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Effect of weight and body composition changes on waist measurement of severely obese women receiving carbohydrate-restricted diet

Efeito da alteração de peso e composição corporal sobre medidas abdominais de mulheres obesas graves, recebendo dieta com restrição de carboidratos

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ABSTRACT

Objective

To evaluate the effect of weight and body composition changes on waist measurement of severely obese women receiving a low-carbohydrate diet for a short-term.

Methods

Nineteen severely obese women divided into an intervention and a control group received a low-carbohydrate diet and a conventional diet, respectively, both with 1,200kcal, for seven days. Anthropometric measurements such as weight, body mass index, arm circumference, waist circumference (at the navel), two proposed measurements of waist circumference (waist circumference 1, 10cm above the navel; and waist circumference 2, 20cm above the navel), hip circumference; and body composition (lean mass and fat mass) were performed at baseline and end of the study.

Results

There was significant reduction of all variables in the intervention group (p<0.01), but the control group had no change in waist circumference (p=0.06) and hip circumference (p=0.36). Patients of the intervention group

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presented greater weight loss (4.4kg, $p<0.01$) and reduction of body mass index, waist circumference, waist circumference 1, waist circumference 2 ($p<0.01$), and fat mass ($p=0.04$) than the control group.

Conclusion

The weight loss and body composition changes were greater in the low-carbohydrate group than in the conventional-diet group, and they had a greater impact on waist measurements. The proposed measurements (waist circumference 1 and waist circumference 2) were sensitive to weight reduction in both groups.

Indexing terms: Abnominal circumference. Body composition. Diet, carbohydrate-restricted. Weight loss.

RESUMO

Objetivo

Avaliar o efeito da alteração de peso e da composição corporal em medidas abdominais de mulheres obesas graves em dieta restrita em carboidratos por curto período.

Métodos

Dezenove mulheres obesas graves, divididas em grupo-intervenção (n=10) e grupo-controle (n=9), receberam durante sete dias, respectivamente, dieta restrita em carboidratos e dieta convencional, com 1 200kcal. As avaliações antropométricas - peso, índice de massa corporal, circunferência do braço, circunferência abdominal (na cicatriz umbilical), incluindo dois novos pontos propostos de medida de circunferência abdominal (circunferência abdominal 1, 10cm acima da circunferência abdominal; e circunferência abdominal 2, 20cm acima da circunferência abdominal), e circunferência do quadril - e as de composição corporal (massa magra e massa gorda) foram realizadas no início e no final do estudo.

Resultados

Houve redução significativa de todas as medidas analisadas no grupo-intervenção (p<0,01), e o grupo-controle não teve alteração em circunferência abdominal (p=0,06) e circunferência do quadril (p=0,36). As pacientes do grupo-intervenção apresentaram maior redução de peso (4,4kg, p<0,01), índice de massa corporal, circunferência abdominal, circunferência abdominal 1 e circunferência abdominal 2 (p<0,01), além de redução da massa gorda (p=0,04), quando comparadas às pacientes do grupo-controle.

Conclusão

A redução de peso, a mudança na composição corporal e o impacto nas medidas abdominais foram maiores com dieta com restrição de carboidratos do que com dieta convencional. As medidas propostas (circunferência abdominal 1 e circunferência abdominal 2) foram sensíveis à redução do peso em ambos os grupos.

Termos de indexação: *Circunferência abdominal. Composição corporal. Dieta com restrição de carboidratos. Perda de peso.*

INTRODUCTION

Severe or grade III obesity is caused by excessive accumulation of adipose tissue and carries a very high risk of comorbidity. Many methods are used for measuring body composition, such as Bioelectrical Impedance Analysis (BIA) and anthropometric assessment. The latter includes weight, height, Body Mass Index (BMI), Waist Circumference (WC), Hip Circumference (HC), and waist-to-hip ratio[1].

Anthropometric measurements are easy and inexpensive ways to assess nutritional status, but they have some problems such as the errors related to the use of the technique that may stem from interpersonal variation or difficulties related to individuals' physical characteristics[2].

Although body mass index is one of the most common nutritional assessment methods, its limitations include not assessing the percentage of body fat and cut-off points unadjusted for gender and ethnicity[3,4]. However, when associated with other methods, it is an effective means of nutritional status assessment.

Waist circumference is more sensitive than BMI for assessing excess visceral adiposity[5]. High

WC is also associated with chronic Non-Communicable Diseases (NCD), such as hypertension and high serum lipids[6], conditions aggravated by the accumulation of abdominal fat[2,7]. The increased of WC measurement prevalence has been higher[8,9] than that of BMI, showing its importance and the need of measuring it accurately.

One of the main challenges regarding body measurements is the determination of the WC of severely obese patients[10] whose excess abdominal fat turns the abdomen into an apron because of gravity. This change in abdominal shape impairs or even prevents measuring waist circumference as usual, which requires finding the midpoint between the last rib and iliac crest[11,12]. The development of sensitive anthropometric measurements for assessing weight changes and distribution of body fat is important for making the nutritional diagnosis and monitoring of obese patients, especially those with severe obesity that often prevent conventional measurement techniques.

According to Fett *et al.*[13], BIA helps the nutritional assessment by determining the body composition; they compared this technique with anthropometric assessments and the association of these measurements with blood markers, such as cholesterol and fractions, triglycerides, glucose, and uric acid in normal weight women and women with different obesity grades. These authors found that anthropometric assessments are sensitive enough for assessing body composition and that the percentage of body fat correlates well with biochemical markers.

Various types of diet are used for treating obesity. A low-carbohydrate diet that restricts carbohydrate intake to less than 20% of the total energy has been widely used for reducing weight and abdominal fat[14,15]. A study with obese women receiving three different diets (low-carbohydrate and high fat diet; high protein diet; and high carbohydrate and fiber diet - control diet) found that the weight loss and waist circumference reduction were higher in women consuming the low-carbohydrate diet after a 24-week intervention[16]. A similar result was showed in another study: a very low-carbohydrate diet followed by obese women resulted in greater fat and lean body mass reduction after three and six months, respectively, than one low fat[17].

The evaluation of body measurements and body composition are very important for identifying obesity and body changes due to dietary interventions. These identify excess body fat, its distribution, especially abdominal obesity, strongly related with the onset of cardiovascular diseases[2,3,18] and allow one to know the effects of diet composition on body changes. Therefore, the objective of this study was to assess the effect of weight and body composition changes on the abdominal measurements of severely obese women receiving a short-term low carbohydrate diet.

METHODS

Twenty obese females with a BMI >40kg/m^2 aged 20 to 50 years were selected for the study and hospitalized at the *Hospital da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo* (HCFMRP-USP). Exclusion criteria were diabetes *Mellitus*, use of diuretics, chronic renal failure, chronic liver failure, obesity caused by endocrine diseases, eating disorders, and severe psychiatric diseases, including alcohol and drug abuse, neoplasms, and active systemic inflammatory or infectious diseases[19]. Indeed, patients taking metformin were asked to discontinue it.

The participants signed an Informed Consent Form and were divided into two groups: the intervention group, which received the hypocaloric, low-carbohydrate diet, and the control group, which received a conventional hypocaloric diet.

This study was approved by the Research Ethics Committee of HCFMRP-USP (Protocol number 2937/2007) and it is a continuation of a greater study on severe obesity and low-carbohydrate diet[20].

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Both groups received the same amount of energy (1,200kcal). However, the macronutrient composition of the diets was different. The intervention group received a diet containing 45g of carbohydrates (15%), 105g of proteins (35%), and 67g of fat (50%). The control group received a diet with 171g of carbohydrates (54%), 74g of proteins (23%), and 32g of fat (23%). Both were administered for seven days and fractioned into six meals per day.

The anthropometric and body composition measurements were evaluated at baseline (before starting the diet) and on the day 8 (after seven days of dieting). Weight was determined by an electronic scale (Filizola ID-1500) with an accuracy of 200g and capacity of 300kg and BMI was calculated. Arm, abdominal, and HC were measured using an inelastic tape measure (200cm). Arm Circumference (AC) was measured at the midpoint between the acromion and olecranon. Abdominal circumference was measured at three points: at the navel, a location used commonly by some services because of the inability to measure at the conventional point[11], the midpoint between the last rib and iliac crest, and two new proposed points: 10cm above the navel (WC1), and 20cm above the navel (WC2). HC was obtained at the widest point between the hip and buttock.

Body composition was assessed by BIA, used for estimating Lean Mass (LM) and Fat Mass (FM). BIA measures resistance in ohms, used in the formula[21] for calculating the LM and FM of obese individuals. The body composition was evaluated after an overnight fast using the device Biodynamics BIA 450.

The data were tabulated in an Excel spreadsheet and analyzed by the statistical software SAS® 9.0. A linear mixed effect model (random and fixed) was used for comparing the baseline and end-of-study variables, and Analysis of Variance (Anova) for comparing the differences between groups[22,23]. The results were presented as means ± standard deviation. The significance level was set at 5% (p<0.05).

RESULTS

Twenty individuals were selected for this study but only nineteen completed the study. One person from the control group was excluded for not following the study protocol. The study sample was considered homogeneous regarding the anthropometric and body composition measurements (Table 1). The mean age was also similar between the groups: 35±8 years in the intervention group and 32±8 years in the control group.

Table 1. Baseline anthropometric and body composition assessment of the groups. *Ribeirão Preto* (SP), Brazil, 2007-2008.

Variables	Intervention group (n=10)		Control group (n=9)		*p*-value
	Mean	SD	Mean	SD	
Weight (kg)	141.9	26.6	135.8	14.8	0.52
BMI (kg/m²)	54.4	9.6	51.2	4.7	0.34
AC (cm)	45.8	4.3	46.9	3.5	0.55
WC (cm)	139.4	15.1	135.6	10.6	0.60
WC1 (cm)	131.5	13.6	128.5	11.4	0.58
WC2 (cm)	123.5	12.3	121.8	12.5	0.76
HC (cm)	152.7	20.3	143.8	5.6	0.19
LM (kg)	67.1	9.4	65.6	6.1	0.67
FM (kg)	74.9	17.7	70.3	9.1	0.45

Note: Values expressed as Mean ± Standard Deviation (SD); There was no statistically significant difference.

BMI: Body Mass Index; AC: Arm Circumference; WC: Waist Circumference; WC1: Waist Circumference 10cm above the navel; WC2: Waist Circumference 20cm above the navel; HC: Hip Circumference; LM: Lean Mass; FM: Fat Mass.

At the end of the study, the patients in the intervention group (n=10) presented significant losses for all anthropometric and body composition measurements (Table 2). On the other hand, the WC and HC of the patients in the control group did not decrease significantly (n=9), but the other parameters did (Table 3). Obese women with low-carbohydrate diet showed greater weight loss and waist circumference (WC, WC1 and WC2) and fat mass reduction than obese women following conventional diet (Table 4).

DISCUSSION

The use of two proposed measurements for determining waist circumference associated with the circumference at the navel was a strategy that evaluated the effect of diet on shape and body composition changes on abdomen. The conventional technique to verify waist circumference does not apply in patients with severe obesity due to large amount of fat in the abdomen. The control group experienced significant WC1 and WC2 losses, but not WC. The

Table 2. Anthropometric and body composition assessment of the intervention group during one week. *Ribeirão Preto* (SP), Brazil, 2007-2008.

Variables	Intervention group (n=10)				*p*-value
	Day 1		Day 8		
	Mean	SD	Mean	SD	
Weight (kg)	141.9	26.6	137.5	26.2*	<0.01
BMI (kg/m²)	54.4	9.6	52.6	9.4*	<0.01
AC (cm)	45.8	4.3	45.1	4.4*	<0.01
WC (cm)	139.4	15.1	134.8	13.5*	<0.01
WC1 (cm)	131.5	13.6	128.4	14.0*	<0.01
WC2 (cm)	123.5	12.3	120.6	12.2*	<0.01
HC (cm)	152.7	20.3	150.2	20.2*	<0.01
LM (kg)	67.1	9.4	65.4	9.3*	<0.01
FM (kg)	74.9	17.7	72.1	17.3*	<0.01

Note: Values expressed as Mean ± Standard Deviation (SD). *Statistically significant difference.

BMI: Body Mass Index; AC: Arm Circumference; WC: Waist Circumference; WC1: Waist Circumference 10cm above the navel; WC2: Waist Circumference 20cm above the navel; HC: Hip Circumference; LM: Lean Mass; FM: Fat Mass.

Table 3. Anthropometric and body composition assessment of the control group during one week. *Ribeirão Preto* (SP), Brazil, 2007-2008.

Variables	Control group (n=9)				*p*-value
	Day 1		Day 8		
	Mean	SD	Mean	SD	
Weight (kg)	135.8	14.8	133.3	14.5*	0.01
BMI (kg/m²)	51.2	4.7	50.2	4.6*	0.01
AC (cm)	46.9	3.5	46.4	3.4*	<0.01
WC (cm)	135.6	10.6	135.2	10.4	0.06
WC1 (cm)	128.5	11.4	127.2	10.9*	<0.01
WC2 (cm)	121.8	12.5	120.7	11.9*	<0.01
HC (cm)	143.8	5.6	143.2	5.8	0.36
LM (kg)	65.6	6.1	64.7	6.1*	<0.01
FM (kg)	70.3	9.1	68.5	8.8*	<0.01

Note: Values expressed as Mean ± Standard Deviation (SD). *Statistically significant difference.

BMI: Body Mass Index; AC: Arm Circumference; WC: Waist Circumference; WC1: Waist Circumference 10cm above the navel; WC2: Waist Circumference 20cm above the navel; HC: Hip Circumference; LM: Lean Mass; FM: Fat Mass.

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Table 4. Comparison of the mean reduction in the anthropometric and body composition measurements of the intervention and control groups after one week. *Ribeirão Preto* (SP), Brazil, 2007-2008.

Variables	Intervention group (n=10)		Control group (n=9)		*p*-value
	Mean	SD	Mean	SD	
Weight (kg)	4.4	2.2	2.6	0.7*	<0.01
BMI (kg/m²)	1.7	0.8	1.0	0.3*	<0.01
AC (cm)	0.7	0.5	0.5	0.5	0.27
WC (cm)	4.6	2.6	1.3	1.1*	<0.01
WC1 (cm)	3.1	1.6	1.3	0.9*	<0.01
WC2 (cm)	2.9	1.3	1.1*	1.0*	<0.01
HC (cm)	2.5	2.9	0.6	0.7	0.08
LM (kg)	1.7	1.0	0.9	0.4	0.05
FM (kg)	2.8	1.4	1.7	0.5*	0.04

Note: Values expressed as Mean ± Standard Deviation (SD). *Statistically significant difference.

BMI: Body Mass Index; AC: Arm Circumference; WC: Waist Circumference; WC1: Waist Circumference 10cm above the navel; WC2: Waist Circumference 20cm above the navel; HC: Hip Circumference; LM: Lean Mass; FM: Fat Mass.

intervention group experienced significant losses in all three measurements.

When the groups are compared, all indicators changed, except for arm and hip circumferences. Regarding anthropometric measurements, abdominal circumferences were more sensitive to dietary changes, despite the short-term intervention. The obese women with low-carbohydrate diet had greater reduction of waist circumference when compared to obese women with conventional diet. Nevertheless, these values were still much higher than those recommended by the World Health Organization (WHO)[24]. Verweij *et al.*[25] discuss the errors associated with abdominal circumference measurements, showing that the changes between them may be clinically significant. However, additional abdominal measurements, such as those performed by the present study (WC1 and WC2), may attenuate the errors by increasing the accuracy of the abdominal measurements.

The significant reduction in the WC measurements of the intervention group may suggest an improvement in the metabolic profile, as demonstrated by Laaksonen *et al.*[26], who studied patients with the metabolic syndrome following a hypocaloric diet during nine weeks and maintaining the weight for one year; they found that weight loss reduced body fat and waist circumference, which correlated with higher insulin sensitivity. According to Ravensbergen *et al.*[7] and Martins & Marinho[27], WC is significantly associated with hypertension and hypercholesterolemia.

Shai *et al.*[28] compared the consumption of a low-carbohydrate, a low-fat, or the Mediterranean diet by obese grade I followed by two years. Even though all groups lost waist circumference, the intergroup differences were not significant. However, the low-carbohydrate diet promoted a waist circumference reduction of 3.8cm, similar to the value found by the present study with a low-carbohydrate diet, which was of 4.6cm (WC), 3.1cm (WC1), and 2.9cm (WC2).

As observed by the control group, the proposed measurements for determining waist circumference (WC1, WC2) were sensitive to weight loss during the study period, showing that these measurements are effective and may be used, along with WC, to follow the body changes in severely obese individuals.

The obese women with low-carbohydrate diet experienced a greater weight loss than the obese women with conventional diet during the intervention period of one week. These data were corroborated by the results of many studies but with longer intervention periods, such as Samaha

et al.[29] who compared a low-carbohydrate diet (<30g/day) with a conventional hypocaloric diet (caloric restriction of 500kcal/day) in 132 severely obese individuals (BMI ≥35kg/m^2). The authors found that, after six months, the low-carbohydrate group had a weight loss of 5.7kg, and the conventional-diet group reduced 1.8kg of body weight[28,30].

The Fat Mass and Lean Mass of both groups decreased significantly after one week. However, only the FM loss differed significantly between the groups, with the intervention group experiencing a greater loss than control group. The LM loss of the two groups did not differ, perhaps because of the short-term intervention. The reductions seen in the FM values for the intervention and control groups were, respectively, 2.7kg and 1.7kg, while for the LM they were 1.9kg and 0.9kg. These results are higher than those found by a review[31] that analyzed the effects of protein and carbohydrate intake on body composition in patients with hypocaloric diets, finding that a low-carbohydrate diet reduced fat mass by 1.8kg and lean mass by 0.3kg in studies up to 12 weeks.

Another study[14] compared a low-carbohydrate diet with a low-fat diet and their effects on the body composition of obese women and found that the low-carbohydrate group experienced a greater FM loss (4.7kg) and LM loss (5.9kg) at three months, and a reduction of 5.1kg and 5.8kg, respectively, at six months.

Dietary changes have an important impact on body composition and body measurements, suggesting the need of improving anthropometric techniques and technologies to assess the body compartments.

CONCLUSION

The proposed abdominal measurements (WC1 and WC2) for severely obese women effectively reflected the effects of a low-carbohydrate diet, especially in abdominal obesity measurements, since they increase the accuracy of abdominal measurement. Weight loss and body composition change were greater in obese women with low-carbohydrate than in obese women with conventional diet and the low-carbohydrate diet had a greater impact on the abdomen of the obese women. Associated with other anthropometric and body composition indicators, the proposed measurements improve nutritional assessment. The validation of these new tools in future studies will allow their use in the professional routine.

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CONTRIBUTORS

AT TRIFFONI-MELO and RW GARCIA DIEZ were responsible for the design, data collection, literature review, analysis and writing of the manuscript. RCL SANTOS collaborated in the study design, data collection, analysis and writing of the manuscript. RW DIEZ-GARCIA supervised this study. All authors were responsible for the critical review of the manuscript.

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Fracionamento da dieta e o perfil nutricional e de saúde de mulheres

Women's meal frequency and nutritional and health profiles

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RESUMO

Objetivo

Verificar a associação entre o fracionamento da dieta e o perfil nutricional e de saúde de mulheres de um Serviço de Promoção da Saúde.

Métodos

Estudo transversal com usuárias de uma Academia da Cidade de Belo Horizonte, Minas Gerais entre agosto de 2009 e dezembro de 2011. Investigaram-se condição sociodemográfica e econômica, perfil de saúde, antropometria e hábitos alimentares. O fracionamento dietético foi obtido pelo número diário de refeições autorreferido, sendo classificado como adequado quando ≥5. Realizou-se regressão de Poisson com variância robusta ao nível de significância de 5% (p<0,05).

Resultados

Avaliaram-se 342 usuárias, 72,5% adultas, 50,6 (±13,7) anos, com renda *per capita* de R$500,00 (85,0; 4.666,7). Constatou-se mediana de 4 (1,0; 7,0) refeições ao dia e 52,0% de fracionamento inadequado da dieta, que foi mais frequente entre as mulheres que referiram hipertensão arterial (RP: 0,71; IC95%: 0,56; 0,90; p=0,005) e constipação intestinal (RP: 0,77; IC95%: 0,61; 0,98; p=0,040). Esse hábito também teve maior ocorrência naquelas que apresentaram inadequação para ingestão de água (RP: 0,74; IC95%: 0,59; 0,93; p=0,009) e de açúcar (RP: 0,79; IC95%: 0,63; 0,98). Apresentar consumo inadequado de frutas (RP: 0,79; IC95%: 0,63; 0,98; p=0,036) e de hortaliças (RP: 0,74; IC95%: 0,59; 0,94; p=0,012) e preferência por leite integral (RP: 0,72; IC95%: 0,57; 0,89; p=0,003) também se associou diretamente ao fracionamento inadequado da dieta.

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Conclusão

O insuficiente número diário de refeições se associou a um pior perfil nutricional e de saúde, denotando a importância da intervenção nutricional nesse aspecto.

Termos de indexação: Comportamento alimentar. Dieta. Doença. Ingestão de alimentos.

ABSTRACT

Objective

To verify whether meal frequency is associated with the nutritional and health profiles of women attending a health-promoting service.

Methods

This cross-sectional study included users of an Academia da Cidade in Belo Horizonte, Minas Gerais *from August 2009 to December 2011. The following were collected: socioeconomic, demographic, health profile, anthropometric, and dietary data. Meal frequency was given by the self-reported number of daily meals and considered appropriate when ≥5. Poisson regression with a robust variance was performed with a significance level of 5% (p<0.05).*

Results

The sample consisted of 342 females with a mean age of 50.6±13.7 years and a per capita *income of R$ 500.0 (85.0; 4,666.7); 72.5% were adults. They had a median of 4 (1.0; 7.0) meals per day and 52.0% had fewer than five meals a day. Inadequate meal frequency was associated with high blood pressure (PR: 0.71; 95%CI: 0.56, 0.90; p=0.005) and constipation (PR: 0.77; 95%CI: 0.61, 0.98; p=0.040); inappropriate intakes of water (PR: 0.74; 95%CI: 0.59, 0.93; p=0.009), sugar (PR: 0.79; 95%CI: 0.63, 0.98; p=0,036), fruits (PR: 0.79; 95%CI: 0.63, 0.98; p=0.036), and non-starchy vegetables (PR: 0.74; 95%CI: 0.59, 0.94; p=0.012); and preference for whole milk (PR: 0.72; 95%CI: 0.57, 0.89; p=0.003).*

Conclusion

Inadequate daily meal frequency was associated with worse nutritional and health profiles, highlighting the importance of pertinent nutrition intervention.

Indexing terms: *Feeding behavior. Diet. Disease. Eating.*

INTRODUÇÃO

Em decorrência do processo de transição epidemiológica e nutricional em curso no Brasil[1,2], verificou-se, nos últimos anos, um aumento na ocorrência de Doenças e Agravos Não-Transmissíveis (DANT), constatando-se prevalências atuais de 23,3% de Hipertensão Arterial Sistêmica (HAS), 6,3% de Diabetes *Mellitus* (DM) e 15,0% de obesidade[3]. Estas doenças apresentam como principal fator de risco as práticas alimentares inadequadas[4], a exemplo do fracionamento insuficiente da dieta[5-7].

