

Breakfast patterns and their association with body mass index in Brazilian adults

Padrões alimentares do café da manhã e associação com índice de massa corporal em adultos brasileiros

Patrones de desayuno y su asociación con el índice de masa corporal en adultos brasileños

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Abstract

The objective was to investigate the relationships between body mass index (BMI), skipping breakfast, and breakfast patterns in Brazilian adults. We analyzed data of 21,003 individuals aged between 20 to 59 from the Brazilian National Dietary Survey 2008-2009. Breakfast was defined as the eating occasion between 5 and 10a.m. with the highest usual food consumption (exceeding 50Kcal/209.2kJ). Dietary patterns were derived by the factor analysis of 18 food groups (usual intake). Controlling for confounders linear regressions of BMI were used to verify the associations considering the survey design. Skipping breakfast was not associated with BMI. Three breakfast patterns were observed (48% variability): Brazilian Northern (positive loading for meats, preparations with corn, eggs, tubers/roots/potatoes, dairy products, savory snacks/crackers, fruit juices/fruit drinks/soy-based drinks); Western (positive for fruit juices/fruit drinks/soy-based drinks, sandwiches/pizza, baked/deep-fried snacks, chocolate/desserts, cakes/cookies) and Brazilian Southeastern (cold cut meat, milk, cheese, coffee/tea, bread). The Brazilian Southeastern pattern was inversely associated with BMI, while the Brazilian Northern pattern was directly associated with it. Therefore, the results suggest a role for breakfast quality in the association with BMI. Thus, a Brazilian Southeastern breakfast usual intake may be inversely associated with BMI.

Breakfast; Feeding Behavior; Body Mass Index; Statistical Factor Analysis

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Introduction

Due to its high and increasing prevalence, and also the struggling understanding of its etiology, obesity is a very important challenge for public health ^{1,2}. The prevalence of obesity, mainly caused by changes in lifestyle, is rising in developing countries ³. In Brazil, it reached approximately 15% in adults, in 2008-2009, approaching values observed in developed countries ⁴.

Dietary determinants of excessive weight gain remain controversial. The idea of investigating overall diets has emerged as an important improvement compared to more traditional analyses focused on nutrients and food items because of the complexity of the human diet ⁵. Dietary patterns are more predictive of disease risks and help to build dietary guidelines considering they capture the correlation between all food items at the same time ^{6,7,8}.

Until now, only a few studies focused on dietary patterns at the meal level, although overall dietary patterns have been associated to body mass index (BMI) in adults ^{9,10,11,12,13}. More specifically, in Brazil, de Oliveira Santos et al. ¹⁴, investigated the association between BMI and lunch patterns and found out that the traditional Brazilian lunch pattern, characterized by the consumption of rice and beans, might protect the insufficiently active individuals from obesity in a population-based sample of adults living in São Paulo.

Regarding breakfast, this is a relevant analysis, as the association between skipping breakfast and obesity that has been observed in some studies, but not in others ¹⁵, suggests this might be due to diet quality. Besides, translating food habits guidance concerning meal composition is a possible effective approach ⁸.

This study aims to investigate the relationship between the BMI, skipping breakfast, and breakfast patterns in a Brazilian representative survey.

Methods

Study population

The study used data from the *Brazilian National Dietary Survey* (INA), which was carried out with the 2008-2009 *Brazilian Household Budget Survey* (POF) conducted by the Brazilian Institute of Geography and Statistics (IBGE), using a representative sample of Brazilian households. The INA was conducted using 24% of the households selected in 2008-2009 POF. All family members were listed, and those over 10-years-old were selected to participate in the INA (N = 34,003) ¹⁶. This study included adults (aged 20-59) and excluded pregnant or lactating women, holding a final sample of 20,962.

