for a 'Western' dietary pattern were more likely to have lower levels of income and education. Our results of the dual pattern are similar to those of previous studies, in which patterns with high loadings in fruit and vegetables were frequently positively associated with age[33,39,40], higher income, higher educational levels[41] or higher socio-economic status, sometimes in a gender-specific manner. Cai *et al.*[39], in Shanghai, reported that more educated people had higher scores for all three patterns retained. The relationship of dietary patterns to sociodemographic and lifestyle characteristics supports the theory that food choices are part of a larger pattern of health-related characteristics and behaviours.

The dual pattern described here, similar to other studies on Mexican Americans, British and Hawaiians[26,42,43], suggests high risk for chronic diseases in a part of the Brazilian population. High availability of sweets, cookies, soft drinks and processed meat was observed in the dual pattern, which accounted for almost one-third of the variability in our sample (Table 2), despite expenditure on fruit and legumes, which was observed in this pattern. The traditional pattern presented high correlations with the two food items that form one of the most common dishes in Brazil, rice and beans, also considered a healthy dish, the intake of which is promoted by the Brazilian Health Minister[44].

The dual pattern presented strong correlations with vitamin C and retinol, markers of the intakes of fruit and vegetables, whereas the traditional pattern was highly correlated with energy, macronutrients (fat, protein and carbohydrate) and cholesterol, and also with fibre, probably because of the contribution of bean intake, the availability of which was estimated at approximately 46 g/d in the highest quintile (data not shown). The significant correlation values observed between the scores of the dual pattern and energy-adjusted nutrients (Table 3) seem to reinforce the concurrent participation of food in this pattern which has an antagonistic role in health; for instance, fat and vitamin C.

Some points should be considered in interpreting the findings of the present study. Our data refer to food acquisition information, rather than to dietary intake, information available on HBS. However, studies comparing the results from HBS with those of individual intake surveys have found considerable agreement between the two methods[45,46]. This analytical strategy of aggregating households was chosen to overcome the impact that the short reference period used by the Brazilian HBS to record the food acquisition data (seven consecutive days) would have. This period, relatively common in budget surveys, does not provide reliable figures on the food acquisition pattern existing in each household. However, we used geographically and socio-economically rigorously determined sampling strata as the unit of aggregation, which makes the units of analysis homogeneous in both geographical and socio-economical terms.

The use of factor analysis has been criticized for its subjective nature, including consolidation of food items into food groups, the number of factors to be extracted and the methods of rotation and labelling[47,48], and there is concern that results cannot be replicated across populations or even in the same population[36].

In conclusion, on the basis of food acquisition data, two food patterns were observed in Brazil, namely dual and traditional, according to the food items that contributed to each pattern. Educational level, income and age were positively associated with the dual pattern, whereas the traditional pattern was inversely associated with educational level and was stronger in the rural setting. The results of the present study have important implications for nutrition prevention. Besides the fact that knowledge of the sociodemographic characteristics related to the patterns might help identify groups for target campaigns and interventions, the dietary patterns described here suggest that food programmes to promote healthy eating need to consider the fact that healthy and non-healthy foods may be integral in the same pattern.

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