Nesse sentido, estudos apontam maior ocorrência de comportamentos relacionados a um estilo de vida não saudável (a exemplo do sedentarismo, tabagismo e maior ingestão de álcool) entre indivíduos que realizam menos de três refeições ao dia em comparação aos que referem maior fracionamento da dieta (seis ou mais refeições por dia)[7,8]. Ademais, existem evidências de que o maior fracionamento da dieta auxilia no controle da concentração sérica de glicose, colesterol e frações e na manutenção do peso corporal adequado[9].

No Brasil, o Ministério da Saúde recomenda a realização de três refeições diárias intercaladas por lanches na forma de uma diretriz nutricional contida nos "Dez Passos para uma Alimentação Saudável"[10].

Nesse contexto, o presente estudo objetivou verificar a associação existente entre o

fracionamento da dieta e o perfil nutricional e de saúde de mulheres atendidas em um Serviço de Promoção da Saúde.

MÉTODOS

Trata-se de um estudo transversal realizado com usuárias adultas e idosas ingressas em um Serviço de Promoção da Saúde de Belo Horizonte, Minas Gerais, intitulado Academia da Cidade.

As Academias da Cidade se caracterizam como serviços públicos de saúde que oferecem orientação nutricional associada à prática de exercícios físicos a adultos e idosos residentes em regiões de elevado índice de vulnerabilidade social. A equipe profissional desses serviços é composta por acadêmicos e profissionais graduados em Nutrição e Educação Física. A estratégia integra um conjunto de políticas da Prefeitura de Belo Horizonte, o BH-Mais-Saudável, e tem por objetivo promover e proteger a saúde mediante adoção de medidas sustentáveis em nível individual, comunitário e populacional, considerando as diretrizes da Organização Mundial de Saúde (OMS) para alimentação saudável, atividade física e saúde[11].

O Serviço de Promoção da Saúde em estudo foi inaugurado em 2008 e funciona no turno matutino e noturno e está inserido em uma região de alta vulnerabilidade social (índice de vulnerabilidade social = 0,5 a 0,63)[12] com capacidade para acompanhamento de cerca de 500 usuários por turno[11].

Foram incluídas no estudo todas as mulheres que ingressaram no serviço por demanda espontânea ou por encaminhamento das Equipes de Saúde da Família, entre agosto de 2009 e dezembro de 2011, para realização de exercícios físicos no turno matutino. Os homens foram excluídos da amostra, tendo em vista a reduzida participação nas atividades da Academia da Cidade, corroborando a literatura, que aponta menor inserção do sexo masculino nos serviços de saúde[13].

O protocolo de coleta de dados foi aplicado face a face por acadêmicos de Nutrição da Universidade Federal de Minas Gerais (UFMG), devidamente treinados e supervisionados. O instrumento utilizado foi pré-codificado e pré-testado e contemplou a condição sociodemográfica e econômica (idade, número de moradores, escolaridade, renda *per capita* e ocupação profissional), perfil de saúde (morbidade referida, uso de medicamentos), dados antropométricos e hábitos alimentares[14]. Considerando os dados antropométricos, foi conduzida a aferição do peso, altura, Circunferência de Cintura (CC) e Circunferência de Quadril (CQ), segundo recomendações da OMS[15]. Destaca-se que a CC foi obtida na menor circunferência, enquanto para a CQ a maior protuberância do quadril foi utilizada como ponto de aferição[15].

As medidas de peso e de altura permitiram obter o Índice de Massa Corporal (IMC=peso(kg)/altura(m)^2), classificado de maneira diferenciada para adultos[15] e idosos[16]. Entretanto, com o objetivo de uniformização da análise dos dados, para ambas as faixas etárias o IMC foi classificado em baixo peso, eutrofia e excesso de peso. A CC tornou possível a classificação dos usuários quanto ao risco para o desenvolvimento de complicações metabólicas, enquanto a associação desse índice a CQ, por meio da Relação Cintura/Quadril (RCQ=CC/CQ), possibilitou o conhecimento do risco para doenças cardiovasculares[17].

Quanto aos hábitos alimentares, as usuárias foram questionadas acerca do consumo *per capita* de sal, açúcar e óleo vegetal, ingestão diária de água e frequências de consumo de frutas, hortaliças, leite e derivados, embutidos, doces e frituras, sendo a adequação desses parâmetros avaliada segundo as recomendações do "Guia Alimentar para a População Brasileira"[10]. As usuárias referiram ainda o tipo de leite mais comumente consumido (integral ou desnatado) e o hábito de ingerir a pele do frango e a gordura aparente da carne.

A partir da obtenção das informações relacionadas ao perfil nutricional e de saúde das mulheres, verificou-se a associação destes ao fracionamento diário da dieta. Para tal, as usuárias foram questionadas quanto ao número diário de

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refeições comumente realizadas. O fracionamento dietético foi considerado adequado quando superior ou igual a cinco refeições e inadequado quando menor que cinco[10].

Para a análise dos dados, foram utilizados os *softwares* Epi Info versão 6.04 e Stata versão 11.0. Realizou-se análise descritiva dos dados com obtenção das frequências das variáveis categóricas e as medidas de tendência central (média e mediana) e de dispersão (Desvio-Padrão e valores mínimo e máximo) das demais. O teste Kolmogorov-Smirnov foi aplicado para conhecimento do padrão de distribuição das variáveis quantitativas.

Para verificação dos fatores associados ao fracionamento da dieta (variável dependente), utilizou-se a Regressão de Poisson com variância robusta, com obtenção da medida de efeito Razão de Prevalência (RP). Considerou-se o fracionamento adequado da dieta como parâmetro de referência. As variáveis que apresentaram associação ao fracionamento da dieta na análise univariada ao nível de significância inferior a 25% (p<0,250) foram inseridas no modelo multivariado pelo método *backward*. Procedeu-se a verificação do ajuste do modelo final pelo teste de Deviance. Adotaram-se 5% como nível de significância (p<0,05).

O presente estudo foi aprovado pelos Comitês de Ética da UFMG (103/07) e da Prefeitura de Belo Horizonte (087/2007). As participantes assinaram um Termo de Consentimento Livre e Esclarecido, conforme preconizado pela Resolução nº 196 do Conselho Nacional de Saúde.

RESULTADOS

Avaliaram-se 342 usuárias, sendo 72,5% adultas, com idade média de 50,6 anos (DP=13,7) e renda *per capita* mediana de R$500,00 (85,0; 4.666,7). Quanto ao número de residentes por domicílio, 29,7% das famílias apresentavam de 1 a 2 moradores, 45,6% de 3 a 4 moradores e 24,7% mais de quatro moradores. Verificou-se que 55,8% das mulheres apresentavam pelo menos oito anos de escolaridade e 40,4% da amostra relataram ser "do lar".

A hipertensão arterial sistêmica foi referida por 40,8% das usuárias assim como o uso de medicamentos por 68,7%. Considerando os desvios nutricionais, o excesso de peso foi verificado em 72,8% da amostra e 54,8% das mulheres apresentaram CC muito elevada (Tabela 1).

Verificou-se mediana de realização de 4,0 (1,0; 7,0) refeições ao dia e 48,0% das mulheres apresentaram fracionamento adequado da dieta (≥5 refeições/dia). Quanto aos demais hábitos alimentares, 73,7% das mulheres referiram consumo adequado de frituras, 17,8% consumiam pele de frango e 26,9% ingeriam a gordura aparente da carne. Observou-se que apenas 15,2% das entrevistadas apresentaram consumo adequado de hortaliças e 19,9% consumo adequado de leite e derivados (Tabela 2).

A análise univariada (Tabelas 1 e 2) evidenciou maior ocorrência de inadequação do fracionamento da dieta entre as hipertensas (RP=0,78; Intervalo de Confiança-IC95%=0,63; 0,97; p=0,026) e entre aquelas que apresentaram ingestão inadequada de água (RP=0,69; IC95%=0,56; 0,87; p=0,001) e de açúcar (RP=0,72; IC95%=0,58; 0,89; p=0,003) e preferência por leite integral (RP=0,69; IC95%=0,55; 0,87; p=0,001). Além disso, verificou-se que a realização de menos de cinco refeições ao dia foi mais frequente entre as mulheres que apresentaram frequência inadequada de consumo de frutas (RP=0,69; IC95%=0,56; 0,85; p=0,001), hortaliças (RP=0,69; IC95%=0,54; 0,87; p=0,002) e leite e derivados (RP=0,74; IC95%=0,59; 0,94; p=0,013).

No modelo final multivariado (Tabela 3), a presença autorreferida de HAS (RP=0,71; IC95%=0,56; 0,90; p=0,005) e a constipação intestinal (RP=0,77; IC95%=0,61; 0,98; p=0,040) foram associadas de maneira independente ao fracionamento insuficiente da dieta. Dentre os

Tabela 1. Análise univariada dos fatores de saúde e antropométricos associados ao fracionamento adequado da dieta de mulheres. Belo Horizonte (MG), 2012.

Variáveis	n	%	RP	IC95%	Valor *p*
Diabetes					
Não	293	87,2	1,00	-	-
Sim	43	12,8	1,03	0,94; 1,14	0,525
Dislipidemias					
Não	199	65,5	1,00	-	
Sim	105	34,5	1,02	0,98; 1,08	0,362
Hipertensão arterial					
Não	202	59,2	1,00	-	-
Sim	139	40,8	0,78	0,63; 0,97	0,026
Úlcera/gastrite					
Não	271	80,4	1,00	-	-
Sim	66	19,6	0,93	0,79; 1,08	0,339
Constipação intestinal					
Não	243	71,3	1,00	-	-
Sim	98	28,7	0,87	0,71; 1,08	0,210
Queimação/azia					
Não	221	64,6	1,00	-	-
Sim	121	35,4	0,80	0,62; 1,03	0,080
Uso de medicamentos					
Não	107	31,3	1,00	-	-
Sim	235	68,7	0,98	0,77; 1,24	0,872
IMC					
Eutrofia	85	24,9	1,00	-	-
Baixo peso	8	2,3	1,11	0,54; 2,33	0,765
Excesso de peso	249	72,8	1,09	0,84; 1,43	0,504
CC					
Sem risco	77	22,6	1,00	-	-
Risco elevado	77	22,6	0,95	0,69; 1,31	0,748
Risco muito elevado	186	54,8	0,92	0,71; 1,21	0,562
RCQ					
Sem risco	192	56,8	1,00	-	-
Com risco	146	43,2	1,03	0,94; 1,13	0,545

Nota: CC: Circunferência de Cintura; IC95%: Intervalo de Confiança de 95%; IMC: Índice de Massa Corporal; RCQ: Razão Cintura/Quadril; RP: Razão de Prevalência.

hábitos alimentares, a realização de menos de cinco refeições diárias se associou ao consumo inadequado de água (RP=0,74; IC95%=0,59; 0,93; *p*=0,009), de açúcar (RP=0,79; IC95%=0,63; 0,98; *p*=0,036), de frutas (RP=0,79; IC95%=0,63; 0,98; *p*=0,036) e de hortaliças (RP=0,74; IC95%=0,59; 0,94; *p*=0,012), assim como a preferência por leite integral (RP=0,72; IC95%=0,57; 0,89; *p*=0,003).

DISCUSSÃO

O estudo evidenciou associação do perfil nutricional e de saúde ao fracionamento da dieta em uma amostra de mulheres de baixo nível socioeconômico e com elevada ocorrência de excesso de peso e DANT. Nesse sentido, constatou-se maior ocorrência de inadequação desse hábito alimentar entre as mulheres que referiram HAS e constipação intestinal, assim como entre

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Tabela 2. Análise univariada dos fatores dietéticos associados ao fracionamento adequado da dieta de mulheres. Belo Horizonte (MG), 2012.

Variáveis	n	%	RP	IC95%	Valor *p*
Ingestão de água					
Adequada (≥2.000mL/dia)	102	29,8	1,00	-	-
Inadequada (<2.000mL/dia)	240	70,2	0,69	0,56; 0,87	0,001
Pele de frango					
Não consome	281	82,2	1,00	-	-
Consome	61	17,8	0,75	0,53; 1,06	0,103
Gordura aparente da carne					
Não consome	250	73,1	1,00	-	-
Consome	92	26,9	0,94	0,72; 1,21	0,611
Sal per capita					
Adequado (<5 g/dia)	151	47,6	1,00	-	-
Inadequado (≥5g/dia)	166	52,4	0,92	0,73; 1,16	0,483
Açúcar per capita					
Adequado (<28g/dia)	132	38,8	1,00	-	-
Inadequado (≥28g/dia)	208	61,2	0,72	0,58; 0,89	0,003
Óleo per capita					
Adequado (<8mL/dia)	47	13,8	1,00	-	-
Inadequado (≥8mL/dia)	294	86,2	0,93	0,68; 1,26	0,621
Tipo de leite					
Desnatado	98	32,3	1,00	-	-
Integral	205	67,7	0,69	0,55; 0,87	0,001
Consumo de frutas					
Adequado (≥3 porções/dia)	101	29,5	1,00	-	-
Inadequado (<3 porções/dia)	241	70,5	0,69	0,56; 0,85	0,001
Consumo de hortaliças					
Adequado (≥3 porções/dia)	52	15,2	1,00	-	-
Inadequado (<3 porções/dia)	290	84,8	0,69	0,54; 0,87	0,002
Consumo de leite e derivados					
Adequado (≥3 porções/dia)	68	19,9	1,00	-	-
Inadequado (<3 porções/dia)	274	80,1	0,74	0,59; 0,94	0,013
Consumo de embutidos					
Adequado (≤2 vezes/mês)	190	55,6	1,00	-	-
Inadequado (>2 vezes/mês)	152	44,4	0,91	0,72; 1,14	0,401
Consumo de doces					
Adequado (≤2 vezes/mês)	265	77,9	1,00	-	-
Inadequado (>2 vezes/mês)	75	22,1	0,76	0,56; 1,04	0,089
Consumo de frituras					
Adequado (≤2 vezes/semana)	252	73,7	1,00	-	-
Inadequado (>2 vezes/semana)	90	26,3	0,76	0,57; 1,01	0,060

Nota: IC95%: Intervalo de Confiança de 95%; RP: Razão de Prevalência.

aquelas que relataram preferência por leite integral e apresentaram ingestão inadequada de água, de frutas e hortaliças, e elevado consumo *per capita* de açúcar.

O primeiro trabalho que investigou a relação do número diário de refeições e o perfil de saúde foi conduzido por Fabry *et al*.[18] e considerou o percentual de excesso de peso e a

Tabela 3. Análise multivariada dos fatores associados ao fracionamento adequado da dieta de mulheres. Belo Horizonte (MG), 2012.

Variáveis	RP	IC95%	Valor *p*
Hipertensão arterial			
Não	1,00	-	-
Sim	0,71	0,56; 0,90	0,005
Constipação intestinal			
Não	-	-	-
Sim	0,77	0,61; 0,98	0,040
Ingestão de água			
Adequada (≥2.000mL/dia)	1,00	-	-
Inadequada (<2.000mL/dia)	0,74	0,59; 0,93	0,009
Açúcar per capita			
Adequado (<28g/dia)	1,00	-	-
Inadequado (≥28g/dia)	0,79	0,63; 0,98	0,036
Tipo de leite			
Desnatado	1,00	-	-
Integral	0,72	0,57; 0,89	0,003
Consumo de frutas			
Adequado (≥3 porções/dia)	1,00	-	-
Inadequado (<3 porções/dia)	0,79	0,63; 0,98	0,036
Consumo de hortaliças			
Adequado (≥3 porções/dia)	1,00	-	-
Inadequado (<3 porções/dia)	0,74	0,59; 0,94	0,012

Nota: *teste de qualidade do ajuste *p*=1,00.
IC95%: Intervalo de Confiança de 95%; RP: Razão de Prevalência.

ocorrência de fatores de risco para DANT como desfechos relacionados ao fracionamento dietético. Os autores hipotetizaram que o menor fracionamento dietético e o grande volume de alimentos consumido nas refeições principais determinam um maior estoque de gordura corporal em decorrência da maior absorção de glicose e maior lipogênese e, por isso, contribuem para o pior estado de saúde dos indivíduos.

À semelhança de Fabry *et al.*[18], mais recentemente outros autores também investigaram a relação entre o fracionamento dietético e o perfil de saúde dos sujeitos. Farschi *et al.*[19], por exemplo, verificaram alterações bioquímicas entre 10 mulheres obesas que seguiram dois tipos de dietas durante 14 dias. O primeiro modelo dietético se caracterizou pela realização de 6 refeições diárias com horários fixos e o segundo pelo fracionamento da dieta em 3 a 9 refeições ao dia, refletindo um padrão mais caótico de consumo alimentar. Houve maior termogênese pós-prandial, menor concentração de colesterol total e de *Low Density Lipoprotein* (LDL, Lipoproteínas de Baixa Densidade) e menor pico de insulina pós-prandial no primeiro modelo dietético.

Oliveira & Sichieri[20] conduziram ensaio experimental em que mulheres com excesso de peso deveriam aumentar o fracionamento dietético diário pela inclusão de frutas (maçã ou pera) e biscoito integral (de aveia) nos lanches. Após 14 semanas de acompanhamento, observou-se que o aumento de três ou mais refeições diárias se associou à redução dos níveis séricos de colesterol total e de LDL, não sendo o mesmo verificado entre as mulheres que aumentaram o fracionamento dietético em uma ou duas refeições.

A literatura aponta ainda que a maior frequência de refeições se associa a menores valores de IMC e manutenção da redução ponderal. A prática de atividade física se configura como um

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importante fator nessa relação, uma vez que o excedente energético dos lanches é equilibrado no aporte calórico total da dieta pelo maior dispêndio de energia pela prática de exercício físico[21]. Ademais, uma coorte formada por 1 273 homens com 26-36 anos apontou relação linear inversa entre a frequência de episódios alimentares e o risco cardiometabólico[22].

Os benefícios do maior fracionamento dietético vão além do controle do peso corporal e da glicemia e lipídeos séricos. Alguns estudos apontam, por exemplo, uma associação inversa entre o número diário de refeições e a ingestão de sódio[23], o que corrobora os achados do presente estudo de maior inadequação do fracionamento dietético entre mulheres hipertensas. O hábito de realizar mais refeições ao longo do dia também é apontado como benéfico para a saúde intestinal. Acredita-se que o ato de se alimentar em períodos mais espaçados ao longo do dia esteja intimamente ligado ao menor número de reflexos gastrointestinais, o que ocasiona baixo peristaltismo e, consequentemente, quantidade reduzida de bolo fecal[24]. A literatura aponta ainda efeito protetor da realização de um maior número de refeições para a ocorrência de câncer colorretal[25]. Na presente investigação, as mulheres que referiram constipação também apresentaram maior fracionamento inadequado da dieta.

Apesar dessas evidências, McCrory & Campbell[26] argumentam que as evidências do impacto positivo do fracionamento dietético na saúde só são notadas quando outros hábitos alimentares saudáveis são verificados, a exemplo da restrição energética e da inclusão de alimentos saudáveis de elevado aporte de micronutrientes nas refeições. No presente estudo, o maior número de refeições se associou a uma maior qualidade nutricional da dieta, o que pode justificar as associações identificadas.

A partir dos dados obtidos pela presente investigação, a equipe da Academia da Cidade optou por contemplar o incentivo ao fracionamento adequado da dieta nas suas próximas intervenções educativas, reforçando a importância de que as refeições incluídas sejam compostas por alimentos saudáveis. Apesar de a presente amostra não ser representativa, acredita-se que intervenções realizadas em outros cenários também possam contribuir para o melhor perfil de saúde dos indivíduos por meio do incentivo à realização de pelo menos cinco refeições ao dia.

Por fim, apontam-se as limitações do estudo relacionadas ao desenho metodológico, do tipo transversal, que dificulta a compreensão das relações de causalidade; a investigação do perfil de morbidade pela referência do próprio usuário; e a adoção de uma amostra intencional, que não reflete a população feminina das Academias da Cidade.

CONCLUSÃO

Ao conhecer os fatores associados ao fracionamento da dieta de mulheres atendidas em um Serviço de Promoção à Saúde, notou-se que a inadequação desse parâmetro está associada ao pior perfil nutricional da dieta e à ocorrência de DANT. O incentivo ao maior fracionamento dietético garantido pela inserção de alimentos mais saudáveis nas refeições, a exemplo de frutas, hortaliças, leite e seus derivados, poderá contribuir para o impacto das intervenções realizadas na Academia da Cidade, tais como atendimento individual e prática orientada de exercício físico.

Estudos com maior número de indivíduos e representatividade amostral poderão contribuir para a melhor compreensão das relações existentes entre fracionamento da dieta e perfil de saúde, o que poderá nortear políticas públicas e definições de guias alimentares, atingindo um maior contingente de indivíduos.

COLABORADORES

LM PEREIRA e ALS VIEIRA participaram da concepção do estudo, coleta de dados e redação do manuscrito; PM HORTA participou da concepção e desenho do estudo, análise e interpretação dos dados e redação do manuscrito; LC SANTOS participou da concepção e desenho do estudo e revisão da redação do manuscrito.

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Clustering of physical inactivity and low fruit and vegetables intake and associated factors in young adults

Agregamento entre a inatividade física e consumo de frutas, legumes e verduras e fatores associados em adultos jovens

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ABSTRACT

Objective

To investigate the cluster of physical inactivity and low fruit and vegetable intake and the associated factors in university students.

Methods

This cross-sectional study included a representative sample (n=717) of *Universidade Federal Rural de Pernambuco* students. Low fruit and vegetable intake was defined as an intake of less than five servings a day and physical inactivity was defined as exercising less than 150 minutes a week. The independent variables were gender, age, socioeconomic status, school year, shift, and study time. Clustering was determined by comparing the observed prevalence with the expected prevalence for all possible risk-factor combinations. Logistic regression analysis, performed by the software Statistical Package for the Social Sciences 17.0 with a significance level of 5% (p<0.05), considered the presence of both risk behaviors adjusted to the independent variables.

Results

The prevalence of low fruit and vegetable intake was 81.7% (CI95%=78.1-84.3) and of physical inactivity was 65.8% (CI95%=62.2-69.4). Most students (58.6%, CI95%=55.3-62.2) were exposed to both risk factors simultaneously, while 11.0% (CI95%=8.9-13.5) were exposed to neither. Full-time students have a risk 1.45

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times greater of simultaneous exposure. Juniors and seniors are, respectively, 1.88 and 2.80 times more likely to present both risk behaviors.

Conclusion

Although complex, the behaviors are modifiable, and both the healthy and the unhealthy behaviors tend to cluster. The implementation of an intervention that targets both risk behaviors is needed. Different strategies can be used, such as providing areas for physical activity and for learning about healthy and risk behaviors.

Indexing terms: Healthy behaviors. Lifestyle. Risk factors.

RESUMO

Objetivo

Investigar o cluster da inatividade física e o baixo consumo de frutas, legumes e verduras e os fatores associados ao contexto universitário.