Usual dietary intake

All participants of INA were asked to keep two daily food records. Food records provide useful information on dietary intake; however, when considering a short term intake, they fail to capture day-to-day variation. In addition, intake distribution was zero-augmented for episodically consumed food. As we are interested in the usual dietary intake rather than a single day intake, we examined within person variability, zero intakes, and the inclusion of covariates to improve intake prediction ^{17,18,19}. The energy intake for each food item was obtained through a food composition table ²⁰ and a food portion table ²¹, especially developed for the INA. The usual food, daily and breakfast energy intakes were estimated with the National Cancer Institute (NCI) method, which uses a two-part mixed model with person-specific correlated effects. The first part models the probability of consumption and the second part models daily consumption based on transformed data ²². We considered age, sex, and country region as covariates in both parts of the model. Details on the pretest, training, and validation of the food records have been published elsewhere ¹⁶.

Breakfast definition

Food records provide information on which food item was consumed in each hour of the day and each hour with any food consumption was defined as an eating occasion. We calculated the energy consumption for each eating occasion. Each food record reported between 5:00a.m. and 10:00a.m. were examined. When in both records the food consumption in this period was zero we classified the individuals as breakfast skippers. For those individuals with two eating occasions in the same record we selected the occasion with the highest energy. Usual breakfast energy intake (as defined before, using the NCI method)²², included those individuals with consumption in at least one record. Finally, we defined as breakfast consumers those with at least 50Kcal (209.2kJ) in the breakfast usual energy intake⁸ and classifying the ones who did not achieve this consumption as breakfast skippers. Thus, breakfast skippers showed zero energy consumption in both records and breakfast usual energy intake lower than 50Kcal.

Statistical analysis

We registered all food or beverages consumed during breakfast. Food items were grouped based on the following criteria: nutritional value, Brazilian population's intake habits, literature data, and other Brazilian studies^{23,24}. Considering the food groups consumed during breakfast, we excluded those mentioned by less than 2.5% of the sample (alcoholic beverages, pasta, vegetables, sugar, soft drinks, beans/vegetables, chocolate powders, rice and cereal).

Dietary patterns for 18 food groups of usual intake were performed by principal component factor analysis (using correlation matrix)²⁵. Kaiser-Meyer-Olkin (KMO) over 0.5 and Bartlett's sphericity test with p-value lower than 0.05 were used to check the applicability of the data for factor analysis²⁶. The number of factors was selected by eigenvalues over 1.5 and the better interpretation was used for the final decision. The communalities were also evaluated, and a minimum cutoff of 0.10 was considered adequate (i.e., the food item sufficiently explains the selected factors). After the selection of factors, the varimax rotation was performed to maximize higher factor loadings and minimize the lowers, simplifying the interpretation (keeping factors uncorrelated). The food groups with factor loadings (according to analysis with rotation) over 0.25 were considered representative of that pattern. The patterns were denominated according to the food groups that stood out in each factor. The factor scores for further analysis were estimated by regression²⁵.

Linear regression analyses were performed to verify the associations between skipping breakfast and BMI, adjusting for sex, age, monthly per capita income and regions of the country, and between breakfast patterns factor scores and BMI, adjusting for sex, age, monthly per capita income, regions and usual daily energy. Statistical analyses were performed in SAS 9.3 (SAS Inst., Cary, USA). The significance level was set at 0.05. Prevalence of skipping breakfast and all linear models considered the complexity of the survey sample design.

Results

Mean age of participants was 37.6 (95%CI: 37.3-37.8) years and 50.2% of them were male. Mean per capita family income was BRL 951.29 (902.61-999.98) [at the time of the POF, USD 399.70 (379.25-420.16)]. Skipping breakfast prevalence was 33.1%; 54.8% of the skippers were male. Average usual daily energy intake was of 1,804Kcal (1,769-1,840) for skippers and 1,878Kcal (1,856-1,899) for breakfast consumers. The breakfast skipping prevalence in the Northern, Southeast, South, North and Central of Brazil was 29.4%, 33.7%, 35%, 35.4%, and 36.3% respectively. The BMI average was 25.48kg/m² (25.34-25.61) for breakfast consumers and 25.45kg/m² (25.28-25.62) for breakfast skippers. Table 1 shows results for the BMI regression model for all adults. Skipping breakfast presented no significant association with BMI levels.