Métodos

Estudo transversal com uma amostra representativa (n=717) de estudantes universitários da Universidade Federal Rural de Pernambuco. Considerou-se baixo consumo de frutas, legumes e verduras a frequência de consumo menor que 5 porções/dia, e inatividade física a prática inferior a 150 minutos/semana. As variáveis independentes foram: sexo, idade, nível socioeconômico, turno, tempo de permanência na instituição e período do curso. O cluster foi calculado comparando-se a prevalência observada e a esperada em todas as possibilidades de agrupamento. Para a análise de regressão logística, considerou-se a presença dos dois comportamentos simultaneamente ajustada às variáveis independentes, sendo as análises realizadas no Statistical Package for the Social Sciences *17.0 (p<0,05).*

Resultados

A prevalência de baixo consumo de frutas, legumes e verduras foi de 81,7% (IC95%=78,1-84,3), e da inatividade física foi de 65,8% (IC95%=62,2-69,4). Verificou-se que 58,6% (IC95%=55,3-62,2) apresentaram exposição aos dois comportamentos simultaneamente, enquanto 11,0% (IC95%=8,9-13,5) não apresentaram nenhuma exposição. Permanecer dois turnos na universidade aumenta 1,45 vez a chance de exposição simultânea. O fato de estar nos dois últimos anos do curso aumenta 1,88 vez a chance de baixo consumo de frutas, legumes e verduras, e 2,80 vezes a chance de inatividade física.

Conclusão

Os comportamentos são modificáveis, apesar de complexos, e a presença ou ausência de um tende a influenciar o outro; sendo assim, sugere-se uma intervenção integrada que focalize ambos. Diferentes estratégias, como oferta de espaços para a prática de atividade física e de ações em educação e saúde para ambos os comportamentos podem ser utilizadas.

Termos de indexação: *Comportamentos saudáveis. Estilo de vida. Fatores de risco.*

INTRODUCTION

According to the World Health Organization (WHO), more than one-third of the global deaths may be attributed to a small number of factors, and the main ones are high blood pressure (responsible for 13% of the deaths), smoking (9%), physical inactivity (6%), and excess weight (5%)[1]. Except for smoking, all other causes are related to physical inactivity and/or low fruit and vegetable intake[1,2].

Despite the actions proposed in the last decades, physical activity and fruit and vegetable intake have not increased significantly in most countries[1,2]. Health-risk behaviors tend to cluster, that is, there is a causal network between exposure to one behavior and the presence of another[3-14]. Moreover, evidence shows that the strategies that focus on actions involving multiple behaviors have a greater impact than interventions on isolated behaviors[11,15-18].

Nevertheless, few studies have investigated the clustering of behaviors and associated factors, especially in the youth[5-10,12,13]. Most studies involved adults and elderly from high-income countries[5-10,12,13]. The transition period between adolescence and adulthood is characterized by significant social relationship and environmental changes that may negatively impact health actions, attitudes, and behaviors, especially in the young who enter university[14,19-22]. Although university is admittedly an educational environment, the prevalence of physical inactivity and low fruit and vegetable intake is high[19]. Information about these isolated behaviors is already available in Brazil, but few studies have looked at clustering[23-26], and none regarded the university context.

Colares *et al.*[27], for example, studied the health behaviors of students from public higher-education institutions of *Recife*, but they did not investigate whether these behaviors were clustered or whether they were associated with attending university. Given the above information, the present study aims to investigate clustering between physical inactivity and low fruit and vegetable intake, and whether this possible clustering is associated with university-related variables.

METHODS

This cross-sectional study was developed at the *Universidade Federal Rural de Pernambuco* (UFRPE). Male and female UFRPE students aged 18 to 24 years were eligible. The exclusion criteria were: (a) intellectual disability; (b) students in student exchange programs (Brazilian or otherwise), and (c) distance learning students and from campuses other than the main campus. The sample size was calculated based on a population size of 7,287 students, a prevalence of 50% for multiple outcomes, an error of 5%, and a sampling design effect of two. The estimated sample size was 695 students, but since the proportion of students aged more than 24 years was unknown and to compensate for eventual sample losses and participation refusals, the sample size was multiplied by 1.2, totaling 834 students.

Cluster sampling was done in two stages. The first stage included students from all academic majors, each academic major being a cluster. The academic majors were then selected randomly considering the following stratification criteria: (a) year density per academic major, (b) number of students per academic major. The second stage considered the proportion of males and females per year and academic major. The software Research Randomizer performed the random samplings.

Two questionnaires were used for collecting data, one to measure fruit and vegetable intake frequency[28] and the other to determine the level of physical activity[29]. Sociodemographic, socioeconomic, and education institution data were also collected. Fruit and vegetable intake data were collected by a semiquantitative food frequency questionnaire with 94 items (10 fruits and 11 vegetables) developed and validated by Slater *et al.*[28]. This instrument includes the serving size of each food item[28]. The available intake frequencies were monthly, weekly, and daily. The reference period was the six months that preceded the interview. Thus, the number of fruit and vegetable servings per day was given by adding the number of servings of all the fruit and vegetable items consumed daily. Those who reported a fruit and vegetable intake below five servings per day were considered at risk. A pilot study found that the intake frequency presented good reproducibility (r=0.56-0.83). The interviews were in person, which allowed the participants to clarify the amounts consumed.

The International Physical Activity Questionnaire (IPAQ) measured the level of physical activity[29]. The instrument measured the time in minutes spent during a regular week doing moderate and vigorous physical activity at leisure, work, and home, and while commuting. Students

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who exercised less than 150 minutes a week were considered physically inactive. A pilot study found that the level of physical activity presented good reproducibility (*r*=0.67-0.91).

The independent variables were age, gender (male/female), socioeconomic status (A, B, C, D, and E)[30], shift (morning, morning and afternoon, and evening), academic major duration, and number of shifts [part-time (1) and full-time (2)]. Socioeconomic status was determined by the instrument *Critério de Classificação Econômica Brasil* (CCEB, Socioeconomic Classification Criterion Brazil) created by the *Associação Brasileira das Empresas de Pesquisa* (Abep, Brazilian Association of Research Companies)[30].

Data were collected as follows: (a) academic major coordinators were contacted to schedule a visit; (b) interviewers were trained for measuring physical activity and food intake, and for administering, filling out, and coding the questionnaire. Data were collected from October to November 2010 by eight interviewers, undergraduate physical education (UFRPE) and nutrition *Universidade Federal de Pernambuco* (UFPE) students attending the 'Introduction to Research' course. The interviews were conducted in private and lasted 25 to 35 minutes. The students were informed that the information was classified, would not affect their grades, and would only be used in research.

The software Epi Data version 3.1 tabulated the data. The data were entered in two different computers and the files were compared and the mistakes corrected. The data were then exported to the statistical software Statistical Package for the Social Sciences (SPSS) version 17.0. The software Epi Info version 6.04d calculated the confidence intervals.

Data analysis grouped some variables and created others. Age was transformed into two categories, namely 18-21 and 22-24. Students from the socioeconomic classes C, D, and E were grouped. The students were grouped by school year, not semester. Regarding academic majors that lasted more than eight semesters, students of the last years were grouped.

Risk behaviors were binary coded as either 0 (absent) or 1 (present). A variable was then created adding the codes: 0=no risk behavior; 1=one risk behavior; and 2=two risk behaviors.

The prevalences of the individual risk behaviors and of all possible combinations stratified by gender were calculated. Clustering occurs when the Observed combination exceeds the Expected prevalence of the combination[5,8,10,12]. The expected prevalence of each combination is given by multiplying the individual probability of occurrence of each behavior by its occurrence. When the result observed-to-expected exceeds one, the behaviors are clustered[5,8,10,12].

Multivariate analysis consisted of binary logistic regression with the reference category being the presence of risk behaviors. The data were analyzed before and after adjustment for the independent variables. The significance level was set at 5% (p<0.05).

The study was approved by the Human Research Ethics Committee of the UFPE Center for Health Sciences under Protocol number 313/2010 and followed the Guidelines and Norms for Human Research.

RESULTS

On data collection day, 748 students were present, two (0.2%) of which were exchange students and so excluded, and 29 (4.0%) refused to participate. Therefore, 717 students joined the study. Table 1 shows the sample's university and health behavior characteristics stratified by gender. Only 18.3% (Confiance Interval of 95% - 95%CI=15.6-21.2) of the students consumed enough fruits and vegetables, and 34.2% were physically active (95%CI=30.7-37.7).

The general prevalences of risk behaviors were 81.7% (95%CI=78.1-84.3) for inadequate fruit and vegetable intake and 65.8% (95%CI=62.2- 69.4) for physical inactivity, and

the differences between genders were significant. More females studied during the day than males (p<0.05) (Table 1).

More than half (58.6%, 95%CI=55.3-62.2) the sample presented both risk behaviors, while 30.4% (95%CI=27.1-33.8) presented only one, and 11.0% (95%CI=8.9-13.5) presented none. The prevalences of the presence and absence of both risk behaviors differed significantly between genders, with the former being more prevalent in women.

Table 2 shows the Observed and Expected results of all possible combinations of the two behaviors stratified by gender. The behaviors clustered in males and females with an Observed-to-Expected ratio of 1:1 for both genders. The clustering of healthy behaviors (adequate fruit and vegetable intake and level of physical activity) also

Table 1. Sociodemographic, socioeconomic, academic major, and risk behavior characteristics of university students (n=717), from *Recife* (PE), Brazil, 2010.

Variables	Men (n=316) %	Women (n=401) %	*p* value*
Low fruit and vegetable intake*	78.5	84.3	0.05
Physical inactivity**	57.6	72.3	0.00
Number of risk factors			
2	51.3	64.3	0.00
1	33.5	27.9	
0	15.2	7.7	
Sociodemographic factors			
Age (years)			
18	19.9	15.2	0.08
19	19.6	18.0	
20	17.7	12.7	
21	11.7	16.0	
22	12.0	13.5	
23	9.5	14.0	
24	9.5	10.7	
*Socioeconomic status****			
A	14.8	16.1	
B	37.3	41.3	
C	47.6	42.3	0.72
D	0.3	0.3	
E	0.0	0.0	
Academic major features			
Year			
First (freshman)	44.9	41.9	0.87
Second (sophomore)	32.3	34.4	
Third (junior)	11.1	11.7	
Fourth (senior)	11.7	12.0	
Study time			
Part-time	42.7	36.2	0.07
Full-time	57.3	63.8	
Shift			
Day	63.3	70.6	0.05
Evening	36.7	29.4	

Note: *<5 servings/day; Chi-square test for heterogeneity; **<150 minutes/week;Chi-square test for trend; ***Economic Classification Criterion of Brazil by *Associação Brasileira das Empresas de Pesquisa* (Brazilian Association of Research Companies).

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occurred, with an observed-to-expected ratio of 1.67 for males and 1.80 for females. Adequate fruit and vegetable intake and physical inactivity was observed only in women, with an Observed-to-Expected ratio of 1.07, while inadequate fruit and vegetable intake and physical activity was found in men and women (Table 2).

Physical inactivity presented a near-linear association with school year in men and women. Physical inactivity increases with school year. Figure 1 shows a near-linear association between school year and exposure to risk behaviors, and Figure 2 shows the same near-linear association for women only.

In unadjusted logistic regression, three independent variables were significantly associated with the presence of two risk behaviors: gender, socioeconomic status, and

Table 2. Prevalence of the clustering of four health-related behaviors presented by university students from *Recife* (PE), Brazil, stratified by gender (n=717), 2010.

Behaviors	Low fruit and vegetable intake	Physical inactivity	Men (n=226)			Women (n=374)		
			O (%)	E (%)	O/E	O (%)	E (%)	O/E
2	+	+	51.3	45.2	1.13	64.3	60.9	1.10
1	-	+	11.0	11.9	0.92	11.0	10.8	1.07
	+	-	33.7	32.7	1.03	23.7	22.6	1.04
0	-	-	15.2	9.1	1.67	7.7	4.3	1.80

Note: +: Factor present; -: Factor absent. *Observed value: 0.

O: Observed; E: Expected.

Table 3. Unadjusted and adjusted analyses of the association between sociodemographic, socioeconomic, and academic major variables and the presence of two health-risk factors in university students (n=717), of *Recife* (PE), Brazil, 2010.

Variables	%	Unadjusted PR (95%CI)	Adjusted* PR (95%CI)
Gender		0.00	0.00
Male	51.3	1.00	1.00
Female	64.3	1.72 (1.27-2.31)	1.87 (1.41-2.54)
Age (years)		*p*=0.67	*p*=0.20
18-21	57.8	1.00	1.00
22-24	59.4	1.06 (0.80-1.43)	1.29 (0.90-1.77)
Socioeconomic status		*p*=0.005	*p*=0.007
A	53.5	1.00	1.00
B	55.6	1.12 (0.82-1.66)	1.19 (0.88-1.87)
C, D, and E	65.5	1.22 (1.10-1.76)	1.33 (1.18-1.91)
Shift		*p*=0.22	*p*=0.51
Day	60.1	1.00	1.00
Evening	55.4	0.82 (0.60-1.12)	0.88 (0.71-1.21)
Study time		0.27	0.04
Part-time	56.1	1.00	1.00
Full-time	60.2	1.18 (0.87-1.60)	1.45 (1.12-2.09)
School year		*p*=0.004	*p*=0.03
First (freshman)	53.5	1.00	1.00
Second (sophomore)	59.6	1.30 (0.69-2.50)	1.51 (0.88-2.74)
Third (junior)	63.4	1.54 (0.90-2.61)	1.88 (1.12-3.15)
Fourth (senior)	69.4	1.97 (1.17-3.28)	2.80 (1.40-4.18)

Note: *Adjusted for all variables.

PR: Prevalence Ratio; CI95%: Confidence Interval of 95%.

school year (Tabela 3). Women presented a Prevalence Ratio (PR) of 1.72 (95%CI=1.27-2.31) in relation to men, and the students in classes C,D, and E presented a PR of 1.22 (95%CI=1.10-1.76) in relation to students in classes A and B. A significant linear trend was also observed between school year and the clustering of both study behaviors. In other words, as graduation approaches, the risk of being exposed to both risk behavior increases (p<0.05).

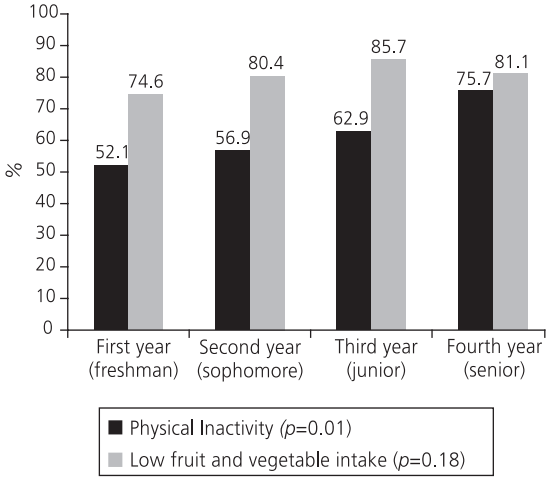

Figure 1. School year presenting a near-linear association with physical inactivity and low fruit and vegetable intake in university students (n=717), from *Recife* (PE), Brazil, 2010.

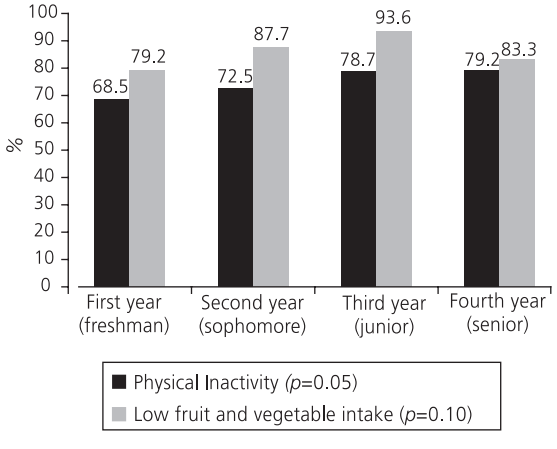

Figure 2. School year presenting a near-linear association with physical inactivity and low fruit and vegetable intake in female university students (n=717), from *Recife* (PE), Brazil, 2010.

In adjusted logistic regression, all variables that discriminate outcome remained significant. Additionally, the amount of time students spent at the institution daily also had a significant impact, with full-time presence being a risk factor (PR=1.35; 95%CI=1.01- 2.04) in relation to part-time (Tabela 3).

DISCUSSION

The objective of the study was to investigate the existence of clustering between physical inactivity and low fruit and vegetable intake, and to verify whether this possible clustering was associated university-related variables. Eight of every ten students do not consume enough fruit and vegetable, and four of every ten are physically inactive. Considering the population of university students, these results corroborate those of Marcondelli *et al.*[31], and exceed those of Colares *et al.*[27]. However, the measurements used by the latter authors did not consider number of servings, and those same authors did not investigate physical activity frequency and intensity.

In the present study, the clustering of low fruit and vegetable intake and physical inactivity has also been found for the general Brazilian population, regardless of cutoff points and instrument used[5,8,10,12,32]. For example, the *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* (Vigitel, Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey) study conducted in 2009 in Brazilian state capitals and Federal District found prevalences of 18.9% for adequate fruit and vegetable intake and 34.0% for physical activity[33]. We expected the study participants to adhere more to healthy behaviors because they are young university students with a family income in excess of the national mean. On the other hand, university-related determinants and university infrastructure hinder healthy practices.

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Full-time students were 1.45 times more likely to present clustering of the study risk behaviors than part-time students. Furthermore, as graduation approached, students spent more time in university-related activities, such as tutoring other students, participating in research groups, and attending introduction to science, training, and extension courses, so again hindering healthy practices.

This trend is clearer for physical activity regardless of gender, but is stronger in men: in the first year, the prevalence of physical inactivity was 52.1%, increasing to 75.7% in the last year. For women, the prevalence was 68.5% in the first year and 79.5% in the last. This trend was also observed in fruit and vegetable intake, but it was not significant. The study finding may be explained by the fact that physical activity requires time and greater physical exertion, while dietary patterns are affected less. This trend was also confirmed by adjusted logistic regression: junior and senior students were two to three times more likely to be exposed to both risk behaviors.

The clustering of both risk behaviors was found in 51.3% of the men and 64.3% of the women ($p<0.05$). On the other hand, the clustering of both healthy behaviors was found in 15.2% of the men and 7.7% of the women. Physical activity seems to account for the gender difference since approximately 50.0% of the men are active, against 25.0% of the women.

In general, healthy and unhealthy behaviors tend to cluster, but the O/E ratio of both risk behaviors was higher than that of both healthy behaviors in both genders. This shows that there is a stronger clustering between healthy behaviors than between risk behaviors. Other studies have also found this same relationship[5,8,10,12], which suggests that these behaviors have a similar degree of complexity.

The study sampling procedure, which took into account the proportion of students enrolled in each academic major and shift, and the proportion of males and females, allows extrapolating the results to all UFRPE students. The present study investigated the clustering of risk behaviors strongly associated with chronic Non-Communicable Diseases (NCD) in an important environment. In addition, this appears to be the first Brazilian study to perform this type of analysis in university students.

The present study has some limitations. Extrapolation of the results to the general youth population requires caution, especially to students attending private institutions and those from other Brazilian regions. Another limitation was that the food intake amounts were self-reported. One of the possible consequences is prevalence overestimation, even though the amounts consumed were collected by interview. However, this limitation is also present in similar studies[5,8,10,12]. Moreover, studies that assessed the clustering of NCD risk factors found that the factors varied greatly, hindering direct comparison of the findings.

CONCLUSION

Given that the study behaviors are complex but modifiable, it is essential to identify population subgroups at greater risk of clustered risk factors to prevent NCD. The present findings may have a significant impact on health practices and policies because the high prevalence of NCD risk factor clustering found herein reinforces the need of NCD-preventive interventions. Although the results suggest that some student subgroups are more vulnerable, interventions should be implemented regardless of academic major duration, shift, time spent at the institution, gender, and socioeconomic status. Different strategies can be used, such as providing areas that consider student particularities for practicing physical activity and for learning about health and risk behaviors.

CONTRIBUTORS

RM TASSITANO conceived the study, analyzed and interpreted the results, wrote and made an

important critical review of the article's intellectual content, and approved the final version for publication. MCM TENÓRIO interpreted the data, wrote and critically reviewed the article, and approved the final version for publication. PC CABRAL interpreted the data, wrote and critically reviewed the article, and approved the final version for publication. GAP SILVA conceived the study, analyzed and interpreted the results, wrote and made an important critical review of the article's intellectual content, and approved the final version for publication.

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Factors associated with serum lipids of adolescents from the Brazilian South[1]

Fatores associados aos lípides séricos em adolescentes no Sul do Brasil

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ABSTRACT

Objective

This study analyzes factors associated with serum lipids in adolescents from southern Brazil.

Methods

This is a school-based cross-sectional study with a probabilistic sample composed of 660 adolescents aged 14 to 19 years from the city of *Três de Maio, Rio Grande do Sul* state, Brazil. The following independent variables were analyzed: body mass index; waist-to-height ratio; moderate to vigorous level of physical activity; sedentary behaviour; lipid, total saturated fatty acid, cholesterol, sodium, and fiber intakes; smoking; and alcohol abuse. Linear regression analysis tested the association between the independent variables and total cholesterol and high density lipoprotein-cholesterol.

Results

Body mass index was directly associated with total cholesterol (β=0.96, p=0.001) and reversely associated with high density lipoprotein-cholesterol (β=-0.45, p<0.001).

Conclusion

High body mass index may have a negative impact on the lipid profile of adolescents. Thus, monitoring nutritional status is important to prevent and control dyslipidemia in adolescents. We suggest multidisciplinary and intersectoral actions that encourage teenagers to acquire a healthy lifestyle, with emphasis on the adoption of an active lifestyle and balanced diet.

Indexing terms: Adolescent. Cholesterol. Diet. Obesity. Physical activity. Risk factors.

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RESUMO

Objetivo

Analisar fatores associados aos lípides séricos em adolescentes no Sul do Brasil.

Métodos

Estudo transversal de base escolar com amostra probabilística composta por 660 adolescentes de 14 a 19 anos de idade do município de Três de Maio, Rio Grande do Sul, Brasil. As variáveis independentes analisadas foram: índice de massa corporal, razão cintura-estatura, atividade física moderada a vigorosa, comportamentos sedentários, ingestão de lipídeos, de ácidos graxos saturados totais, de sódio e de fibras, colesterol, tabagismo e consumo abusivo de álcool. A associação entre as variáveis independentes e o colesterol total e as lipoproteínas de alta densidade foi testada por meio da análise de regressão linear.

Resultados

O índice de massa corporal se mostrou associado de forma direta ao colesterol total (β=0,96; p=0,001) e inversa à lipoproteína de alta densidade (β=-0,45; p<0,001).

Conclusão

A elevação do índice de massa corporal pode contribuir para alterações negativas no perfil lipídico de adolescentes; o monitoramento do estado nutricional representa, assim, uma estratégia importante para prevenção e controle das dislipidemias em adolescentes. Sugerem-se ações de caráter multidisciplinar e intersetorial que estimulem nos adolescentes hábitos saudáveis, com ênfase na aquisição de um estilo de vida ativo e de uma alimentação equilibrada.

Termos de indexação: *Adolescente. Colesterol. Dieta. Obesidade. Atividade física. Fatores de risco.*

INTRODUCTION

Despite the global strategies and actions to control and reduce cardiovascular diseases, they continue to have high morbidity and mortality[1]. Cardiovascular events are mainly caused by atherosclerosis, which is associated with risk factors found in young individuals[2,3].