Table 2 shows the food patterns among breakfast consumers. Three patterns explained 48% of total variance and the first pattern comprised food groups typically consumed in Brazilian Northern breakfast: meats, preparations with corn, tubers/roots/potatoes, eggs, dairy products, savory snacks/

Table 1

The relationship between breakfast skippers and eaters and usual breakfast dietary patterns with among Brazilian adults. 2008-2009 *Brazilian Household Budget Survey* (POF).

Effect	BMI means	Coefficients	p-value
Model 1 *			
Breakfast skippers – eaters	25.50-25.45	0.05	0.663
Model 2 **			
Brazilian Northern pattern		0.51	0.001 ***
Western pattern		-0.08	0.262
Brazilian Southeastern pattern		-0.24	0.002 ***

BMI: body mass index.

* Linear regression analysis considering sex, age, per capita income, region of the country;

** Linear regression analysis considering all variables above plus total daily usual energy intake;

*** Significant at 0.05.

Table 2

Factor loadings after rotation of food groups identified for Brazilian Northern, Western and Brazilian Southeastern in breakfast patterns among Brazilian adult breakfast eaters. 2008-2009 *Brazilian Household Budget Survey* (POF).

	Brazilian Northern	Western	Brazilian Southeastern
Meats	0.86 *	0.06	0.10
Preparations with corn	0.82 *	-0.12	0.04
Tubers, roots or potatoes	0.80 *	0.00	-0.30 *
Eggs	0.79 *	-0.04	0.09
Dairy products **	0.73 *	-0.10	0.07
Savory snacks or crackers	0.62 *	-0.05	-0.24
Fruit juices, fruit drinks or soy-based drinks	0.57 *	0.42 *	-0.15
Cold cut meats	-0.40 *	0.21	0.60 *
Sandwiches, pizza or baked or deep-fried snacks	-0.36 *	0.63 *	0.10
Milk	-0.30 *	0.07	0.50 *
Chocolate or desserts ***	-0.03	0.69 *	0.11
Cakes, cookies	0.02	0.39 *	0.05
Fruits	-0.01	-0.53 *	0.19
Cheese	0.04	-0.29 *	0.69 *
Coffee or tea	0.12	0.03	0.39 *
Bread	-0.05	0.22	0.26 *
Oil or butter	0.03	0.13	0.11
% of accumulated explained variance	26.3	36.2	47.7

Note: extraction method – principal component analysis; rotation method – varimax with Kaiser normalization.

* Pointed out as loads > |0.25|;

** Excluding cheese and milk-base desserts;

*** Including candies and chocolate drinks.

crackers, fruit juices/fruit drinks/soy-based drinks and a negative loading of cold cut meats, sandwiches/pizza, baked/deep-fried snacks, and milk. The pattern labeled Western has factor loadings higher than 0.25 for fruit juices/fruit drink/soy-based drinks, sandwiches/pizza baked/deep-fried snacks, chocolate/desserts, cakes/cookies and a negative loading for fruits and cheese. The last pattern was characterized by typical Southeastern Brazilian breakfast group foods: cold cut meats, milk, cheese, coffee/tea, bread and a negative loading for tubers/roots/potatoes.

In the regression analysis for breakfast patterns and BMI (Table 1), a significant and positive association was found for the Brazilian Northern pattern (0.51, p -value < 0.01) and the Western pattern was not significant (p -value = 0.262). Furthermore, Brazilian Southeastern pattern effect was negatively associated with BMI (-0.24, p -value < 0.01), despite its weaker effect.