Among the risk factors, serum lipids in excess of the recommended levels are directly associated with the atherosclerotic process. Atherosclerosis is generated by cholesterol and cholesterol ester deposits in the intima of the great arteries. During adolescence, depending on lifestyle and genetic factors, some fatty streaks accumulate more lipids, forming a lesion called fibrous plaque that grows, calcifies, bleeds, ulcers, ruptures, or thromboses over the years, resulting in clinical manifestations or cardiovascular events[4]. Hence, one of the goals to promote cardiovascular health and reduce diseases is to control cholesterol levels in all age groups[1].

There is a growing prevalence of dyslipidemia in the youth. Moreover, serum levels of lipids and lipoproteins in children and adolescents tend to remain unchanged during adulthood, justifying the concern with these age groups[5,6]. In Brazilian adolescents, the prevalences of undesirable lipid levels vary from 20.3%[7] to 51.0%[8] for total cholesterol and from 5.0%[9] to 25.9%[7] for High Density Lipoprotein-cholesterol (HDL-c). Similar variations have been found in other countries[10,11]. Many factors have been associated with dyslipidemia in adolescents, such as socio-environmental conditions, behavior patterns, genes, low birth weight, and excess weight[8,12-16]. Nevertheless, only a few studies explore the relationship between serum lipids and anthropometric and lifestyle variables, considered important confounding factors.

Knowing the relationship between multiple risk factors and serum lipids in adolescents, especially modifiable risk factors, is critical for public health, since early interventions are possible. The objective of this study was to analyze the factors associated with serum lipids in adolescents from the Brazilian South.

METHODS

This study is linked to an epidemiologic, school-based survey done in 2006 with adolescents from *Três de Maio* (RS), Brazil, called "Risk factors for atherosclerosis in adolescents". The study was approved by the Human Research Ethics Committee from the *Universidade Federal de Santa Catarina* (UFSC) under Protocol number 41/2006, and all participants or their guardians signed an Informed Consent Form.

Três de Maio is a town in the Northwestern region of the state of *Rio Grande do Sul*, a state in the Brazilian South region. The resident population in 2006 was 24,245 inhabitants, and 2,209 were aged 10 to 14 years and 2,236 were aged 15 to 19 years[17]. Most of the population descend from Germans, Italians, and Poles.

Sample

The study population (n=1,642) consisted of adolescents aged 14 to 19 years enrolled in the public and private schools of the town in 2006. The sample size was based on the prevalence of one of the main survey outcomes that motivated this study: a prevalence of physical inactivity of 40.0%, a confidence interval of 95.0%, a sampling error of 3.5%, resulting in a sample size of 516 adolescents; 40.0% more students were added to compensate for losses and refusals. This resulted in a final sample of 723 adolescents.

Sampling was probabilistic, stratified, and proportional to the socioeconomic status and sex distributions in the town. At first the schools were characterized by socioeconomic status proxy (public and private schools). All schools offering elementary and secondary education, as well as technical courses, were included in the study (5 public and 2 private schools).

In the sequence, all students of each school aged 14 to 19 years were listed and ordered alphabetically by gender. The study participants were selected systematically and the interval defined by dividing the total number of adolescents in each list by the number of students who should be included in each school.

Data collection

Data were collected in June and July of 2006 by a trained team of different professionals who participated in a pilot study. The following sociodemographic data were collected: gender, age, skin color (self-reported), and economic class according to the *Associação Brasileira de Empresas de Pesquisa* (ABEP, Brazilian Association of Market Research) criteria[18]. The adolescents were also asked about their family history of high cholesterol and early myocardial infarction as follows: "*Does anyone in your family have high cholesterol level?*" (No; I don't know; mother; father; siblings); "*Has anyone in your family had an acute myocardial infarction before age 55 years?*" (No; I don't know; mother; father; siblings). The answer "*I don't know*" was entered as missing. The adolescent's birth weight was informed by one of the parents.

The level of physical activity was measured by a validated questionnaire[19] that has been used in studies with Brazilian adolescents. The adolescents informed the number of days per week (frequency) and duration (minutes per day) of the moderate and vigorous physical activity practiced in the last seven days. A list containing 18 physical activities was used with a space reserved for adding other activities. The level of physical activity was determined by multiplying the frequency by the duration, resulting in a score of minutes per week.

Sedentary behaviour (hours/day) was given by the weighted average of the total screen time spent by adolescents on weekdays (Monday through Friday) and weekend days (Saturday and Sunday) in front of a television/videogame/computer.

Diet was assessed by a dietary recall that included the foods and beverages consumed on a typical or normal day within the past 15 days.

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Photographs, food replicas, and a set of cooking units were used for minimizing the error sources such as memory bias and cooking unit size. The adolescents were asked about the type and amount, in cooking units, of each food consumed in each of the meals (breakfast, snacks, lunch, and supper). Total energy and nutrient intakes (lipids (g), total saturated fatty acids (g), cholesterol (mg), sodium (mg), and fibers (g)) were calculated by the software DietPro 4.0[20].

Smoking and alcohol abuse were assessed by the Global School-Based Student Health Survey[21]. Anyone who smoked on one or more days in the past 30 days was considered a smoker, regardless of amount. Alcohol abuse was defined as the consumption of five or more doses on one occasion in the last 30 days.

The anthropometric measurements were taken twice by the same researcher (technical measuring error <1%) and the final result was given by the average of the two. Body Mass Index (BMI) was given by dividing the weight in kilograms by the square of the height in meters; weight and height were measured as described elsewhere[22]. An electronic scale of the brand Filizola® with stadiometer was used for the measurements. Waist circumference was measured by a fiberglass tape measure (Mabis) at the midpoint between the last rib and the iliac crest - also measured twice and the average used. The Waist-to-Height Ratio (WHR) was given by dividing the waist circumference in centimeters by the height in centimeters.

Blood was collected from a vein on the inside of the elbow after a 10- to 12-hour fast with the individual in the seated position to determine total cholesterol (mg/dL) and HDL-c (mg/dL). Collection was done at the school by a biochemist. The determinations were done by the automated device BioSystems, model BTS 370 Plus.

Statistical analysis

Descriptive measures (means and standard deviations) were calculated for the quantitative variables and frequency distribution for the categorical variables. The Student's *t* test for independent samples was used for comparing the mean values of the quantitative variables and the Chi-square test for comparing the proportions of the qualitative variables of male and female adolescents.

Simple and multiple regression analyses were used for analyzing the association between the dependent variables (total cholesterol and HDL-c) and the following independent variables: BMI; WHR; moderate and vigorous physical activity (minutes per week); inactivity (hours per day); smoking (yes=1; no=0); and lipid (g), total saturated fatty acid (g), cholesterol (mg), sodium (mg), and fiber (g) intakes. Nutrient intake was adjusted to total calorie intake, which is given by the residues of linear regression models where nutrient intake and total calories are the dependent and independent variables, respectively. This technique is recommended for epidemiologic nutritional assessments. The procedure allows assessing the influence of consuming a certain nutrient on the occurrence of a disease, cancelling the influence caused by the total energy intake on the outcome of what is being investigated[23]. After the variable physical activity (minutes per week) was transformed into log 10, it presented a positive asymmetric distribution. One was added to the physical activity scores to allow the logarithmic transformation given that some students admitted to being inactive (score of zero).

In adjusted multivariate analysis, all independent variables were included in the model, regardless of the *p* value obtained in the unadjusted model. The variables were selected by backward selection. The variables that remained in the model were those with $p<0.10$. The same criterion was used for potential confounding factors, namely gender (female=0; male=1), decimal age in years, skin color (white=0; non-white=1), economic class (classes A/B=0, C=1, D/E=2), family history of high cholesterol (yes=1; no=0), family history of early myocardial infarction (yes=1; no=0), and low birth

weight (<2500g). Variables with $p \leq 0.05$ were considered to be associated with total and HDL-c.

Multicollinearity was checked by determining the Variance Inflation Factors (VIF) and correlation coefficients between the independent variables. VIF varied from 1.03 to 2.08, and the correlation coefficients remained below 0.56, indicating the absence of multicollinearity. Waist circumference was not used in the analysis because it is highly correlated with BMI (r=0.89). The adequacy of the final models was tested by analyzing residues, adjusting the determination coefficient, adding the regression residue squares, testing regression residue normality, and analyzing.

RESULTS

The sample consisted of 660 adolescents, 317 males and 343 females, after a sample loss of 8.8%. For this study the a posteriori statistical power of the sample showed that this number of participants allows estimating determination coefficients of any magnitude with up to 13 predictors (independent variables). It also used a confidence level of 95%, α=5.0%, and 1-β=80.0%.

The sociodemographic characteristics of the adolescents and the descriptive values of the study variables are shown in Tables 1 and 2, respectively. The prevalences of some variables were as follows: low birth weight, 8.9% (n=59); family history of high cholesterol, 49.7% (n=328); and family history of early acute myocardial infarction, 14.5% (n=96). The mean age, body

Table 1. Sociodemographic characteristics of the study adolescents from *Três de Maio* (RS), Brazil, 2006.

Variables	n	%	(95%CI)
Gender			
Male	317	48.0	(42.3 - 54.6)
Female	343	52.0	(46.5 - 57.3)
Age			
14-15 years	238	36.1	(30.0 - 42.6)
16-17 years	337	51.0	(45.6 - 56.5)
18-19 years	85	12.9	(6.6 - 22.0)
Skin color			
White	487	73.8	(69.6 - 77.6)
Non-white	173	26.2	(19.6 - 33.2)
Economic class			
A, B	240	36.4	(30.2 - 42.7)
C	312	47.3	(41.8 - 53.1)
D, E	108	16.3	(10.2- 25.1)

Note: Economic class: A,B: high; C: average; D,E: low.
95%CI: Confidence Interval of 95%.

Table 2. Study variable means ± standard deviations and percentages. *Três de Maio* (RS), Brazil, 2006.

Variables	All (n=660)		Male (n=317)		Female (n=343)		*p*-value
	M	SD	M	SD	M	SD	
Total cholesterol (mg/dL)	151.1	27.1	145.0	25.8	156.6	27.1	<0.001
HDL-c (mg/dL)	53.0	11.8	49.4	10.8	56.4	11.7	<0.001
Body mass index (kg/m²)	21.3	3.5	21.3	3.1	21.3	3.8	0.828
Waist-to-height ratio	0.44	0.05	0.43	0.04	0.44	0.05	0.005
Physical activity* (min/week)	319.3	310.8	401.8	378.0	243.1	204.9	<0.001
Sedentary behaviour (h/day)	4.4	2.4	4.2	2.5	4.5	2.2	0.230
Lipids (g)	103.9	60.1	118.1	67.0	90.7	49.6	<0.001
Total SFA (g)	23.5	16.8	29.5	18.2	17.9	13.1	<0.001
Cholesterol (mg)	237.9	167.3	300.1	187.5	180.4	120.6	<0.001
Sodium (mg)	2,967.9	1,640.4	3,696.3	1,733.9	2,294.7	1,208.7	<0.001
Fibers (g)	26.9	19.6	33.08	21.2	21.2	16.1	<0.001
Smoking (≥1day/30days, %, n)	6.8	45.0	8.5	27.0	5.3	18.0	0.096
Alcohol (≥5doses/occasion, %, n)	40.0	264.0	50.8	161.0	30.0	103.0	<0.001

Note: *Moderate and vigorous physical activity. The Student's *t* test compared continuous variables of independent samples and the Chi-square test compared percentages.
HDL-c: High Density Lipoprotein-cholesterol; SFA: Saturated Fatty Acids; M: Mean; SD: Standard Deviation.

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weight, and body height, and respective standard deviations were respectively 16.05±1.34 years, 63.96±11.65 kilos, and 1.73±0.07 meters for boys and 15.76 ±1.33 years, 56.37±10.86 kilos, and 1.62±0.06 meters for the girls (data not in the Tables).

The girls had higher total and HDL-c means than the boys (p<0.001). The boys consumed more lipids, total saturated fatty acids, cholesterol, sodium, and fibers, and abused alcohol more frequently. Girls also had higher waist-to-height ratio and spent fewer minutes doing moderate and vigorous physical activities (Table 2).

Tables 3 and 4 show the results of regression analysis for the factors associated with serum lipids in the study sample. Total cholesterol was positively associated with BMI and negatively associated with HDL-c.

The final multiple regression model for total cholesterol (Table 3) showed a direct association between BMI adjusted for gender and family history of early myocardial infarction, while the final HDL-c model (Table 4) presented an inverse association with BMI adjusted for gender.

DISCUSSION

There is a significant linear relationship between BMI and serum total and HDL-c, suggesting that adolescents with high BMI tend to have high total cholesterol and low HDL-c.

Lifestyle-related variables, namely physical activity; sedentary behaviour; fiber, fat, and cholesterol intakes; smoking; and alcohol abuse were not associated with serum lipids in adolescents. Guedes *et al.*[12] have also not found an association between physical activity and total and HDL-c. However, LeBlanc & Janssen[24] found that small amounts of moderate to vigorous physical activity reduced the risk of low HDL-c levels. Moreover, studies suggest that a diet high in fats, cholesterol, and sodium, and poor in fibers can have a negative impact on the lipid profile of adolescents[12,16].

The lack of an association between lifestyle variables and total and HDL-c has various explanations. Regarding physical activity, the use of a questionnaire to determine its level may underestimate or overestimate the level and lead to the lack of association with certain outcomes.

Table 3. Simple and multiple linear regression analysis of total cholesterol and anthropometric and lifestyle variables of adolescents from *Três de Maio* (RS), Brazil, 2006.

Variables	Total cholesterol (mg/dL)					
	Unadjusted analysis			Adjusted analysis		
	β	SEM	*p* value	β†	SEM	*p*-value
Body mass index (kg/m²)	0.995	0.301	0.001	-0.957	0.294	0.001
Waist-to-height ratio	-54.74	22.94	0.017	-35.97	22.92	0.117
Physical activity*	-1.655	2.160	0.444	0.671	2.221	0.763
Sedentary behaviour (h/day)	-0.409	0.441	0.354	-0.665	0.456	0.145
Lipids	-0.014	0.030	0.636	-0.035	0.039	0.372
Total SFA	-0.170	0.078	0.030	-0.027	0.110	0.805
Cholesterol	-0.015	0.008	0.043	-0.005	0.009	0.560
Sodium	-0.002	0.001	0.011	0.000	0.001	0.998
Fibers	-0.130	0.065	0.045	-0.120	0.084	0.154
Smoking (≥1day/30days)	1.414	4.188	0.785	1.692	4.271	0.692
Alcohol (≥5doses/occasion)	-2.679	2.152	0.214	-1.805	2.278	0.428

Note: *Moderate and vigorous physical activity - converted to log 10; SFA: Saturated Fatty Acids; SEM: Standard Error of Measurement; Lipids, SFA, sodium, and fibers adjusted for total calories. †Final model adjusted for gender (p<0.001) and family history of acute myocardial infarction (p=0.061). Low birth weight (p=0.69); skin color (p=0.640); family history of high cholesterol (p=0.254); economic class (p=0.135), age (p=0.129) were excluded from the model because p≥0.10.

Table 4. Simple and multiple linear regression analysis for high-density lipoprotein cholesterol (HDL-c) and anthropometric and lifestyle variables of adolescents from *Três de Maio* (RS), Brazil, 2006.

Variables	HDL-c (mg/dL)					
	Unadjusted analysis			Adjusted analysis		
	β	SEM	*p*-value	β‡	SEM	*p*-value
Body mass index (kg/m²)	-0.445	0.131	0.001	-0.453	0.125	<0.001
Waist-to-height ratio	-5.939	10.025	0.554	0.088	9.817	0.993
Physical activity*	-1.695	0.938	0.071	-0.046	0.951	0.962
Sedentary behaviour (h/day)	-0.182	0.192	0.344	-0.277	0.195	0.157
Lipids	0.003	0.013	0.811	-0.005	0.017	0.755
Total SFA	-0.034	0.034	0.315	0.020	0.047	0.669
Cholesterol	-0.005	0.003	0.142	-0.001	0.004	0.762
Sodium	0.000	0.000	0.309	0.000	0.001	0.401
Fibers	-0.021	0.028	0.464	-0.008	0.036	0.822
Smoking (≥1day/30days)	0.456	1.823	0.802	1.287	1.829	0.482
Alcohol (≥5doses/occasion)	-0.890	0.937	0.343	0.631	0.976	0.518

Note: *Moderate and vigorous physical activity - converted to log 10; SFA: Saturated Fatty Acids; SEM: Standard Error of Measurement; Lipids, SFA, sodium, and fibers adjusted for total calories. ‡Final model adjusted for gender (p<0.001).
Skin color (p=0.794); family history of acute myocardial infarction (p=0.717); age (p=0.529); family history of high cholesterol (p=0.441); economic class (p=0.413); and low birth weight (p=0.218) were excluded from the model because p≥0.10.

Past food intake, despite the strategies used for collecting information, depends on subjects' memory. Yet, despite the caution to ensure response privacy, variables related to smoking and alcohol intake may not be accurate. Furthermore, studies have found different associations or lack thereof between the lipid profile of adolescents and lifestyle variables.

Body mass index may be associated with high cholesterol levels in adolescents, even after adjustment for gender and family history of early myocardial infarction. Similar results were reported elsewhere[9,14] suggesting that excess weight during adolescence may be associated with undesirable total cholesterol levels. On the other hand, other studies have not found an association between BMI and cholesterol in adolescents[15,25].

High-Density Lipoprotein-cholesterol was not inversely associated with BMI adjusted for gender, indicating that adolescents with high BMI have low levels of HDL-c. Other studies done in Brazil[8,15] and elsewhere[13,26] also found an inverse association between HDL-c and overweight or obesity. Since HDL-c is antiatherogenic, low levels predispose to cardiovascular diseases.

These findings are worrisome because there is a global pandemic of overweight during adolescence[27] which may tend to favor a higher prevalence of dyslipidemia in this age group. Additionally, dyslipidemia and overweight have an important role among the factors associated with the intima-media thickening of the coronary and carotid arteries, which is considered an early marker of atherosclerotic disease[2,3]. The interrelationship and synergy between these cardiovascular risk factors already during adolescence may precipitate other health problems in this population and contribute to the morbidity and mortality related to early cardiovascular events during adulthood.

Overweight is caused by many factors, that is, it is influenced by the environment, metabolism, and biology, and is considered a modifiable cardiovascular risk factor[28,29]. Environmental issues are measured by lifestyle, which influences the nutritional status and consequently, adolescent serum lipids. A longitudinal study that examined the effect of lifestyle changes on the stability of serum lipids in youth and adults found that positive changes, such as control of body weight, physical activity,

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not smoking, and better socioeconomic status may help to prevent dyslipidemia during adulthood[30]. What is more, maintaining a healthy body weight is critical for preventing dyslipidemia in adolescence and maintaining an appropriate lipid profile in adulthood[5,7].

This study has some limitations, such as using a typical day to determine diet, especially considering that weekday and weekend meals tend to vary, and the study did not take into account those variations. Although this type of instrument is individual and sensitive to cultural differences, it may facilitate food intake over- or underreporting, resulting in information bias[23]. Another limitation is the use of a questionnaire to determine the level of physical activity, since this method depends on the subjects' ability to remember and estimate precisely the parameters of the activities that are being measured.

However, the study also has some strengths, such as the use of a representative sample of school adolescents and the simultaneous analysis of anthropometric and lifestyle variables considered important confounding factors, such as family history of high cholesterol, family history of early myocardial infarction, low birth weight, age, gender, skin color, and economic class.

In conclusion, high BMI contributes to the negative lipid profile of adolescents. Multidisciplinary and intersectoral public health actions are suggested to prevent and control excess weight and consequently, dyslipidemia in adolescents, especially education and health actions. In this context, the school may be the main intervenor, preferably through the discipline physical education, which can develop educational situations that encourage adolescents to adopt healthy life habits, with emphasis on autonomous physical activities and an active lifestyle.

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CONTRIBUTORS

CC BECK conceived and designed the study, created the study protocol, coordinated and supervised data collection, analyzed and interpreted the data, wrote and reviewed the manuscript, and approved the final version of the manuscript. AS LOPES helped to conceive the study, review the manuscript, and interpret the results; approved the final version of the manuscript. JC FARIAS JÚNIOR analyzed the data, interpreted the results, reviewed the manuscript, and approved the final version of the manuscript.

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Identification of food intake patterns and associated factors in teenagers[1]

Identificação dos padrões de consumo alimentar e fatores associados em adolescentes

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ABSTRACT

Objective

To identify schoolchildren«s dietary patterns and investigate the demographic, social, and economic determinants of the differences found between patterns.

Methods

The sample consisted of 1,330 students aged 11 to 17 years attending the public schools of *Salvador, Bahia*, Brazil. The subjects' food intake data were collected by a semiquantitative Food Frequency Questionnaire comprising 97 food items. All information was collected during a single interview. The exposure variables were gender, age, and socioeconomic class, and the outcome variables were categorized food consumption pattern in "mixed pattern", "traditional pattern", and "healthy pattern". The data were treated by simple and multiple linear regression analyses and the dietary patterns determined by factor analysis.

Results

Most participants were female (56.9%) and over 13 years old (79.2%). The "mixed pattern" was positively associated with females (β=0.181, p<0.001). The "traditional pattern" was negatively associated with classes

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D, C, and B (β=-0.149, *p*<0.007), and the "healthy pattern" was negatively associated with females (β=-0.200, *p*>0.0001) and classes D, C, and B (β=-0.125, *p*<0.023).

Conclusion

Three dietary patterns were identified among the adolescents, namely mixed, traditional, and healthy. Gender and socioeconomic class were associated with dietary patterns. Male teenagers and those in the lower socioeconomic classes had a healthier dietary pattern than their peers of higher socioeconomic classes and females.

Indexing terms: Adolescent. Food consumption. Socioeconomic factors. Linear models.

RESUMO

Objetivo

Identificar os padrões de consumo alimentar entre escolares e investigar os determinantes demográficos, sociais e econômicos dos diferentes padrões encontrados.

Métodos

Foi estudada uma amostra de 1 330 indivíduos entre 11 e 17 anos, estudantes da rede pública de ensino, em Salvador, Bahia. A avaliação do consumo alimentar dos adolescentes foi obtida por meio de Questionário da Frequência Alimentar semiquantitativo, com 97 itens alimentares, sendo as informações coletadas em uma única entrevista com os estudantes. As variáveis de exposição foram sexo, idade e o indicador econômico; a variável desfecho foi padrão de consumo alimentar categorizada em misto, tradicional e saudável. Os dados foram analisados pela regressão linear simples e múltipla, e os padrões alimentares foram obtidos a partir da análise fatorial.

Resultados

A partir da análise das características da população, observou-se o predomínio do sexo feminino (56,9%), e idade maior que 13 anos (79,2%). A adoção do padrão alimentar misto esteve associada positivamente ao sexo feminino (β= 0,181), p<0,001. O padrão tradicional associou-se negativamente às classes D, C, B (β=-0,149), p<0,007, enquanto o padrão alimentar saudável esteve associado negativamente ao sexo feminino (β=-0,200), p<0,0001 e às classes D, C, B (β=-0,125), p<0,023.

Conclusão

Foram identificados, entre os adolescente, três padrões alimentares: misto, tradicional e saudável. Observou-se que o sexo e o indicador da condição econômica estiveram associados aos padrões alimentares. Os adolescentes da classe econômica mais baixa e do sexo masculino adotam consumo alimentar mais saudável em relação àqueles das classes econômicas mais altas e do sexo feminino.