Discussion

The results of this study do not support the relationship between skipping breakfast and BMI in a representative sample of Brazilian adults. Three derived breakfast dietary patterns were found: Brazilian Northern, Western, and Brazilian Southeastern. Two patterns were significantly associated with BMI (controlling for confounders). Patterns labeled Brazilian Northern were directly associated with BMI, whereas the Southeastern was inversely associated with it.

Prevalence of skipping breakfast was 33.1% in our study, higher than the values found for adults from the USA (23%²⁷, 17.3%²⁸ and 20%²⁹), Republic of Korea 17.2%³⁰, and Japan (16.6%³¹). These differences can be partially explained by our definition of breakfast that does not only consider the time, but also a minimum of 50Kcal of usual energy intake in this period, whereas the common definition of breakfast is any intake after a long fasting. For a possible association with obesity, the aim of this study, the intake of a small coffee could not be adequate. A survey in Taiwan presented only 8.1% of breakfast skippers, defined as those who had breakfast once a week or not so often or even who never ate breakfast³². In this study, the authors found a dose-response association of breakfast frequency and obesity in Taiwanese adults, considering the participants' age, sex, marital status, educational level, monthly income, habits such as smoking, drinking, betel quid chewing and exercising. In a Japanese survey with population aged between 20 and 80 years, breakfast skipping was defined using a specific question "do you skip breakfast at least three days per week?", and the authors did not find association with overweight³¹.

Song et al.²⁷ found, among women from the United States, an odds ratio of 0.76 for excessive weight for breakfast consumers compared to skippers and of 0.70 for consumers compared to not consumers of ready-to-eat-cereal during breakfast (considering aspects such as age, ethnicity, smoking and exercising habits, energy intake, and weight control). However, when the authors used the variable ready-to-eat-cereal in breakfast as a covariate, breakfast eaters were no longer associated with excessive weight²⁷. The authors emphasize that meal composition should be considered as an important determinant of obesity. On the other hand, in a randomized study with 49 female breakfast skippers, half of them were required to eat at least 15% of their daily energy requirement before 8:30a.m., whereas there was another group who did not need to make this change. The result of the trial showed weight gain only among breakfast consumers³³. However, it is important to highlight that authors did not look at the quality of the meal, just to its energy content.

Furthermore, in an article discussing several myths and facts about obesity, breakfast was considered an obesity-related presumption that has never been proved to be true or not³⁴. It was argued that only two randomized controlled trials evaluated the effect of skipping breakfast on weight; in the group who had stopped having breakfast, a higher weight lost was observed, but in these articles, the authors did not advise individuals to stop having breakfast, because, according to them, having breakfast was associated with a reduction in total fat intake and in impulsive snacking^{34,35}. Moreover, in a cumulative meta-analysis, with the purpose of investigating research lacking probative value and biased research on the relation between breakfast and obesity, the authors found a pooled odds ratio of 1.55 (1.46-1.65) for skipping breakfast and obesity. The authors considered only cross-sectional studies and indicated possible bias as well as dataset limitations in most cases. The authors brought attention to the fact that data on the association of skipping breakfast and obesity frequently have

biased research reports: “1) *biased interpretation of one’s own results*, 2) *improper use of causal language in describing one’s own results*, 3) *misleadingly citing others’ results*, and 4) *improper use of causal language in citing others’ work*”¹⁵ (p. 1298-9).

Despite the large amount of studies focusing on the importance of eating breakfast for our health, little focus has been given to breakfast food patterns. This approach can substantially improve the research in this theme because of the capacity of dietary patterns to account for the quality of items consumed in this meal.