Termos de indexação: *Adolescente. Consumo alimentar. Fatores socioeconômicos. Modelo linear.*

INTRODUCTION

Food is a human need that encompasses a multiplicity of aspects that influence quality of life. In this context dietary patterns emerge as a strategy to characterize population food intake trends, which contain multiple meanings, including cultural, social, and economic aspects[1,2].

Dietary patterns can be defined as a set or group of foods consumed by a given population[3]. Thus, analysis of dietary patterns could better predict the risk of diseases than analysis of individual nutrients or foods[2,4-7].

Many studies have found an association between dietary patterns and socioeconomic class. However, their results indicate that the relationship between socioeconomic factors and dietary patterns is controversial and varies among populations, suggesting the pertinence of investigating these relationships in other contexts and different population groups[8,9].

For Sichieri *et al*.[8], the factors income and education level better explain the dietary patterns seen in the Brazilian Northeast and Southeast. Studies conducted in *Pelotas* (RS) indicate a higher frequency of poor dietary habits among

adolescents of higher-income families. In *Diamantina* (MG) people with higher income had unhealthier dietary patterns than those with lower income[4]. Nevertheless, other studies reported that higher socioeconomic status encourages children and adolescents to adopt healthier diets, as seen in *Salvador* (BA)[10]. Likewise, higher-income adolescents from *São Paulo* consume more produce[11].

Adolescence encompasses the period from ages 10 to 19 years[12]. This period is biologically important because this is when most psychological and cognitive development and physical growth occur after early childhood[13]. In Brazil 20% of the population is in this phase of life, adolescence. Adolescents are considered a low-risk segment for morbidity and mortality from many diseases, so they have received little attention from public policies, especially with respect to health care[14].

Few studies have investigated the association between the dietary patterns of adolescents attending public schools and social and environmental factors[15]. Knowing the effects of dietary patterns on disease promotion and prevention and understanding their relationship with socioeconomic factors are important aspects for developing intervention programs and health-promoting measures[8,16]. Hence, the objective of this study is to identify the dietary patterns of adolescents attending the public schools of *Salvador* (BA) and determine the demographic, social, and economic factors associated with each dietary pattern.

METHODS

This cross-sectional study was conducted in the urban area of *Salvador* (BA), from June to December 2009, and involved 207 public schools included in the 2009 school list provided by the Department of Education and Culture of *Bahia* State. Students aged 11 to 17 years enrolled in the sixth, seventh, and eighth grades of the selected schools were eligible to participate in the study. This study is part of a broader study investigating the risk factors for asthma whose sample size is based on a 24.6% prevalence of asthma symptoms[17], a confidence level of 95.0%, and a maximum allowable error of 3.0%. The final sample size was 1,027 students, but 1,330 students were interviewed.

The sampling strategy used by the present study is complex because selection of the grades and finally, the classes that encompassed this population group required taking into account both the age bracket of adolescents, which, according to the World Health Organization (WHO), ranges from 10 to 19 years, and the schools listed in the state network. Students aged 10, 18, and 19 were excluded from this population group because very few students in the study grades were that old. Therefore, the sampling calculation used Simple Random Sampling Without Replacement (SRSWOR); schoolchildren selection relied on a two-stage cluster sampling: the first stage consisted of selecting the schools, and the second stage of selecting the classes. Twenty-one schools were selected from the 207 state schools, and three classes were selected from each school and in each, given that each class had approximately 30 students. All students who agreed to participate in the study and obtained their guardians' consent were interviewed. The study was approved by the Research Ethics Committee of *Universidade Federal da Bahia* (UFBA) Institute of Collective Health under Protocol number 002/08 CEP/ISC. The students' guardians who agreed with their children's participation in the study signed a free and informed consent form or provided their fingerprints if they were illiterate.

Adolescents who were pregnant, breastfeeding, or wearing casts were excluded.

A semiquantitative Food Frequency Questionnaire (FFQ) with 97 food items was used for collecting the adolescents' food intake data. Food item intake frequency was divided into five categories: never/rarely=0; 1 to 3 times a month=1; once a week=2; 2 to 4 times a week=3;

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≥4 times a week=4; and the number of times the food was consumed during the day. The interviews were conducted by trained dieticians and dietary technicians from July to December 2009 using a standardized and validated questionnaire. All data were collected during a single interview. The FFQ was administered directly to the students who informed the foods consumed at and away from home.

Social and economic information regarding the ownership of goods, home appliances, and education level of the family head (incomplete elementary school, elementary school, high school, and higher education) were provided by the adolescent's guardian and noted in a standardized questionnaire. Their socioeconomic class was given by the *Critério de Classificação Econômica Brasil* (CEEB, Brazilian Economic Classification Criterion) created by the *Associação Brasileira de Empresas de Pesquisas*[18] (Brazilian Association of Market Research Companies), which classifies the Brazilian population into the following socioeconomic classes: A1, A2, B1, B2, C1, C2, D, and E. Nobody in the study population represented the A strata. The strata were associated with the following incomes: A (A1/A2): more than 30 minimum salaries (m.s); B (B1/B2): 15 to 30 m.s; C (C1/C2): 6 to 15 m.s; D: 2 to 6 m.s; and E: up to 2 m.s The minimum salary per month in 2009 corresponded to R$465,00. The CEEB indicator uses the following information to determine socioeconomic class: ownership of goods and home appliances, and education level of the family head (incomplete elementary school, elementary school, high school, and higher education). In the present study, the families were categorized as having better socioeconomic status (classes B, C, and D) or worse socioeconomic status (class E). Age was categorized as <13, 13-15, and >15 years.

Dietary patterns were identified by factor analysis using Principal Component Analysis (PCA)[6,18]. First, the number of factors was given by values greater than one for variance and the number of components that remained in the screen plot whose points of maximum slope indicated the most appropriate number of retained components that would define the dietary patterns[4,6,9]. Many authors find factor analysis suitable for determining dietary patterns[2,19].

For factor analysis, the foods were grouped according to their nutritional characteristics, the intake habits of this population, and the study objectives (Table 1). Next, the frequencies of the foods consumed from each food group were added, constituting the numerator of the summary measurement. The denominator corresponded to the maximum number of foods that an individual could consume per food group multiplied by five[7]. A score was generated for each food group. Factor analysis was performed after this procedure.

Factor analysis requires meeting some prerequisites. The first regards the ratio between the number of individuals and the number of foods (variables in the FFQ). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy tested the appropriateness of the data for factor analysis[4,5,7,9]. Varimax rotation examined the exploratory factor structure (pattern) of the FFQ, considering factor loadings greater than 0.30[7]. Factor analysis groups the foods listed in the FFQ according to the degree of correlation between them and creates new variables called factors or principal components to represent these groups. The total variance explained by the three generated factors identified the number of factors retained by factor analysis, in addition to those given by the screen plot.

Simple and multiple regression analysis assessed the potential risks associated with the dietary patterns of the study population. Multivariate regression analyzed the relationships between dietary patterns and the variables economic class, age, and gender. The associations were controlled for age. The confidence level was set at 95% and the significance level at 5%. The analyses were weighted by the Data Analysis and Statistical Software (Stata) Survey Commands

Table 1. Grouping of foods used in factor analysis according to their nutritional characteristics. *Salvador* (BA), Brazil, 2009-2010.

Groups	Foods
Sugar/Sweets	Sugar, homemade sweets, candy, lollypops, chocolate bars, ice cream/popsicles, gelatin desserts, cocoa powder, frozen yogurt.
Dairy products	Whole milk, low-fat milk, fermented milk products, whole/diet/light yogurt, instant cocoa mix, yellow cheese, white cheese, cream cheese.
Grains	Rice, pasta, noodle, whole-grain or regular breakfast cereal, wheat germ, baby cereal, cornmeal, popcorn, granola.
Soda	Regular/diet/light soda.
Drink mixes	Drink mixes, fruit drink mixes, carbonated drinks, energy drinks.
Fast foods	Deep-fried preparations, hot dogs, French fries, pizza, sandwiches, corn/potato chips, bacon crisps, soup mixes.
Sauces	Ketchup, mayonnaise, salad dressing, processed pizza sauce.
Fats/oils	Butter, margarine, oil, olive oil.
Typical foods	*Feijoada, dobradinha, feijão tropeiro, acarajé, abará, vatapá, caruru*, coconut milk, palm oil.
Non-starchy vegetables	Lettuce, cabbage, cauliflower, squash, carrot, potato, chayote, gherkin, beetroot, okra, vegetable soup with noodles, salad.
Fruits	Pineapple, avocado, acerola, Prata banana, plantain, cashew, jackfruit, papaya, mango, apple, watermelon, acai berry, melon, orange, mandarin orange, strawberry.
Seafood	Seafood.
Poultry	Poultry.
Beef	Beef, organ meats, charqui.
Processed meats	Calabrese sausage, ham, mortadella, hot dog.
Eggs	Boiled and fried eggs, egg preparations.
Tubers	Cassava, yam, sweet potato.
Breads/cakes	Bread, cookies, homemade cake, cake mix.
Legumes	Beans, peanuts.
Fruit juice	Fruit juice, pulp juice.
Coffee	Coffee.
Tea	Tea.

(SVY). The database was created and processed by the software Epi Info version 6.04, and analyzed by the software Stata version 10.

RESULTS

Most of the study sample were females (56.9%) older than 13 years. Approximately half the sample was from class E and the other half from classes B, C, and D.

Food Frequency Questionnaire analysis resulted in three dietary patterns named "mixed", "traditional", and "healthy" (Table 1). Although all foods occur in each of these three patterns, the "mixed" pattern had a prevalence of fast foods, sugar, sweets, processed beverages, dairy products, soda, and typical foods; the "traditional" pattern had a prevalence of poultry, processed meats, beef, eggs, coffee, breads/cakes, and cassava flour; and the "healthy" pattern had a prevalence of fruits, vegetables, and grains.

For testing the appropriateness of using factor analysis, the first criterion to be met was determining the ratio between the number of individuals and the number of foods listed in the FFQ, which was 14:1. For PCA, the KMO was 0.946, and Bartlett's test of sphericity was

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13044.43 (p=0.000). These results indicate that the method is appropriate for this analysis. PCA resulted in three factors with a root greater than 1 that explained 47.9% of the total variance. Foods from each group with loadings below 0.30 were excluded to simplify the analysis. Also, these food items contributed little to the dietary patterns (Table 2).

The factors gender and socioeconomic class were associated with the three dietary patterns identified in this study (Table 3). The "mixed" pattern was positively associated with being female (β=0.181, p<0.001); the "traditional" pattern was negatively associated with classes D, C, and B (β=-0.149, p<0.007); and the "healthy" pattern was negatively associated with being female (β=-0.200, p<0.000) and the classes D, C, and B (β=-0.125, p<0.023).

DISCUSSION

Analysis of the dietary patterns of the study adolescents identified three dietary patterns named "mixed," "traditional," and "healthy." The "mixed" pattern contained a prevalence of fast foods, sugar and sweets, processed beverages, soda, and some seafood, fruits, and legumes; the "traditional" pattern contained a prevalence of poultry, processed meats, beef, eggs, coffee, and manioc flour; and the "healthy" pattern contained a prevalence of produce and grains.

The dietary pattern of the study adolescents was associated with gender. Females prefer the "mixed" pattern and males, the "healthy" pattern. Gender did not influence adherence to the "traditional" pattern. Therefore,

Table 2. Distribution of the factor loadings of the dietary patterns of the study population. *Salvador* (BA), Brazil, 2009-2010.

Variables	Mixed	Traditional	Healthy	h^2
Dairy products	0.621	-	0.360	0.574
Grains	0.415	0.451	0.488	0.613
Tubers	-	-	0.644	0.508
Cassava flour	-	0.522	-	0.302
Breads/Cakes	0.470	0.486	-	0.542
Fast foods	0.779	-	-	0.670
Typical foods	0.630	-	0.344	0.536
Sugar/Sweets	0.732	-	-	0.633
Fats/Oils	0.409	0.500	-	0.421
Legumes	0.411	0.349	0.381	0.436
Fruits	0.398	-	0.685	0.659
Fruit juice	0.331	-	0.300	0.246
Non-starchy vegetables	-	-	0.728	0.619
Beef	0.337	0.596	-	0.544
Poultry	-	0.607	-	0.449
Seafood	0.390	-	0.378	0.351
Processed meats	0.360	0.602	-	0.492
Eggs	-	0.585	-	0.390
Coffee	-	0.513	-	0.294
Tea	-	-	0.568	0.330
Drink mixes	0.670	-	-	0.499
Soda	0.665	-	-	0.445
Sauces	0.585	-	0.306	0.462
Accumulated variance	36.00	42.47	47.90	
KMO	0.946			
Bartlett's coefficient	13044.43	(p=0.000)		

Note: KMO: Kaiser-Meyer-Olkin.

Table 3. Factors associated with the dietary patterns of the study population. *Salvador* (BA), Brazil, 2009-2010.

Variables	Dietary pattern 1 - Mixed			
	β [b]	*p*-value	β [a1]	*p*-value
Gender				
Male	*		*	
Female	0.172	0.002	0.181	0.001
Economic class				
Class E	*		*	0.080
Classes D, C, B	0.089	0.100	0.095	
Variables	Dietary pattern 2 - Traditional			
	β [b]	*p*-value	β [a1]	*p*-value
Gender				
Male	*		*	
Female	0.043	0.433	0.040	0.471
Economic class				
Class E	*		*	
Classes D, C, B	-0.150	0.033	-0.149	0.007
Variables	Dietary pattern 3 - Healthy			
	β [b]	*p*-value	β [a1]	*p*-value
Gender				
Male	*		*	
Female	-0.193	0.000	-0.200	0.000
Economic class				
Class E	*		*	
Classes D, C, B	-0.115	0.035	-0.125	0.023

Note: β [b]: Unadjusted coefficient; β [a1]: Coefficient adjusted for gender, age, and patterns 2 and 3; β [a2]: Coefficient adjusted for gender, age, and patterns 1 and 3; β [a3]: Coefficient adjusted for gender, age, and patterns 1 and 2.

males have healthier dietary patterns than females.

These results are in agreement with those of other studies on this subject. Bigio *et al.*[11] conducted a study with 812 adolescents aged 12 to 19 years in *São Paulo* (SP) and found that males consumed more fruits and non-starchy vegetables than females. In South Africa a study found that females consume fast foods more often than males[20]. This behavior may result in higher calorie intake and stem from the fact that females stay at home more and are more inactive than males. In *João Pessoa* (PB) Farias Junior *et al*.[21] found that males were more physically active than females. This may be explained by biological, sociocultural, and body image differences and different gender attributes. Gender differences with respect to healthy food habits were also found in *Pelotas* (RS) since male adolescents followed the recommendations of consuming healthy foods (grains and milk, for example) more often than female adolescents[9].

However, some studies show opposite results, such as a study conducted in the Balearic Islands in the Mediterranean Sea that found that boys adhered more to the Western diet while girls, to the Mediterranean diet, a diet high in healthy foods[22]. In the United States of America, a study conducted from 1977 and 2006 with 31,337 children and adolescents found that males consumed larger portions than females[23].

In the present study, the "traditional" and "healthy" dietary patterns were associated with low socioeconomic class. Adolescents from higher socioeconomic classes adhere less to healthier patterns and more to the Western diet. These

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findings corroborate those of Olinto *et al.*[19] who found that individuals from *Pelotas* (RS) of lower socioeconomic classes adhered more to the traditional Brazilian dietary pattern than those of higher socioeconomic classes, who consumed more ready-to-eat processed foods typical of the Western diet. In Brazil, Silva *et al.*[24] and Levy-Costa *et al.*[25] found a direct relationship between higher socioeconomic class and consumption of diets with high fat and simple sugar contents. Better socioeconomic status has been associated with consumption of unhealthy foods because unlike individuals of low socioeconomic classes who can only afford staple foods, such as rice, beans, bread, milk, and coffee (regardless of low produce intake), those of higher socioeconomic classes can afford ready-to-eat processed foods.

In Western Australia, Ambrosini *et al.*[15] found that low income was associated with the Western diet in 14-year-old adolescents. Low food availability is often due to low income, which usually has a negative impact on the amount and quality of the foods consumed by poor families[26]. This situation frequently leads to compensatory eating practices, such as higher intake of fast foods, soda, canned foods, sweets, or candy[27], as seen in some of our study participants. A study in Spain showed that the intake of sweets, pastry (a source of fat), sugar, and savory snacks was higher among adolescents from lower income families[28]. In *Salvador* (BA) D'Innocenzo *et al.*[10] found that children aged 4 to 11 years of higher socioeconomic classes consumed a higher amount of healthy foods than those of low socioeconomic classes. However, the sample of the said study consisted mostly of children, not adolescents, and D'Innocenzo *et al.*[10] included children from higher-income neighborhoods whose characteristics differ from those of the present study population, probably contributing to the different results.

Food intake expresses food availability in regional contexts and in contexts related not only to local cultural aspects but also to the conditions of different social strata, which will influence the acquisition of different types of food[9]. These specificities explain the diversity of dietary patterns since each population and region have their own characteristics. These characteristics will impact the formation of each dietary pattern differently and hinder the comparison of dietary pattern studies in different contexts.

The association between better income and foods in the "mixed" pattern seems to be mediated by changes imposed especially by the modern lifestyle adopted by Brazilian families in the last decades. For some authors, food away from home and a greater availability of fast and processed foods are directly associated with family income[29], education level[11], and food availability.

Although food intake studies have limitations, such as memory bias, classification, and quantification, and because the present study is cross-sectional, thereby preventing: the establishment of causal relationships; the contemplation of the temporal sequence of exposure and effect; and the subjectivity associated with factor analysis and the number of study factors[9,19]; the results confirm that socioeconomic conditions determine dietary patterns[15,18,25].

CONCLUSION

The study adolescents presented three dietary patterns, namely mixed, traditional, and healthy. The food choices of adolescents attending state schools who live mostly in the outskirts of *Salvador* (BA) are influenced by socioeconomic class and gender. Low-income male adolescents have a healthier dietary pattern than those of higher income families and female adolescents. Considering the vulnerability of children and adolescents to overweight and other diseases, studies such as this one should be encouraged and developed to elucidate the nutritional profile of these individuals and make scientific contributions to the scarcity of this information in the literature.

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CONTRIBUTORS

JMO MASCARENHAS and ML BARRETO helped to conceive the study, analyze the data, interpret the results, and write the manuscript. RCR SILVA, AMO ASSIS, and MLP SANTANA helped to interpret the results and write the manuscript. LTLP MORAES analyzed the data.

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Impact assessment of an intervention on the consumption of fruits and vegetables by students and teachers[1]

Avaliação do impacto de uma intervenção no ambiente escolar sobre o consumo de frutas e hortaliças por alunos e professores

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ABSTRACT

Objective

To evaluate the impact of an intervention that promoted the consumption of fruits and vegetables on the intake of these products by students and teachers in *Rio de Janeiro* (RJ), Brazil.

Methods

This is a one-group pretest-posttest study of students and teachers from elementary public schools in *Rio de Janeiro*. The intervention included a training course for promoting healthy eating; distribution of educational materials; and holding of a one-day health fair. We assessed the activities that had been carried out, teachers' habitual fruits and vegetables intake, students' fruits and vegetables intake at school, and intervention-related issues.

Results

Before the intervention, 65.1% of the students consumed the school lunch and most (≥79.4%) accepted and consumed the fruits and vegetables served. Most teachers (>75.0%) consumed fruits and other vegetables regularly, but only 36.4% consumed leaf vegetables regularly. The intervention was implemented only moderately (52.7%) but was well accepted by the teachers. The students of schools that implemented the intervention more extensively showed better acceptance of vegetables (p=0.009). Teachers' fruits and vegetables intake did not change.

[1] Article based on the dissertation of SC FARIAS intitled "Avaliação de impacto de uma intervenção de promoção de frutas e hortaliças sobre o consumo desses alimentos por alunos e professores de escolas públicas". Universidade do Estado do Rio de Janeiro; 2011.

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Conclusion

Students' fruits and vegetables intake changed modestly. This study contributes to the design of intervention studies for Brazilian schools because it coordinated the National School Food Program with educational activities.

Indexing terms: Fruits. Intervention study. Promotion of Healthy Eating. Students. Vegetables.

RESUMO

Objetivo

Avaliar o impacto de uma intervenção dirigida à promoção de frutas e hortaliças sobre o consumo desses alimentos por alunos e professores no Rio de Janeiro (RJ).

Métodos

Trata-se de estudo de intervenção do tipo antes e depois, não randomizado, com alunos e professores do primeiro ciclo do ensino fundamental de escolas públicas do Rio de Janeiro. A intervenção abarcou um curso de formação sobre promoção da alimentação saudável, distribuição de materiais educativos e realização de feira de saúde na comunidade. Foram avaliadas as atividades de promoção da alimentação saudável desenvolvidas, o consumo usual de frutas e hortaliças pelos professores e o consumo pelos alunos das frutas e hortaliças oferecidas pelo Programa de Alimentação Escolar.

Resultados

Foi observada adesão à alimentação escolar de 65,1% e alta proporção (≥79,4%) de alunos que aceitaram e que consumiram frutas e hortaliças na escola no momento pré-intervenção. Observaram-se baixa proporção de consumo regular de verduras (36,4%) e alta de frutas e legumes (>75,0%) entre os professores. A intervenção atingiu nível intermediário de implementação (52,7%), tendo sido bem avaliada pelos professores. Foi observado aumento da aceitação de hortaliças entre alunos das escolas com melhor nível de implementação da intervenção (p=0,009). Não houve mudança no consumo de frutas e hortaliças entre professores.

Conclusão

Os resultados alcançados foram modestos em termos de variação do consumo de frutas e hortaliças entre os alunos. O presente estudo contribui para o desenho de estudos de intervenção no ambiente escolar no contexto brasileiro, uma vez que articulou o Programa Nacional de Alimentação Escolar com ações educativas.

Termos de indexação: *Frutas. Estudo de intervenção. Promoção da Alimentação Saudável. Estudantes. Verduras.*

INTRODUCTION

Inadequate Fruits and Vegetables (FV; here considered as non starchy vegetables) intake occurs in many countries and ranks among the ten risk factors that most contribute to mortality around the world[1]. In Brazil FV participation in the number of calories available in households remained relatively stable at 3.0% to 4.0%, which is below the minimum World Health Organization's (WHO) recommendation of at least 6.0% to 7.0%. Moreover, inadequate FV participation was found throughout the country and all income strata, indicating that other factors, in addition to purchasing power, promoted their low comsumption[2]. For children, motivating factors such as preference, influence of parents and friends, the home environment, and access are some determinants of FV intake[3]. Thus, promoting FV intake today is one of the great challenges and priorities of Brazilian and other countries' public policy agendas[4].

Schools are one of the best places for promoting healthy food practices and FV intake because they reach a large part of the population. They are favorable environments both for providing a quantitatively and qualitatively balanced diet and for developing health education actions that favor healthy choices[5], sensitize and train school food professionals, and incorporate the theme healthy diet in the curriculum[6]. Hence, educators are critical for ensuring the success of actions that promote a healthy diet in schools. Educators are

important opinion leaders with a crucial role in actions that promote healthy diets, arousing students' and the school community's interest and participation, and promoting the collective construction of knowledge. Therefore, designing healthy diet-promoting actions requires paying special attention to these professionals' education, and enabling and motivating them to include this theme in their daily activities in a cross-sectional and interdisciplinary manner[7-9].