Identification of dietary patterns is considered the best choice to overcome the limitations of studies that show the effects of specific food and nutrients on health because of a complex mix of nutrients and anti-nutritional factors involved in the human diet^{5,36}. However, most studies that used this approach considered the diet as a whole, not incorporating the consumption occasion, consequently, they were not capable to identify specific meal characteristics and composition. As people usually choose and combine food items with specific compositions³⁷, meal patterns might be easier to translate into dietary recommendations and guidelines policies. The few recent studies that evaluated dietary patterns through meals, more specifically considering breakfast patterns, showed a more refined measurement of diet. Min et al.³⁸ observed three breakfast patterns in a sample of 371 Korean adults: “rice, vegetables and kimchi (fermented cabbage, typical of Korean cuisine)”, “potatoes, fruits and nuts” and “eggs, bread and processed meat”; Yoo et al.³⁰, using data from a nationally representative survey also carried out in Korea, which identified two breakfast patterns called “traditional Korean pattern”, composed by spices and condiments, vegetables, sugar, fish, refined grains, potatoes, salt, and kimchi; and “dairy-cereal pattern”, consisting of dairy products, fruits, cereals, breads, and jellies. In our study, detailed breakfast patterns were observed and additionally, two patterns stood out that included typical food items from a Brazilian macro-region: Brazilian Northern with meats, preparations with corn, eggs, tubers/roots/potatoes, dairy products, savory snacks/crackers, fruit juices/fruit drinks/soy-based and a second pattern based on coffee/tea, milk, cheese, bread, and cold cut meats, typically consumed in the Southeastern Brazilian region (similarly to what de Oliveira Santos et al.²⁴ found in the city of São Paulo).

In addition, we identified the Western dietary pattern, commonly observed in global dietary patterns of adults in Brazil^{12,13,39}. In our study, this pattern may reflect the westernization of dietary habits in the breakfast meal. This dietary pattern was not associated with BMI, in contrast to previous studies that observed that such food components have been associated with obesity and metabolic problems^{6,13,40,41,42}. On the other hand, the Brazilian Northern pattern was directly associated to BMI, whereas the Southeastern Brazilian pattern was inversely associated with it. These findings are similar to Cho et al.⁴³ results, who investigated the relationship between breakfast type and BMI and found out that individuals who ate ready-to-eat-cereal, cooked cereal, or breads for breakfast had significantly lower BMI compared to skippers and meat and eggs eaters. The possible reason for the inverse association of the Southeastern Brazilian pattern with BMI among Brazilians can be the composition of this pattern with lower level of fat and sugar and good sources of protein and calcium, nutrients currently associated with a lower weight gain^{44,45}. A review of protein content indicated a lower energy intake with high protein meals⁴⁶ and, regarding calcium, there is some evidence of its role in obesity prevention⁴⁴.

Some limitations of our study must be considered. Because of its cross-sectional design, residual confounding can not be disregarded. In addition, in our study, eating occasions were not named by the participants; thereby, we had to adopt methods to determine the breakfast meal. There might have been late or morning snacking from 5:00a.m. to 10:00a.m., which could be understood as breakfast; to avoid confounding, we used a cut point based in energy intake. However, with this large data set, we believe that if, indeed, there were misunderstandings, they were small. Nevertheless, considering the definition of breakfast is not well established in the scientific literature, further discussion on this topic seems to be necessary. The dietary data comprise two daylong food records that may not represent the usual consumption of the population. Another thing to consider is that whereas it is possible that the NCI method did not properly correct the intra variability of all food items, this method enables usual intake of food items consumed daily by most participants. On the other hand, our study shows some advantages compared to other studies. As far as the authors know, this is the first study

that evaluated the association between breakfast consumption and breakfast pattern with BMI using a large representative national sample, which includes all socio-economic classes and regions of the country.

Conclusions

In conclusion, skipping breakfast was not associated with BMI in a representative sample of Brazilian adults. Three main breakfast dietary patterns were identified and two of them were associated with BMI. Moreover, this study suggests the role of the Southeastern Brazilian pattern is inversely associated with obesity and the authors hypothesize that the quality of breakfast is the main reason for this association.

Contributors

V. T. Baltar formulated the research questions, coordinated the data analyses and drafted the manuscript. D. B. Cunha and R. de Oliveira Santos contributed to data analyses and drafted the manuscript. D. M. Marchioni participated in results interpretation and drafted the manuscript. R. Sichieri coordinated the study design, participated in data analyses, and drafted the manuscript. All authors read and approved the final manuscript before publishing.