Intervention studies conducted globally assessing the impact of school interventions for promoting healthy diets have found that FV intake increased modestly in the study groups. Such studies have also shown that it is important for these interventions to consider the school's context, assessing the local geographic, economic, social, and environmental factors that impact food choices[10,11]. In Brazil such interventions have improved schoolchildren's food habits[12-14], and educator sensitizing and training[7-9]. Nevertheless, effective public policies require intervention studies to analyze schools subject to different Brazilian realities.

The present study assessed the impact of an intervention that promoted the consumption of FV on the intake of these products by public school students and teachers from a Brazilian city. Aiming to contribute to the advancement of the knowledge on this issue, the study intervention was designed to allow its reproduction in public elementary schools.

METHODS

The present study was part of a larger project called "Building a local intervention strategy for promoting FV intake", coordinated by *Empresa Brasileira de Pesquisa Agropecuária* (Embrapa, Brazilian Agricultural Research Corporation) and many other institutions. Its objective was to develop instruments and strategies to promote FV intake in daycare centers, schools, companies, FV retailers, and households covered by the *Estratégia da Saúde da Família* (Family Health Strategy) and *Programas de Agentes Comunitários de Saúde* (Community Health Agent Program) located in the western region of the municipality of *Rio de Janeiro* (RJ) that could be used in other cities. This municipal region has a very low Human Development Index (HDI) and the lowest municipal per capita income[15]. Communities were selected among the 22 communities located in the catchment area of the larger project covered by the Family Health Strategy when the study activities began. The selection criteria were: presence of schools and FV retailers in the Family Health Strategy catchment area; presence of a well-established Family Health Strategy team with low personnel turnover; and willingness of the Family Health Strategy supervisor to implement the project. Three of the 22 communities had these characteristics, so the project was implemented in them.

This is a one-group pretest-posttest study (therefore, with no control group) conducted in all eight municipal elementary schools located in the three study communities. The study population were the first, second, and third graders, their teachers, and the school principals. These grades were chosen because each class had only one teacher. Hence, the teacher training activities composing the study intervention would be able to focus on a smaller number of teachers who are strong opinion leaders among their students. There were no student or teacher inclusion or exclusion criteria.

The pre-intervention diagnosis occurred in April 2008 to estimate the adherence of the students to the *Programa Nacional de Alimentação Escolar* (PNAE, National School Food Program), their acceptance and intake of the FV served in the school lunch, the habitual FV intake of the teachers, and the existing school activities for promoting healthy eating. The diagnosis included: (1) observing the proportion of students who had lunch on the study days; (2) observing acceptance (students taking the fruits or letting the cook place vegetable items on their plate)

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and actual ingestion of the FV; (3) interviewing the teachers and principals or education coordinators; and (4) observing the school environment.

The standard menu of the municipal school network of the city of *Rio de Janeiro* consists of one grain, one legume, one source of animal protein, one vegetable, and one fruit. The vegetable is a side dish or mixed with the meat or grain, and the fruit is served as dessert[16]. The students were observed (have lunch and accept and ingest the FV) on three nonconsecutive days when different FV were served. Three days should be enough to observe the level of student acceptance of the FV. This number of days has been used by many studies on food intake, and even as a reference method in validation studies on food intake questionnaires and indicators[17].

For each class, the following data were registered: number of students who had a fruit and a vegetable (registered separately) on their plate; and to what extent these food items were consumed (also registered separately): totally, partially, or not consumed. Data were collected by directly observing the group, not by student. Structured questionnaires were administered to the teachers to collect the following data: habitual FV intake (separate questions for fruits, leaf vegetables, and other non-starchy vegetables), activities performed during class, and interest in participating in discussions and/or activities about the promotion of healthy eating at school. Another questionnaire was administered to the principal or education coordinator to collect information about the development of activities directed to healthy eating promotion. This questionnaire also included a section for registering the existence of posters or other displays promoting healthy eating.

The post-intervention diagnosis performed during the months of October and November 2009 relied on the same pre-intervention data collection procedures. This time the second, third, and fourth graders were studied because they were the first, second, and third graders assessed and exposed to the intervention in 2008, and they were still in touch with the teachers who participated in the intervention. The questionnaires for teachers and education coordinators also included questions to investigate their knowledge about and use of materials provided by the intervention, their assessment of the project, and how the project contributed to their personal and professional lives.

This phase lasted from July 2009 to July 2009 and included actions to promote healthy eating, emphasizing FV intake, as follows:

The educational activities included a basic training course and school sensitizing and mobilizing activities. The course was offered jointly to the teachers, cooks, and education coordinators of the three communities. Three seats were available per school to be filled preferably by the education coordinator, the reading teacher, and a cook. This course was developed and given by dieticians, home economists, food engineers, agricultural engineers, and educators, members of the larger project on which this study is based, and lasted 28 hours. The course modules included: healthy eating (cooking workshop); home gardening (fruits and vegetables); making full use of FV; education and health: communication tools; and assessment of the previous stages and planning of the school activities.

Professional attendance decreased with each passing module, so a sensitizing activity focused on FV promotion was performed in each school involved in the project as soon as the basic training course ended, on a teachers' meeting day with the school's professionals.

A one-day health fair was held in each community to encourage the community to interact with the schools, daycare centers, and Family Health Strategy units, creating a favorable environment for the development of new actions that promote health and FV intake.

The health fair included: FV-themed games, step-by-step demonstration of how to

wash FV consumed raw, anthropometric assessment, and vaccination, among others. They were performed by the project's researchers together with professionals from the local Family Health Strategy, daycare centers, schools, and local institutions.

At the end of the basic training course and according to participant demand, six educational materials were created to aid FV intake-promoting actions: a booklet with the preliminary results of the pre-intervention diagnosis; a booklet called "Promoting FV intake: Schools and Daycare Centers" containing information about suggested educational activities, including how to encourage students to eat the school food; a booklet called "Promoting FV intake: Food School Program" for the educators responsible for developing the PNAE; educational folder containing the twelve steps to healthy eating based on the "ten steps to a healthy diet", published by the Ministry of Health[18]; flyers containing a brief description and the characteristics of four fruits and eight non-starchy vegetables, the importance of consuming them, tips on how to buy and prepare them, and healthy recipes containing them; and a magnetic sheet with step-by-step instructions on how to wash fruits and vegetables. These materials were distributed during an activity to encourage their use directed at teachers, education coordinators, reading teachers, and principals.

Data analysis

The coverage and implementation level of each project action were analyzed and the following indicators were constructed:

- *Educational activities*:

- School participation in the basic training modules in relation to the number of noted available;

- Teacher participation in the meeting about promoting FV intake and in the training sessions about how to use the educational materials created by the project team.

- *Access to the educational material produced by the project team*:

- Acknowledgment, expressed in percentage, of each and all the materials produced by the project team;

- *Student activity performed by the interviewed teachers*:

- Students participation in the health fair held in their community;

- Inclusion of the theme food and nutrition in a class activity.

- *Intervention implementation level*:

- Complementarily, a summary indicator was created to express the intervention implementation level by taking the simple mean of the following percentages: (school participation in the training modules + teacher participation in the roundtable + teacher participation in the meeting that taught them how to use the educational materials + teacher's recollection of the booklet Schools and Daycare Centers + teacher's recollection of the magnetic sheet + teacher's recollection of the recipe flyers + teacher's recollection of the 12-steps folder + student participation in the healthy farmer's market + inclusion of the food and nutrition' theme as a classroom activity)/9. For example, a school with the following percentages for the items above would have an intervention implementation level of 79.8%: (60+75+85+90+ 70+83+60+95+100)/9. The objective of this indicator was to synthesize the intervention implementation level, allowing measuring how intervention implementation level in each school affected student acceptance and intake of FV, and teacher habitual FV intake.

The indicators intervention adherence', FV acceptance', and FV intake' were given by calculating the mean proportions obtained at each school in each collection day. For example, adherence to school lunch was given by the following formula: (number of students (first, second, and third graders) who consumed the PNAE meal on the first day of school "Y"/number

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of students at school on the first day of data collection "Y") + (number of students who consumed the PNAE meal on the second day of data collection "Y"/number of students at school on the second day of data collection) + (number of students who consumed the PNAE meal on the third day of data collection "Y")/number of students at school on the third day of data collection "Y")/3x100].

$$\text{Adherence to school lunch} = \frac{(C1/P1) + (C2/P2) + (C3/P3) \times 100}{3}$$

Where C_1, C_2, and C_3 are the number of students at first, second, and third graders who *consumed* the PNAE meal on the first, second, and third days of data collection, respectively; and P_1, P_2, and P_3 are the number of students at first, second, and third graders who were *present* in school on the first, second, and third days of data collection, respectively.

This indicator was included because student adherence to school meals affects their exposure to FV, which may increase their FV intake[19].

The acceptances of fruits and vegetables in each school were calculated separately in a similar manner (mean number of students who consumed these food items on the respective data collection days divided by the mean number of students who consumed the PNAE meal on the respective data collection days).

The fruit and vegetable intakes were given by dividing the mean number of students who consumed those items (counted separately) divided by the mean number of students who had those items on their plates. Students who ate some or all of the fruits and/or vegetables on their plates were classified as fruit and/or vegetable consumers because (1) the rates of partial intakes (children who did not consume the entire fruit or vegetable serving) were very low, and (2) the analyses that treated them together or separately produced similar results. A second variable was created for fruits: whether the child took the fruit with himself/herself. As can be seen, the variables that composed the outcome assessment indicators for the students are group-based (ecological), not individual.

The indicators of teachers' habitual FV intake were calculated based on the teachers' answers about their fruit and vegetable intakes (registered separately) in a regular week. These calculations included only the teachers who were interviewed twice, once before and once after the intervention.

These data generated the following pre-intervention and post-intervention indicators: proportion of teachers who consumed fruits, leaf vegetables, and other non-starchy vegetables (noted separately) at least five days a week; and mean number of days per week they consumed fruits and non-starchy vegetables (noted separately).

The answers given by the education coordinators/principals before and after the intervention were compared to identify whether: (1) the number of activities that directed to healthy eating promotion at school increased or decreased, and (2) the education strategy changed.

Finally, the teachers, education coordinators, principals, or principal assistants who participated in the intervention informed their opinion about the project by means of: indicating on a scale of one to five whether the intervention had been implemented at the school; informing how much the intervention contributed to their personal lives; and making comments and suggestions for promoting FV intake at school.

The schools reported that nearly all the students from 2008 returned in 2009. However, the schools could not inform precisely in which classes of each grade the students were placed. Hence, instead of analyzing the data by class, the data was analyzed by school.

First, indicators mentioned above were analyzed descriptively. Next, we calculated the pre- and post-intervention variation in the students' FV acceptance and intake indicators. The paired Student's *t* test was used for statistical analyses of these variations. All tests used a

significance level of 5% (p<0.05). The same procedure was used for analyzing the pre- and post-intervention variation in the mean number of days teachers consumed FV. The McNemar's Chi-Square test assessed the pre- and post-intervention variation in the proportion of teachers who consumed FV on at least five days a week (dichotomous variable).

Finally, linear regression models (or logistic models in the case of teachers' FV intake on at least five days a week) assessed how school intervention implementation level influenced the results. The dependent variables were the variations in students' FV intake and acceptance, and teachers' FV intake. The independent variable was the intervention implementation level adjusted for the students' baseline acceptance and intake, or teachers' baseline intake values. One model was constructed for each dependent variable.

The database was built in the software Microsoft Office Excel 2007, and the data were analyzed by the statistical software Statistical Package for the Social Sciences (SPSS) 13.0.

The larger project of which this study is part was approved by the Research Ethics Committee of *Rio de Janeiro*'s (RJ) Municipal Department of Health under Protocol number 120/07. The teachers, principals, and education coordinators who participated in the study signed an Informed Consent Form before entering the study.

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RESULTS

Before the intervention, the eight study schools had 70 classes and 2,032 first, second, and third graders. After the intervention, the schools had 67 classes and 1,946 second, third, and fourth graders. A total of 66 and 82 teachers were interviewed before and after the intervention, respectively, and, in each school, one principal or his/her representative before and after the intervention.

At baseline the mean student adherence to the school meal for all eight schools was 65.1%, and a high proportion of the students (≥79.4%) accepted and consumed FV (Table 1). A higher proportion of teachers (more than

Table 1. Adherence to school food, and acceptance and intake of fruits and vegetables by students of the eight study schools before and after the intervention. Municipal schools included in the Project FLV-*Embrapa*. *Rio de Janeiro* (RJ), Brazil, 2008-2009.

Indicators	Before (95%CI)	After (95%CI)	Δ	p^*
ATSF	65.1 (57.3-72.9)	75.5 (62.7-88.3)	10.4	0.05
Took fruit	79.4 (70.9-87.8)	78.6 (69.4-88.0)	-0.8	0.78
Ate fruit	85.4 (79.1-91.8)	86.8 (78.0-95.6)	1.4	0.84
Kept fruit	12.1 (6.7-17.5)	10.5 (1.4-19.6)	-1.6	0.79
Accepted vegetable	85.5 (65.5-105.3)	90.0 (81.9-98.0)	4.5	0.46
Ate vegetable	88.3 (81.7-94.8)	86.5 (79.0-94.0)	-1.8	0.68

Note: *Paired Student's *t* test comparing the observed means of each school.
Embrapa: *Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Agricultural Research Corporation); 95%CI: Confiance Interval of 95%; Δ: Delta; ATSF: Adherence to School Food.

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75.0%) consumed fruits and non-leaf, non-starchy vegetables regularly than leaf vegetables (36.4) regularly. Similar results were found for the mean number of days these foods were consumed (Table 2).

The mean intervention implementation level was intermediate (52.7%), ranging from 38.2% to 65.1%. The scope of each intervention component also varied, from 28.1% to 88.0% (Table 3).

Table 2. Intake of fruits, leaf vegetables, and other vegetables by the interviewed teachers before and after the intervention. Municipal schools included in the Project FLV-*Embrapa*. *Rio de Janeiro* (RJ), Brazil, 2008-2009.

Indicators	Before (95%CI)	After (95%CI)	Δ	*p*
Regular intake ≥5 days per week (%)				
Fruits	75.8 (59.0-91.0)	78.8 (63.0-93.0)	3.0	1.00*
Other vegetables	81.3 (67.0-96.0)	66.7 (48.0-83.0)	-14.6	0.23*
Leaf vegetables	36.4 (20.0-55.0)	39.4 (20.0-55.0)	3.0	1.00*
Mean number of intake days (days)				
Fruits	5.6 (4.9- 6.4)	5.9 (5.2- 6.5)	0.3	0.44**
Other vegetables	5.7 (5.0- 6.5)	5.5 (4.7- 6.2)	-0.2	0.51**
Leaf vegetables	3.9 (3.0- 4.8)	4.2 (3.4- 5.0)	0.3	0.31**

Note: *McNemar's Chi-square test. **Paired Student's *t* test.

Embrapa: *Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Agricultural Research Corporation); Δ: Delta; 95%CI: Confiance Interval of 95%.

Table 3. Intervention implementation indicators by school. Municipal schools included in the Project FLV-*Embrapa*. *Rio de Janeiro* (RJ), Brazil, 2009.

Indicators	Intervention implementation indicators by school								
	1	2	3	4	5	6	7	8	Total
Training activities									
Basic training*	93.3	13.3	13.3	26.7	53.3	13.3	6.7	26.7	30.8
Meeting of FV intake promotion	33.3	42.9	50.0	16.7	80.0	100.0	44.4	50.0	52.2
Training for using the intervention material	55.6	57.1	33.3	83.3	20.0	75.0	44.4	33.3	50.3
Access to the educational materials									
School booklet	42.9	33.3	50.0	42.9	75.0	37.5	0.0	25.0	38.3
Magnetic sheet	64.3	55.6	50.0	92.9	50.0	12.5	37.5	50.0	51.6
Flyers	92.9	55.6	50.0	100.0	62.5	25.0	75.0	50.0	63.9
12 Steps	78.6	55.6	50.0	57.1	75.0	62.5	62.5	37.5	59.9
Knew all materials	11.1	33.3	66.7	41.7	60.0	0.0	0.0	16.7	28.1
Student activities									
Take class to the health fair	33.3	57.1	50.0	83.3	0.0	50.0	4.4	0.0	39.8
Discuss the theme during class	77.8	85.7	85.7	83.3	100.0	100.0	100.0	71.4	88.0
*Synthesis indicator***	63.5	50.7	48.0	65.1	57.3	52.9	46.1	38.2	52.7

Note: *This indicator refers to the intervention coverage according to the number of seats available for each school. The other indicators shown in this table (except for the synthesis indicator) refers to the proportion of target teachers per school who were covered by each intervention component.

**Synthesis indicator= ($\sum$ of the percentages of all indicators in the table (Except recollection of all materials))/9.

Embrapa: *Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Agricultural Research Corporation).

Students' adherence to the school meal, FV acceptance, and FV intake before and after the intervention were similar. Analysis of FV acceptance and intake variations by intervention implementation level showed that only vegetable acceptance improved with higher intervention implementation level (p=0.009) (Table 1). The teachers' mean number of days of FV intake and the proportion of teachers who consumed FV regularly did not change (Table 2).

At baseline, seven of the eight study schools had already included diet-related activities in their curricula. Five schools already had food-related materials in display. The materials were displayed in the cafeterias of three schools, classrooms of two schools, or hall of one school.

After the intervention, the theme 'FV' was present in the curriculum of seven schools. The theme was in the curriculum of four schools before 2008, of five in 2008, and of seven in 2009, and three of the eight schools had the theme in the curriculum in all three periods. All schools reported having included the theme 'FV' in routine classroom activities. Some schools had food-related displays in the cafeteria (three schools) and/or classroom (one school).

Of the interviewed teachers and principals/coordinators, 47.1% considered that the intervention had been fully implemented (score of 5). The mean score was 4.2 of a maximum of 5 points. They believe this intervention supported their work of sensitizing students to the theme and encouraged students and teachers to consume FV and adopt healthy habits. Most education professionals expressed the importance of performing ludic activities regularly to promote FV intake at school.

DISCUSSION

The students' and teachers' FV intake in all study schools did not increase. However, students' acceptance of vegetables increased with intervention implementation level. In other words, children were more likely to let cooks put vegetables on their plate as intervention implementation level increased, suggesting that higher implementation levels would yield better results.

The intervention was implemented in schools with an already high rate of FV acceptance and intake by students and teachers. The teachers had a higher baseline FV intake than the national average for adults[20,21]. Although many of the student indicators could improve, the maximum possible variation was 20.0%. The Project ProChildren, for example, tried to increase FV intake indicators by 20.0% in an environment with a baseline intake of 17.6% of the 400g recommended per day[22]. Regardless of the indicators used by that project and the present study, the maximum possible variation depends directly on the baseline values.

The intervention implementation level, critical for its success, was influenced by the schools' curricular flexibility. The low attendance of school personnel in the training activities (30.8%) reflects the difficulties that educators have of leaving their routine activities. A similar difficulty was found in public schools of *São Paulo* (SP) and public and private schools of *Brasília* (DF)[7,8], showing the need of viable strategies for training these educators. It is also possible that despite the training, some teachers were not enough mobilized to include the theme in their educational routine.

The intervention was designed to focus on educational activities, that is, to focus on individuals, not on the environment, such as changing the menu or the place where the children ate their meals. The inclusion of cooks in the basic training course may have helped them to improve the school food, but this is not enough to characterize the intervention as having had an environmental component. Interventions that include individual and environmental actions[5,23,24] by encouraging, supporting, and promoting healthy eating[25] achieve better results[5,23,24].

The students' post-intervention indicators of school FV intake were not able to detect other

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behavioral changes, such as higher FV intake at home and/or changes in lunchbox content. However, the choice of these indicators is justified theoretically and operationally: theoretically because children spend a significant portion of the day at school and need to eat during this time; and because PNAE supplies free meals to all children attending public elementary schools; and operationally because of the difficulty of obtaining accurate information from young children about their food intake, whether at school or elsewhere.

CONCLUSION

Students' and teachers' FV intake did not increase. Despite the limitations, the present study contributes to the design of intervention studies in Brazilian schools by having made a joint assessment of PNAE (through the outcome indicators chosen for the students) and the study educational actions. The study also tried to innovate in the design of its exposure and outcome indicators.

CONTRIBUTORS

SC FARIAS helped to design the study, performed the field work, organized and analyzed the data, and wrote the manuscript. IRR CASTRO helped to design the study, supervised the field work, analyzed the data, and reviewed the manuscript. VM MATTA helped to design the study, analyzed the data, and reviewed the manuscript. LMC CASTRO helped to design the study, performed the field work, organized and reviewed the manuscript.

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Diversity of eating patterns in older adults: A new scenario?

Diversidade de padrões alimentares em idosos: um novo cenário?

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ABSTRACT

Objective

To identify eating patterns and their distribution in a representative sample of older adults from the municipality of *Botucatu, São Paulo*, Brazil.

Methods

This cross-sectional study used food frequency and sociodemographic questionnaires to collect the respective data from 355 older users, selected by stratified sampling, of *Botucatu*'s primary health care units from March to June 2011. Principal component analysis extracted six eating patterns. Individual food intake scores were divided into tertiles, classifying individual adherence to each eating pattern as low, moderate, or high, to measure the relationship between adherence tertiles and sociodemographic variables.

Results

Six eating patterns were identified and named as follows: healthy foods; snacks and weekend meals; fruits; light and whole foods; soft diet; and traditional diet. Individuals with elementary school adhered highly to the patterns 'healthy foods' and 'fruits'. On the other hand, men and individuals with the highest education levels adhered highly to the pattern 'snacks and weekend meal'. Females adhered more often to the patterns 'light and whole foods' and 'soft diet'. The pattern 'soft diet' was also preferred by the oldest subgroup.

Conclusion

The study population presented a diversity of eating patterns influenced by sociodemographic characteristics.

Indexing terms: Aged. Feeding beharvior. Population studies in public health. Principal component analysis.

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RESUMO

Objetivo

Identificar padrões alimentares e a distribuição dos mesmos, em uma amostra representativa de idosos do município de Botucatu, São Paulo.

Métodos

Estudo transversal, ocorrido entre março e junho de 2011, com 355 idosos cadastrados na rede básica de saúde do município, selecionados por amostragem estratificada entre as unidades de saúde. Aplicou-se um questionário de frequência alimentar e questionário sociodemográfico. Padrões alimentares foram identificados utilizando-se análise de componentes principais. Escores de consumo individual foram divididos em tercis, caracterizando a adesão baixa, moderada e alta dos indivíduos para cada padrão alimentar. Realizaram-se análises entre os tercis dos padrões alimentares e as variáveis sociodemográficas.

Resultados

Identificaram-se seis padrões alimentares: saudável; lanches e refeição de final de semana; frutas; light *e integral; dieta branda; e tradicional. A alta adesão aos padrões "saudável" e "frutas" é atingida por indivíduos que cursaram até o primário; e a alta adesão ao padrão "lanches e refeição de final de semana" é mais prevalente no sexo masculino e em indivíduos com nível máximo de escolaridade. A alta adesão aos padrões "*light *e integral" e "dieta branda" é mais prevalente no sexo feminino, sendo este último padrão também característico de idosos em idade mais avançada.*

Conclusão

Identificou-se uma diversidade de padrões alimentares nessa população de idosos e o comportamento alimentar variou de acordo com as condições sociodemográficas inseridas no grupo.

Termos de indexação: *Idoso. Comportamento alimentar. Estudos populacionais em saúde pública. Análise de componente principal.*

INTRODUCTION

In the context of ageing, eating behavior is frequently associated with nutritional problems[1] and dietary monotony[2,3] because many physiological, economic, and psychosocial factors limit food intake[3-5]. Thus, older adults are not only vulnerable, but also a heterogeneous group with respect to many aspects, including diet[5]. The higher food diversity resultant from food processing and trade may encourage new dietary patterns in a population group.

In nutritional epidemiology, eating patterns may be identified by statistical methods for reduction and/or aggregation components. Methods of identifying eating patterns, known as a posteriori methods, are based on empirical food data, which are aggregated by statistical analysis followed by assessment[6]. Principal component analysis is one of the most common statistical methods used for deriving eating patterns empirically[6]. Eating patterns derived a posteriori do not necessarily represent ideal patterns[7,8]. However, the specificity of these methods has the advantage of reflecting the real behavior of a population group, providing useful information for the creation of nutritional guidelines[9]. Eating patterns may be the result of cultural heritage, ethnic and multiple environmental factors[8].

The present study was conducted in *Botucatu, São Paulo*, a city that stands out for developing an increasing number of aging researches and having high prevalence of older adults (13.35%)[9], exceeding the national (10.8%) and state (11.6%) prevalences[10].

Until now, only a few studies have used statistical methods for empirically identifying the eating patterns of older adult subgroups[11-13]. In Brazil, such statistical analysis were not published only with a sample of older adults.

Knowledge of the eating behavior of older adults is essential once this group is more

vulnerable to nutritional problems and their consequences, which are much more severe in old age than in other life stages[5].

Based on the hypothesis that the eating environment in old age is diversifying, the objective of this study was to identify the eating patterns and their distributions in a representative sample of older urban users of the municipal primary health care network of *Botucatu* (SP).

METHODS

This is a cross-sectional epidemiological study of a representative sample of urban adults aged 60 years or more, users of the Basic Health units and family health strategy units of *Botucatu* (SP).

The participants answered a Food Frequency Questionnaire (FFQ) validated for this population containing 71 food items[14]. The sample size was given by multiplying the number of food items in the FFQ (K) by five because the FFQ contained more than fifteen food items, as follows: if K>15, then n=5xK[15]. Hence, a sample of 355 older adults was randomly selected from the 16 health care units of *Botucatu* (SP) by stratified sampling. These units included the Basic Health units and family health strategy units.

The older adults who agreed to participate in the study were interviewed after being informed of the study objectives and proving capable of answering the questionnaires. The interviews were conducted at the participants' homes or the health care units they frequented, depending on their preference. Participants with hearing loss and those who could not understand the questions well were included in the study since they were accompanied by a caregiver who had previously agreed to answer the questions for them. New participants were randomly selected to replace those who refused to participate. All participants signed an Informed Consent Form.

The participants answered the FFQ validated for this population and a sociodemographic and lifestyle-related questions during interviews conducted at their homes or the primary health care units they frequented between March and June 2011.

Sociodemographic variables were gender (male, female); age in years (60-69; 70-79; 80-89; 90 or more); education level (never attended school, incomplete elementary school, elementary school, high school, higher education); family income per member (continuous variable); and skin color (white, black, and brown).

Exploratory factor analysis, namely Principal Component Analysis (PCA), was used to extract and interpret dietary patterns from the dietary information collected by the FFQ.

We used a Food Frequency Questionnaire (FFQ) with 71 food items, referring to previous year, with response options in consumption frequencies ranging from "never" to "10 times" for units of time "day", "week", "month" and "year", and a field to mark the usual individual portion relative to a middle portion indicated for each food. But to simplify data collection and analysis, only the intake frequency was collected, not the amount consumed. All intake frequencies (per day, week, month, and year) were converted to daily intake frequency (frequency numerator divided by the number of days in the frequency denominator), and this value was used in factor analysis.

Then were withdrawn from the FFQ food items whose frequency of consumption did not apply to this type of qualitative analysis, since these were foods with more quantitative importance in the diet of individuals. The excluded items were: common oils, salad dressings, table salt added to salads, seasoning, and table sugar/honey/fruit preserves. Therefore, PCA included only 66 of the 71 FFQ food items.

The following stages of principal component analysis were performed as suggested by Olinto[6]: using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett test of sphericity for assessing the appropriateness of using PCA; preparing the correlation matrix; extracting a set

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of factors from the correlation matrix; determining the number of factors; rotating the factors to ease their interpretation; naming the eating patterns.

Individual food intakes were scored to improve the understanding of the distribution of these eating patterns in the study population, resulting in factor scores, which are estimated composite measures for each individual in each factor (eating pattern) extracted by factor analysis[15]. These scores were divided into tertiles: the first tertile included individuals with low adherence to an eating pattern; the second tertile included individuals with moderate adherence to an eating pattern; and the third tertile included individuals with high adherence to an eating pattern.

Bivariate analyses (Chi-square test) checked how the adherence tertiles related to the sociodemographic variables (gender, age group, skin color, and education level). Multiple logistic regression analysis adjusted for gender and education level, both identified as confounding variables, measured the association between family income per member and adherence tertiles. The Odds Ratios (OR) were calculated with a Confidence Interval of 95% (95%CI) and a significance level of 5% (p<0.05) for the statistical tests.

The software Statistical Analysis System (SAS) version 9.2 for Windows performed the statistical treatments.

This study was approved by the Research Ethics Committee of School of Medicine of *Botucatu, Universidade Estadual Paulista Júlio de Mesquita Filho* (Unesp), under Protocol number 3560/2010.

RESULTS

Characteristics of the study population

The study sample consisted of 355 individuals aged 60 years or more. Of these, 163 (45.9%) were males and 192 (54.1%) were females, percentages close to those reported by the Brazilian Census of 2010[16] (42.7% males and 57.3% females), indicating that this sample is representative of the municipal population.

The participants' ages varied from 60 to 92 years. The mean age and Standard Deviation were 69.5±7.73 years. This population had a mean family income per member of 1.76 minimum salaries.

Identification of the eating patterns

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (0.636) and Bartlett test of sphericity (p<0.000) indicated the appropriateness of factor analysis for analyzing the data.

Analysis of the 66 study food items resulted in 28 factors with eigenvalues greater than one, which explained 67.44% of the variability of the 66 original items. However, this elevated number of factors hindered data interpretation and characterization because many food items in many factors were loaded, and some factors had less than three food items.

The scree plot showed that the six factors above the "elbow" in the plot were appropriate for factor analysis because they explained 25.89% of the variability of the 66 original food items. Based on this datum, the factors were re-extracted, resulting in six factors that improved interpretation coherence.

Only the items with a factor loading greater than 0.3 were maintained in the matrix, as suggested by Hair *et al.*[15].

Varimax rotation was used to extract the six factors.

Table 1 shows the food items, their factor loadings, their communalities, and the percentage of explained variance by each factor after Varimax rotation. Factor loadings greater than 0.3 are highlighted. Only the food items with a factor loading above 0.3 in at least one factor were included in the table.

The food items with factor loading above 0.3 in more than one factor were maintained according to their original factor loadings, except for those with negative values. The food items

Table 1. Factor loading matrix, solutions of six factors for older adults from *Botucatu* (SP), Brazil, 2011.

Variables	Factors						
	1	2	3	4	5	6	Commonality
Soup	0.18886	-0.01929	0.00995	0.10890	**0.58335**	-0.19785	0.42743598
Deep-fried savory snack	-0.09431	**0.38677**	0.07355	-0.17669	-0.05896	-0.10341	0.20928645
Baked savory snack	-0.00492	**0.41349**	0.01932	0.05400	0.03444	-0.06528	0.17973793
Pasta with meat	-0.04553	**0.35786**	0.02374	0.06349	0.09663	0.14525	0.16516339
Pizza/pancake	0.08745	**0.47204**	-0.07935	0.08443	-0.15561	-0.14376	0.28877716
Polenta	0.07114	0.01600	-0.06945	-0.16111	**0.30953**	-0.02068	0.13233529
Pork	0.18624	0.14658	-0.04074	**-0.40018**	-0.19753	-0.04525	0.25904567
Bacon/jerky	0.01870	**0.39987**	-0.05000	0.14124	-0.10720	-0.02335	0.19473225
Sausages	-0.09966	0.24777	0.02116	**-0.36038**	0.01080	0.24854	0.26353317
Other processed meats	-0.00460	**0.60340**	0.02853	-0.05810	-0.05810	-0.25292	0.43774218
Patties/nuggets/meatballs.	0.13372	**0.38924**	-0.02059	-0.11578	0.04145	0.06769	0.18951889
Seafood	**0.38755**	0.01162	0.14022	-0.10567	-0.10836	-0.08559	0.20022526
Whole milk	-0.10789	-0.06409	0.01195	-0.24047	**0.34172**	0.05863	0.19392623
Milk, semi/skimmed	0.08115	-0.01817	0.07173	**0.58645**	-0.12542	-0.05171	0.37438581
Yellow cheeses	0.10085	**0.50186**	0.09554	-0.07658	-0.24799	-0.21173	0.38335648
Beans	-0.03858	-0.16888	-0.09772	-0.18950	0.00077	**0.57362**	0.40451007
White rice	0.00298	0.03289	-0.08930	-0.28656	-0.01832	**0.61393**	0.46843146
French or cassava fries	-0.09373	**0.33141**	-0.06265	-0.19838	0.02430	-0.00156	0.16248962
Cooked potato/cassava	0.16580	-0.00961	0.11770	0.08603	**0.65393**	-0.16336	0.50314769
Potato salad w/mayonnaise	0.09463	**0.35493**	0.02470	0.03715	0.08421	0.29638	0.23185233
Lettuce	**0.43882**	-0.00835	-0.00910	0.19890	-0.05116	**0.32017**	0.33740423
Tomato	**0.47015**	0.08009	0.04118	0.21302	0.00975	**0.30598**	0.36825020
Carrot	**0.54347**	0.05159	0.03115	0.18109	**0.33932**	-0.10287	0.45751082
Other non-starchy vegetables	**0.64190**	0.00928	0.05913	-0.10230	0.25369	-0.05602	0.49357503
Other raw leaf vegetables	**0.66238**	0.01562	0.21746	-0.09040	-0.01996	-0.01934	0.49522289
Other cooked leaf vegetables	**0.55270**	-0.00664	0.10540	-0.03644	0.04018	0.11113	0.33192789
Broccoli/cabbage/cauliflower	**0.62533**	-0.12436	0.09394	0.08992	0.12417	0.04772	0.44110494
Orange	0.04776	-0.00395	**0.42152**	0.11189	0.02761	0.01049	0.19337064
Banana	-0.01758	0.01653	**0.38011**	0.19003	0.22355	0.10814	0.24284694
Apple	0.12455	-0.01164	**0.54907**	0.23143	-0.19282	-0.06871	0.41258776
Melon	0.28500	-0.00633	**0.44710**	-0.01969	0.01855	-0.01894	0.28225539
Papaya	0.27553	-0.02270	**0.58547**	0.14700	-0.14838	-0.21073	0.50724502
Guava	0.11717	-0.03453	**0.68944**	-0.00900	-0.06454	-0.10794	0.50614241
Avocado	0.16233	-0.10929	**0.71030**	-0.19347	-0.13020	0.00486	0.59723062
Fruit juice w/added sugar	0.13810	0.00082	-0.01736	-0.17100	0.28098	**-0.42054**	0.30441870
Coffee w/o added sugar	0.08060	0.00494	0.26805	0.16984	**-0.36358**	0.08755	0.24707542
Coffee w/added sugar	-0.19107	0.00124	-0.13042	**-0.37337**	0.27129	-0.06656	0.27095361
Conventional soda	-0.18317	**0.37142**	-0.05635	-0.03979	0.01607	0.06702	0.18101517
Bread roll	-0.25351	**0.35843**	0.13324	-0.02916	**0.39359**	0.29032	0.45053886
Conventional butter	-0.11190	**0.38085**	0.26102	0.26975	0.29752	0.26254	0.45590910
Desserts	0.03405	**0.33373**	0.07418	0.03276	0.11768	0.08999	0.14105578
Oatmeal	**0.32436**	0.00925	0.18084	**0.32941**	-0.00916	-0.17134	0.27594809
Extra-virgin olive oil	**0.50458**	0.15005	0.11387	**0.31180**	-0.16229	-0.12678	0.42971110
Fruit juice w/o added sugar	0.09911	-0.04062	-0.04208	**0.38553**	0.02591	-0.09723	0.17200329
Whole bread	0.18013	0.02284	0.08350	**0.45993**	**-0.30313**	-0.07047	0.34833032
Number of items	10	14	7	8	8	5	
% explained variance	7.65%	4.74%	4.17%	3.43%	3.10%	2.80%	

Note: Factor loadings greater than 0.3 are highlighted.

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with negative factor loadings were excluded to maintain the foods that are actually consumed in the eating patterns.

The name of each factor (eating pattern) was based on two criteria: first, the nutritional and functional characteristics of the foods; and second, characteristics of the food items with the greatest factor loadings.

The six eating patterns are:

1. Healthy: other raw leaf vegetables; other non-starchy vegetables; broccoli/cauliflower/cabbage; other cooked leaf vegetables; carrot; extra-virgin olive oil; tomato; lettuce; seafood; oatmeal.

2. Snacks and weekend meal: sausages; yellow cheeses; pizza/pancake; baked savory snacks; bacon/jerky; meat patties/chicken nuggets/meatballs; deep-fried savory snacks; conventional butter; conventional soda; bread roll; pasta with meat; potato salad with mayonnaise; desserts/sweets; French fries/cassava fries.

3. Fruits: avocado; guava; papaya; apple/pear; melon/watermelon; orange/mandarin orange/pineapple; banana.

4. Light and whole foods: skimmed/semi-skimmed milk; whole bread; fruit juice without added sugar; oatmeal; extra-virgin olive oil.

5. Soft diet: cooked potatoes/cassava; soup; bread roll; whole milk; carrot; *polenta* (cornmeal boiled into a paste and eaten as is or baked, fried, or grilled).

6. Traditional: white rice; beans; lettuce; tomato.

Distribution of eating pattern adherence

Table 2 shows the logistic regression results for the association between family income per member and eating patterns, and Tables 3, 4, and 5, the distribution of the eating pattern adherences according to the demographic characteristics.

Table 2 shows that income prevents adherence to the patterns 1. Healthy (p=0.0083; OR=0.825; 95%CI=0.715-0.952); 3. Fruits (p=0.0377; OR=0.864; 95%CI=0.752-0.992); and 4. Light and whole foods (p<0.0001; OR=0.704; 95%CI=0.598 -0.829); and that income promotes adherence to the patterns 2. Snacks and weekend meals (p<0.0001; OR=1.674; 95%CI=1.393-2.011); and 5. Soft diet (p=0.0059; OR=1.223; 95%CI=1.060-1.411).

Table 3 shows that high adherence to the eating pattern 1. Healthy prevailed in individuals with incomplete or complete elementary school, and low adherence prevailed in individuals with a high education level (p=0.0017); high adherence to the pattern 2. Snacks and weekend meal prevailed in males (p=0.0095) and individuals with higher education (p<0.0001).

Table 4 shows that high adherence to the pattern 3. Fruits prevailed in whites (p=0.0004)

Table 2. Multiple logistic regression analysis* for the association between family income per member and the dietary patterns of older adults from *Botucatu* (SP), Brazil, regarding the highest adherence tertile, 2011.

Dietary patterns	Family income per member			
	Estimate	Standard error	*p*-value*	OR (95%CI)
1. Healthy	-0.1924	0.0729	0.0083	0.825 (0.715-0.952)
2. Snacks and weekend meal	0.5150	0.0937	<0.0001	1.674 (1.393-2.011)
3. Fruits	-0.1467	0.0706	0.0377	0.864 (0.752-0.992)
4. Light and whole foods	-0.3507	0.0831	<0.0001	0.704 (0.598-0.829)
5. Soft diet	0.2010	0.0730	0.0059	1.223 (1.060-1.411)
6. Traditional	-0.0429	0.0680	0.5286	0.958 (0.838-1.095)

Note: *Logistic model adjusted for gender and education level obtained by full model maintaining all the variables of interest.
OR: *Adjusted Odds Ratio*; 95%CI: Confidence Interval of 95%.

Table 3. Distribution of adherence to the eating patterns 1-Healthy and 2-Snacks and weekend meal according to sociodemographic characteristics of older adults from *Botucatu* (SP), Brazil. 2011.

Variables	Pattern 1. Healthy							
	Low Adherence		Moderate		High		n	p^*
	n	%	n	%	n	%		
Gender								0.1527
Male	61	37.42	54	33.13	48	29.45	163	
Female	57	29.69	61	31.77	74	38.54	192	
Age group								0.2987
60-69	56	28.57	66	33.67	74	37.76	196	
70-79	42	36.84	39	34.21	33	28.95	114	
80-89	18	46.15	8	20.51	13	33.33	39	
90 or more	2	33.33	2	33.33	2	33.33	6	
Skin color								0.4062
White	97	32.33	100	33.33	103	34.33	300	
Black	7	36.84	3	15.79	9	47.37	19	
Brown	12	37.50	12	37.50	8	25.00	32	
Education level								0.0017
Never attended school	10	27.03	13	35.14	14	37.84	37	
Complete elementary school	8	20.00	5	12.50	27	67.50	40	
Middle school	20	32.79	21	34.43	20	32.79	61	
High school	64	36.99	59	34.10	50	28.90	173	
Higher education	16	36.36	17	38.64	11	25.00	44	
Variables	Pattern 2. Snacks and weekend meal							
	Low Adherence		Moderate		High		n	p^*
	n	%	n	%	n	%		
Gender								
Male	40	24.54	58	35.58	65	39.88	163	0.0095
Female	75	39.06	62	32.29	55	28.65	192	
Age group								
60-69	66	33.67	64	32.65	66	33.67	196	0.5614
70-79	30	26.32	42	36.84	42	36.84	114	
80-89	16	41.03	13	33.33	10	25.64	39	
90 or more	3	50.0	1	16.67	2	33.33	6	
Skin color								
White	105	35.0	99	33.00	96	32.00	300	0.1133
Black	2	10.53	7	36.84	10	52.63	19	
Brown	7	21.88	12	37.50	13	40.63	32	
Education level								
Never attended school	23	62.16	11	29.73	3	8.11	37	<0.0001
Complete elementary school	23	57.50	8	20.00	9	22.50	40	
Middle school	18	29.51	26	42.62	17	27.87	61	
High school	43	24.86	64	36.99	66	38.15	173	
Higher education	8	18.18	11	25.00	25	56.82	44	

Note: *p-value for the Chi-square test.

and individuals with incomplete or complete elementary school, and the lowest adherence was found in those with higher education (p=0.0027). High adherence to the pattern 4. Light and whole foods prevailed in females (p=0.0007).

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Table 4. Distribution of adherence to the eating patterns 3. Fruits and 4. Light and whole foods according to sociodemographic characteristics of older adults from *Botucatu* (SP), Brazil. 2011.

Variables	Pattern 3. Fruits							
	Adherence						n	p^*
	Low		Moderate		High			
	n	%	n	%	n	%		
Gender								0.3710
Male	49	30.06	53	32.52	61	37.42	163	
Female	68	35.42	65	33.85	59	30.73	192	
Age group								0.5614
60-69	66	33.67	59	30.10	71	36.22	196	
70-79	36	31.58	42	36.84	36	31.58	114	
80-89	14	35.90	13	33.33	12	30.77	39	
90 or more	1	16.67	4	66.67	1	16.67	6	
Skin color								0.0004
White	90	30.00	100	33.33	110	36.67	300	
Black	8	42.11	11	57.89	0	0.00	19	
Brown	18	56.25	5	15.63	9	28.13	32	
Education level								0.0027
Never attended school	9	24.32	9	24.32	19	51.35	37	
Complete elementary school	7	17.50	12	30.00	21	52.50	40	
Middle school	21	34.43	16	26.23	24	39.34	61	
High school	59	34.10	65	37.57	49	28.32	173	
Higher education	21	47.73	16	36.36	7	15.91	44	

Variables	Pattern 4. Light and whole foods							
	Adherence						n	p^*
	Low		Moderate		High			
	n	%	n	%	n	%		
Gender								
Male	70	42.94	40	24.54	53	32.52	163	0.0007
Female	48	25.00	75	39.06	69	35.94	192	
Age group								
60-69	77	39.29	54	27.55	65	33.16	196	0.2009
70-79	29	25.44	45	39.47	40	35.09	114	
80-89	10	25.64	14	35.90	15	38.46	39	
90 or more	2	33.33	2	33.33	2	33.33	6	
Skin color								
White	96	32.00	99	33.00	105	35.00	300	0.1346
Black	5	26.32	6	31.58	8	42.11	19	
Brown	17	53.13	9	28.13	6	18.75	32	
Education level								
Never attended school	8	21.62	9	24.32	20	54.05	37	0.0516
Complete elementary school	9	22.50	12	30.00	19	47.50	40	
Middle school	20	32.79	20	32.79	21	34.43	61	
High school	63	36.42	63	36.42	47	27.17	173	
Higher education	18	40.91	11	25.00	15	34.09	44	

Note: $^*p$-value for the Chi-square test.

Table 5 shows that high adherence to the pattern 5. Soft diet prevailed in females (p=0.0484) and in the oldest individuals (p=0.0003). No socioeconomic or demographic

characteristic was associated with the pattern 6. Traditional, confirming its highly homogeneous distribution: most of its components are consumed habitually by most older adults.

Table 5. Distribution of adherence to the eating patterns 5. Soft diet and 6. Traditional according to sociodemographic characteristics of older adults from *Botucatu* (SP), Brazil. 2011.

Variables	Pattern 5. Soft diet							
	Low Adherence		Moderate		High		n	p^*
	n	%	n	%	n	%		
Gender								0.0484
Male	62	38.04	56	34.36	45	27.61	163	
Female	56	29.17	60	31.25	76	39.58	192	
Age group								0.0003
60-69	74	37.76	70	35.71	52	26.53	196	
70-79	37	32.46	37	32.46	40	35.09	114	
80-89	6	15.38	9	23.08	24	61.54	39	
90 or more	1	16.67	0	0.00	5	83.33	6	
Skin color								0.6374
White	104	34.67	95	31.67	101	33.67	300	
Black	6	31.58	7	36.84	6	31.58	19	
Brown	7	21.88	11	34.38	14	43.75	32	
Education level								0.0781
Never attended school	20	54.05	9	24.32	8	21.62	37	
Complete elementary school	18	45.00	12	30.00	10	25.00	40	
Middle school	21	34.43	21	34.43	19	31.15	61	
High school	47	27.17	59	34.10	67	38.73	173	
Higher education	12	27.27	15	34.09	17	38.64	44	

Variables	Pattern 6. Traditional							
	Low Adherence		Moderate		High		n	p^*
	n	%	n	%	n	%		
Gender								
Male	53	32.52	48	29.45	62	38.04	163	0.3027
Female	65	33.85	68	35.42	59	30.73	192	
Age group								
60-69	69	35.20	62	31.63	65	33.16	196	0.4511
70-79	37	32.46	42	36.84	35	30.70	114	
80-89	11	28.21	11	28.21	17	43.59	39	
90 or more	1	16.67	1	16.67	4	66.67	6	
Skin color								
White	99	33.00	99	33.00	102	34.00	300	0.8821
Black	5	26.32	6	31.58	8	42.11	19	
Brown	12	37.50	11	34.38	9	28.13	32	
Education level								
Never attended school	12	32.40	10	27.03	15	40.54	37	0.3242
Complete elementary school	16	40.00	7	17.50	17	42.50	40	
Middle school	15	24.50	23	37.70	23	37.70	61	
High school	59	34.10	63	36.42	51	29.48	173	
Higher education	16	36.30	13	29.55	15	34.09	44	

Note: $^*p$-value for the Chi-square test.