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Conflict of interests

The authors did not have any conflict of interest.

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Resumo

O estudo teve como objetivo investigar as relações entre o índice de massa corporal (IMC), o fato de deixar de tomar o café da manhã e os padrões alimentares do café da manhã dos adultos brasileiros. Analisamos os dados de 21.003 brasileiros entre 20 e 59 anos de idade, entrevistados na Inquérito Nacional de Alimentação 2008-2009. O café da manhã foi definido como a ocasião de maior consumo usual de alimentos (superior a 50Kcal/209,2kJ) entre 5 e 10 da manhã. Os padrões alimentares foram derivados pela análise fatorial de 18 grupos alimentares (consumo usual). Regressões lineares foram usadas para verificar as associações da realização do café da manhã e dos padrões de café da manhã com o IMC, levando em conta o delineamento do inquérito. Não tomar o café da manhã não teve associação com IMC. Foram observados três padrões para o café da manhã (48% de variabilidade): Norte brasileiro (carga positiva para carnes, pratos feitos com milho, ovos, tubérculos/raízes/batatas, laticínios, salgadinhos/bolachas, sucos/bebidas de fruta/bebidas com soja); Ocidental (carga positiva para sucos/bebidas de fruta/bebidas com soja; sanduiches/pizza, salgados assados/fritos, chocolate/sobremesas, bolo/biscoitos) e Sudeste brasileiro (embutidos, leite, queijo, café/chá, pão). O padrão do Sudeste brasileiro esteve inversamente associado ao IMC, enquanto o padrão do Norte brasileiro diretamente associado. Os resultados sugerem um possível papel para a qualidade do café da manhã na associação com o IMC. Assim, um consumo usual de café da manhã típico do Sudeste brasileiro pode estar associado inversamente ao IMC.

Desjejum; Comportamento Alimentar; Índice de Massa Corporal; Análise Fatorial

Resumen

El objetivo de este estudio fue investigar las relaciones entre el índice de masa corporal (IMC), saltarse el desayuno, y los patrones de desayuno en adultos brasileños. Analizamos los datos de 21.003 personas, con una edad comprendida entre los 20 a los 59 años, procedentes de la Encuesta Nacional de Alimentación 2008-2009. El desayuno fue definido como la comida entre las 5 y las 10a.m., con el consumo más elevado de alimentos (excediendo 50Kcal/209,2kJ). Los patrones dietéticos procedieron del análisis de 18 grupos de alimentos (de consumo habitual). Se utilizaron regresiones lineales para analizar las asociaciones de los patrones de desayuno y el IMC, considerando factores de confusión y el diseño de la encuesta. Saltarse el desayuno no estuvo asociado con el IMC. Se observaron tres patrones de desayuno (un 48% variabilidad): el del Norte brasileño (con una carga positiva en carnes, preparados con maíz, huevos, tubérculos/raíces/patatas, productos lácteos, aperitivos salados/galletas saladas, zumos de fruta/bebidas de fruta/bebidas a base de soja); el Occidental (positivo en zumos de frutas/bebidas de fruta/bebidas a base de soja, sándwiches/pizza, aperitivos horneados/fritos, chocolate/postres, pasteles/galletas) y el de la zona del Sudeste brasileño (embutidos, leche, queso, café/té, pan). Los patrones del Sudeste brasileño estuvieron inversamente asociados con el IMC, mientras que los patrones del Norte brasileño estuvieron directamente asociados con él. Por lo tanto, los resultados sugieren un papel importante respecto a la calidad del desayuno en su asociación con el IMC. Por este motivo, el consumo habitual de alimentos del desayuno del Sudeste brasileño puede estar inversamente asociado al IMC.

Desayuno; Conducta Alimentaria; Índice de Masa Corporal; Análisis Factorial

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