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DISCUSSION

The various dietary patterns found by the present study show that this population has different dietary preferences. Unlike findings made in Brazil some years ago, older adults are not limiting their diets to a monotonous list of foods mostly consisting of Brazilian staples, like rice and beans. The study sample also adhered to other patterns that may reflect the local culture (characterized by the intake of pasta, potato salad with mayonnaise, and desserts on weekends), the Western diet (high in carbohydrates and fats), specific situations (like intake of healthier or diet/light foods), and chewing difficulties (such as the soft diet, high in soft, cooked foods).

The eating pattern 5. Soft diet contains foods consumed mostly by women and the oldest adults.

An eating pattern containing easy-to-chew and pureed foods is expected in studies of very old individuals either because of affordability, ease of preparation, poor masticatory ability due to dentures, or even swallowing problems caused by certain diseases.

A qualitative analysis of the habitual diet of 308 older adults seen at a geriatric service of *São Paulo* found a high intake of vegetables and attributed the finding to the intake of soups; soups are frequently consumed by older adults and vegetables are their main ingredient[17].

The last national food intake survey conducted by the *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute of Geography and Statistics), the 2008-2009 *Pesquisa de Orçamentos Familiares* (POF, Family Budget Survey), found that older adults consume more whole milk than other adults and adolescents[18].

The eating pattern 6. Traditional was given this name because of the presence of rice and beans, staples of the Brazilian diet, and because of the similarity between this pattern and other patterns found in Brazilian studies given this same name[19,20]. Moreover, lettuce and tomato were correlated with these two traditional items, placing them in the same eating pattern and confirming the preference of the study sample for lettuce and tomato salad.

A study investigated the meals consumed at home in the city of *São Paulo*[21] and found that the most common meal consisted of rice, pinto beans, main course (meat or eggs), French fries, and lettuce and tomato salad. Although the authors refer specifically to *São Paulo* city's cuisine, the components of this meal are very similar to those of the pattern 6-Traditional consumed by older adults from *Botucatu* (SP).

The eating pattern 2. Snacks and weekend meal was also found in the study population and consisted of foods high in carbohydrates and saturated and trans fats.

This eating pattern reflects the regional tradition of eating pasta, potato salad with mayonnaise, and dessert, usually on weekends with the family; and the modern practice of consuming fast foods, also on weekends and in the company of others. The participants who preferred this pattern were usually males with higher education levels and better income.

Instituto Brasileiro de Geografia e Estatística's 2008-2009 POF also confirms that individuals from the highest socioeconomic classes consume more soda, baked and deep-fried savory snacks, pizzas, sweets, and ham[18].

Another eating pattern identified herein was the 1. Healthy pattern, containing foods high in fiber, monounsaturated fatty acids, and phenolic compounds; low in energy density and fat content; and with omega-3 fatty acids.

Income was reversely associated with adherence to the 1. Healthy pattern. High adherence to this eating pattern was found in individuals with incomplete or complete elementary school, and low adherence in those with high education level. These results oppose those of other Brazilian studies[18,22].

Alves *et al.*[22] identified the eating patterns of adult women from *Rio Grande do Sul* and found that healthy patterns prevailed in women with higher family income per member and education level.

The 2008-2009 POF found that individuals with higher incomes consume more raw leaf vegetables[18].

This contradictory result requires future studies to determine the eating patterns of individuals with low income and education level from *Botucatu* (SP), since some resident-related characteristics, such as the habit of fishing and maintaining community gardens in the city's outskirts, may promote the intake of healthy foods (eating pattern 1. Healthy).

Some 2008-2009 POF findings corroborate the study finding of an inverse relationship between income and the intake of some healthy foods. According to this national survey, low-income individuals present a higher intake of many food items considered healthy besides rice and beans, such as fish, salted fish, and sweet potato[18].

The eating pattern 3. Fruits identified herein consisted only of fruits. High adherence to this pattern prevailed in whites and those with incomplete and complete elementary school education. Similarly to the eating pattern 1. Healthy, higher income reduces an individual's likelihood of adhering to the 3. Fruits pattern.

Additionally, fruits were not in the same pattern as non-starchy vegetables and other healthy foods, possibly because their intake was not sufficiently correlated with that of non-starchy vegetables and other foods.

Perozzo *et al.*[23] also found that fruits and non-starchy vegetables occurred in different eating patterns of adult women from *Rio Grande do Sul*.

The pattern 4. Light and whole foods seems to be preferred by health-conscious individuals who try to prevent or improve health problems. Adherence to this pattern prevailed in women, but decreased with income.

Generally, the inverse relationship between family income per member and the intake of light and whole foods is unexpected because this pattern contains some items that cost more, such as extra-virgin olive oil and whole bread. However, foods consumed mainly by people who are trying to lose weight or control blood sugar, like oatmeal, skimmed milk, and fruit juice, are not necessarily expensive.

The present study implemented some measures to reduce the number of bias sources, such as interviewer training and the establishment of participant inclusion and exclusion criteria. Nevertheless, not all bias sources can be fully eliminated.

The occurrence of bias cannot be discarded because individuals aware of the positive and negative effects of foods can overestimate or underestimate their intake. There is also memory bias, since these individuals are older and may have difficulties remembering what they ate, requiring longer interviews and careful question wording.

The type of instrument used, the FFQ, assessed a long intake period (one year), which also contributes to memory bias. To reduce memory bias, the interviews focused only on intake frequency, giving the participants more time to think and answer more accurately.

The Food Frequency Questionnaire seems to have an inherent reporting error effect because it tends to overestimate the intake of non-starchy vegetables when compared with other food intake assessment instruments[24]. However, Hu *et al.*[25] compared two eating patterns called prudent and Western, extracted from a FFQ and a 24-hour recall (considered the instrument of reference), and found that the two patterns extracted from the FFQ were comparable to those extracted from the 24-hour recall.

Researchers widely recognize the subjective nature of factor analysis for determining eating patterns, so they must decide how many and what types of patterns will be derived and analyzed. This calls for thorough detailing of the study methods. To minimize

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subjectivity, the present study selected the best solution, which entails keeping the factors above the "elbow" in the scree plot, representing the optimal number of factors. The role of the researcher is to determine the interpretability of the factors selected by statistical methods and then define which solution is closest to the actual dietary patterns of the study participants.

Another limitation related to eating patterns derived by factor analysis regards their low stability and the high specificity of the results. These characteristics hinder comparisons between studies. Even so, this technique enables expressing the actual intake of the study population and provides useful information for the development of intervention measures[8].

Although dietary pattern particularities vary between populations, many similarities can be found between certain patterns. Newby *et al.*[26] suggests that similarity may stem from the good consistency of the dietary patterns determined by factor analysis, suggesting that they can be reasonably reproduced.

Since a golden standard for identifying dietary patterns does not yet exist, the present study, which used exploratory factor analysis, should be the starting point for future validation studies that investigate other methods of dietary pattern derivation.

CONCLUSION

A population of older adults has a diversity of dietary patterns that are often associated with specific sociodemographic characteristics.

Dietary assessment of these older adults resulted in six eating patterns that coherently reproduced the different dietary characteristics of Botucatu's older population and revealed the food preferences of some older adult subgroups.

The study findings can be the starting point for the development of more effective primary care measures that promote healthy eating habits because the study sample represents users of the primary health care network.

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CONTRIBUTORS

PM FERREIRA project design and execution, data analysis and interpretation, article writing and critical review, and approval of the final version of the article. SJ PAPINI critical review and approval of the final version. JE CORRENTE data analysis and interpretation, article writing and critical review, and approval of the final version of the article.

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Factors associated with exclusive breastfeeding in the Legal Amazon and Northeast regions, Brazil, 2010

Fatores associados ao Aleitamento Materno Exclusivo na Amazônia Legal e no Nordeste, Brasil, 2010

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ABSTRACT

Objective

The objective of this study was to identify the factors associated with exclusive breastfeeding in children aged less than six months from the Brazilian Legal Amazon and Northeast regions.

Methods

The study used data from a survey that assessed prenatal and infant (<1 year) care in 2010. Sociodemographic, prenatal, delivery, and puerperium care factors with $p<0.05$ in multivariate analysis were associated with exclusive breastfeeding.

Results

For both regions, the prevalence of exclusive breastfeeding decreased with age, which was the main variable associated with early weaning. In the Legal Amazon, exclusive breastfeeding prevailed among: mothers aged 35 years or more; mothers living in state capitals; and mothers who breastfed on the first hour of life. In the Northeast, the probability of exclusive breastfeeding was greater for mothers aged 35 years or more.

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Conclusion

The factors associated with exclusive breastfeeding were child's and mother's age in both regions; and residence location and breastfeeding in the first hour of life in the Legal Amazon, suggesting the need of differentiated strategies for the promotion of exclusive breastfeeding.

Indexing terms: Breast feeding. Epidemiologic factors. Epidemiology. Infant.

RESUMO

Objetivo

O objetivo foi identificar fatores associados ao aleitamento materno exclusivo em crianças menores de seis meses de idade, residentes na Amazônia Legal e no Nordeste do Brasil, com base nos dados da pesquisa de avaliação da atenção ao pré-natal e aos menores de um ano de idade em 2010.

Métodos

Consideraram-se fatores associadas ao aleitamento exclusivo as variáveis sociodemográficos e de assistência ao pré-natal, parto e puerpério que mantiveram p<0,05 em análise multivariada.

Resultados

Em ambas as regiões, a prevalência de aleitamento materno exclusivo apresentou declínio com aumento da idade da criança, que se configurou na principal variável associada ao desmame precoce. Na Amazônia Legal, a probabilidade de aleitamento materno exclusivo foi maior para: mães com 35 ou mais anos de idade, mães que residiam nas capitais dos estados e mães que amamentaram na primeira hora de vida da criança. No Nordeste, a probabilidade de aleitamento materno exclusivo também foi maior para mães com 35 ou mais anos de idade.

Conclusão

Os fatores associados ao aleitamento materno exclusivo foram idade da criança e idade da mãe nas duas regiões, localização de moradia e mamada na primeira hora na Amazônia Legal, o que sugere a necessidade de estratégias diferenciadas para a promoção do aleitamento materno.

Termos de indexação: *Aleitamento materno. Fatores epidemiológicos. Epidemiologia. Lactente.*

INTRODUCTION

Exclusive breastfeeding is understood as feeding an infant breast milk only, either directly from a breast or extracted from the mother or a donor, and no other fluid or solid, except for vitamin, mineral, or medical drops or syrups[1]. The actions for promoting, protecting, and supporting breastfeeding are effective and inexpensive strategies against childhood morbidity and mortality[2]. The World Health Organization (WHO)[3] recommends exclusive breastfeeding for six months and non-exclusive breastfeeding for at least two years, and the Brazilian Ministry of Health (MH)[4] has supported the recommendation since 2001. Breastfeeding is closely related to the child's good nutritional and health statuses, and to greater resistance against infectious diseases, especially gastrointestinal infections.

Breastfeeding may reduce the preventable death rates of children less than five years of age by as much as 13% worldwide[5]. Although childhood mortality is decreasing in Brazil[6], reducing preventable deaths is a permanent challenge, and the rates represent a public health problem that affects Brazilian regions differently[7]. In the North and Northeast regions, these rates are still high, so in 2009 the Pact for Reducing Childhood Mortality was signed in the Northeast and Legal Amazon to reduce these regional inequalities. The pact has six cores, one of them being prenatal, delivery, and newborn care qualification[8].

Some Brazilian studies conducted at the end of the 20th century covering a period of 25 years already detected a gradual improvement in the breastfeeding practices of the children less

than one year of age, but the breastfeeding indicators varied significantly throughout the different geographic regions of the country[9,10]. Brazil has a high percentage of mothers who start breastfeeding their children (95.0%), but exclusive breastfeeding does not reach the ideal duration, being much smaller than the recommended six months. The 2006 *Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher* (PNDS, National Child's and Mother's Demographic and Health Survey)[11] found an exclusive breastfeeding rate of 38.6% in children less than six months of age, with the Northeast region having the lowest median: 1.1 months. The II Breastfeeding Prevalence Survey[12] conducted in 2008 in Brazilian capitals and *Distrito Federal* found an exclusive breastfeeding rate of 41.0% in children aged less than six months, with the highest and lowest prevalences occurring in the North (45.9%) and Northeast (37.0%) regions, respectively.

Given this landscape, investigation of the possible factors associated with exclusive breastfeeding in children aged less than six months is one of the requirements for promoting exclusive breastfeeding policies and programs, and identifying the occasions that most contribute to early weaning. The present study assesses this aspect in municipalities of the Legal Amazon and Northeast regions in 2010 using data from the survey "Neonatal Call: assessment of prenatal care and care of infants aged less than one year in the North and Northeast regions".

METHODS

This study is based on secondary data from the "Neonatal Call: assessment of prenatal care and care of infants aged less than one year in the North and Northeast regions" conducted in 2010 and approved by the Research Ethics Committee of *Escola Nacional de Saúde Pública Sérgio Arouca/Fundação Oswaldo Cruz* (Ensp/Fio Cruz). The cross-sectional study included mothers of children aged less than one year who received the multiple vaccines in 252 of the 256 primary municipalities of the Pact for Reducing Childhood Mortality[8]. The municipalities are located in nine states of the Legal Amazon (*Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Pará, Roraima, Rondônia, and Tocantins*) and in eight states of the Northeast region (*Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte*, and *Sergipe*).

The Neonatal Call used probabilistic sampling to select the children vaccinated in each planned domain: the capital of each state and all other municipalities of the state. The minimum sample size of each domain, 750 mother/child dyads, was estimated considering a delivery complication of 22.0%[13], an error ≤3.5%, a confidence coefficient ≥95.0%, and a design correlation factor (deff) ≤1.5, totaling 23,399 interviews. The mother/child dyads were selected by two-stage cluster sampling[14] and probability proportional to cluster size. The first stage randomly selected the main vaccination stands in each municipality; the second stage consisted of a systematic selection of mother/child dyads at each vaccination stand, according to the study inclusion criteria. Mothers of children aged more than one year, living in other municipalities, and whose children were twins and/or adopted were excluded. A total of 16,863 mothers of children aged less than one year were interviewed, corresponding to a 3.5% to 4.4% increase in the sampling error while maintaining all other sample-size calculation criteria fixed.

A pretested form with closed questions on demographic and socioeconomic characteristics was used for collecting the following data; prenatal, delivery, and puerperium care; and child's growth and feeding; among others.

The present study included only the mothers of children aged less than six months (n=9,090); 30 were excluded because of missing data about the child's diet so only 9,060 forms were valid. The study sample size conforms to the sampling error criteria of 2.2, confidence coefficient of 95.0%, deff=2.0, considering the real prevalence of the study outcome (exclusive

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breastfeeding prevalence of 39.9%), allowing stratification by region.

The study dependent variable was exclusive breastfeeding, classified as yes or no. The child was considered to be exclusively breastfed when the child was fed only breast milk and no other fluid or solid, as recommended by the WHO[1]. The 24-hour dietary recall was used to identify the breastfeeding and/or feeding practices. The questionnaire included questions about the intake of breast milk, other types of milk, and other foods, including water, tea, and other fluids in the previous 24 hours. Thus, the instrument indicates whether the child was exclusively breastfed in the 24 hours before the interview[15,16].

The independent variables were child's characteristics (age, gender, and birth weight); mother's sociodemographic characteristics (age, education level, skin color, and location of residence); prenatal care characteristics (attending prenatal care, prenatal care location, and advice on breastfeeding during prenatal care); delivery (type of delivery and delivery location); puerperium care (breastfeeding in the first hour of life, rooming-in, and recent visit from a health agent or Family Health Strategy agent).

The study sample distribution was assessed according to sociodemographic, and prenatal, delivery, and puerperium care variables (total and by region) with a Confidence Interval of 95% (95%CI). The exclusive breastfeeding prevalence was calculated for each month of the child's age with a 95%CI for all sociodemographic, prenatal, delivery, and puerperium variables, separately and by region, according to the Chi-square test (χ^2). The exclusive breastfeeding Prevalence Ratio (PR) and respective 95%CI were calculated and stratified by region (Legal Amazon and Northeast region) by Poisson Regression adjusted for all variables. The significance level was set at 5% (p<0.05).

All estimates take into consideration the study design, correcting for the clustering effect and giving individual weights proportional to sampling probability. The weighting factor according to the number of children aged less than one year of each municipality, according to the 2010 Census, was also considered (http://www.ibge.gov.br). The data were treated by the software Stata version 11.0, using the svy command, with a significance level of 5% (p<0.05) and 95%CI.

RESULTS

Of the 9,060 study children, 4,116 were from the Legal Amazon and 4,944 were from the Northeast regions; both groups had similar ages and gender distribution. Roughly 94% of the children in both regions had normal birth weight.

Most mothers from both regions were 20 to 34 years old, finished high school, were Black, lived in urban areas other than the capital, attended prenatal care at a public service, received breastfeeding advice during prenatal care, delivered at a public service, breastfed in the first hour of life, and were roomed-in with their child. In the Legal Amazon, most of the study mothers had not been visited by the health agent or Family Health Strategy agent, unlike the Northeast mothers who had (Attached 1).

The prevalence of exclusive breastfeeding on the first month of life was 72.0%, decreasing to 57.5%, 49.9%, 39.5%, 24.4%, and 11.6% from the second to the sixth months in the study Legal Amazon municipalities. In the Northeast region, exclusive breastfeeding also decreased, reaching 13.3% at six months of age but starting at 66.3%. The prevalence of exclusive breastfeeding in the Northeast sample was statistically lower than that in the Legal Amazon sample, but equal when compared on a monthly basis (Figure 1).

In the Legal Amazon municipalities, the prevalence of exclusive breastfeeding was greater among older women, reaching 48.1% in mothers aged more than 35 years; in those who breastfed the child in the first hour of life; and in those who had not been visited recently by a health agent or Family Health Strategy agent (p<0.05).

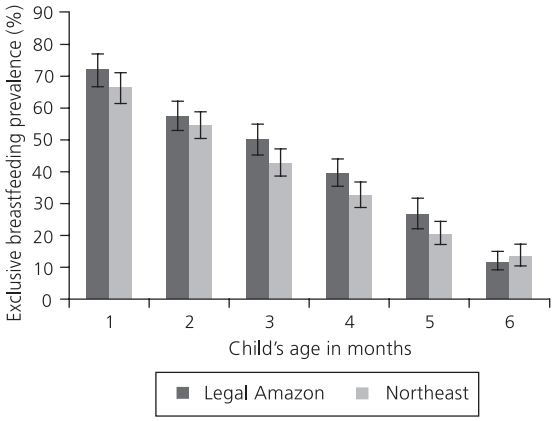

Figure 1. Distribution of the prevalence of exclusive breastfeeding and confidence interval of 95% according to the child's age in months. Children younger than six months of age living in the study municipalities of the Legal Amazon and Northeast regions. Brazil, 2010.

In the Northeast municipalities, the prevalence of exclusive breastfeeding increased with mother's age, reaching 45.6% in the mothers aged ≥35 years; in those who attended prenatal care; and in those who had been visited recently by a health agent or Family Health Strategy agent (p<0.05) (Attached 2).

Multivariate analysis identified the child's age as the main variable associated with early weaning in both regions (Attached 3). The mother's age comes next: children whose mothers are older than 34 years are 28% and 42% more likely to be exclusively breastfed in the Legal Amazon and Northeast regions, respectively, than those of mothers aged less than 20 years. Living in the State Capital (17%) and breastfeeding in the first hour of life (16%) were protective factors only in the Legal Amazon.

DISCUSSION

The objective of this study was to investigate the factors associated with exclusive breastfeeding in children aged less than six months from primary municipalities in the Legal Amazon and Northeast regions of Brazil, since the literature has indicated that early weaning is strongly influenced by geographic region[17]. This situation was confirmed by the present study: exclusive breastfeeding was associated with different factors in the two study regions. The variables associated with exclusive breastfeeding were: child's age, mother's age, location of residence, and breastfeeding in the first hour of life, but the associations varied by region.

The prevalence of exclusive breastfeeding in children aged less than six months found by the present study (39.9%) was similar to that found by the II Breastfeeding Prevalence Survey (41.0%), including variation by region[16]. In the present study, the prevalence of exclusive breastfeeding in the selected Northeast municipalities was lower in children aged less than six months, but equal to that of the Legal Amazon when compared by month, declining sharply with the child's age. The decreasing prevalence of exclusive breastfeeding with child's age was also observed by Pereira *et al.*[18] in a study of 1,029 mothers of children aged less than six months frequenting primary health care units in the city of *Rio de Janeiro*: the prevalence of breastfeeding decreased by 17.0% per month of the child's life.

One can see that, in Latin American countries, exclusive breastfeeding duration varies greatly. Data from demographic and health surveys show that the median breastfeeding duration of four months in Bolivia was much greater than the medians in Brazil (1.4 months), El Salvador (1.4 months), Dominican Republic (0.5 months), and Haiti (0.4 months), countries with the lowest medians[11,19].

The mother's age was strongly associated with exclusive breastfeeding in both regions. The prevalence of exclusive breastfeeding was greater among older mothers even after adjustment: higher mother's age was a protective factor for exclusive breastfeeding. These results are similar to those found by Venâncio & Monteiro[20] in a study of 34,435 children younger than six months of age from 111 municipalities in the state of *São Paulo*, which found that the duration of exclusive breastfeeding increased with mother's age until the age group of 25 to 29 years. Saldiva *et al.*[17]

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studied 18,929 children aged less than six months from the II National Breastfeeding Prevalence Survey and found that adolescent mothers (<age 20 years) were more likely to introduce porridge early.

Breastfeeding within the first hours after birth is important for breastfeeding maintenance, and is a recommendation of the Pan-American Health Organization[21]. After adjustment for all variables included in multiple analysis, the variable breastfed within the first hour after birth' remained in the model as a protective factor for children aged less than six months from the Legal Amazon region and the study state capitals.

Santos *et al.*[22] studied the factors associated with preventable deaths in children aged less than four years in a cohort born in *Rio Grande do Sul* and found that not being breastfed within the first 24 hours of life was associated with a higher risk of dying from preventable causes, even after adjustment for confounders. Not being breastfed in the first 24 hours of life reduces the prevalence of breastfeeding[23,24]. Although marginally, breastfeeding within the first hour of life is conceptually important and according to many studies, promotes breastfeeding. Therefore, promoting breastfeeding in the first 24 hours after delivery it is an essential prenatal care activity.

In adjusted data from household surveys on mother mother/child nutrition in the State of *Pernambuco*, Carminha *et al.*[25] found that living in the Metropolitan Region of *Recife* promoted exclusive breastfeeding. Living in the state capital strongly indicates access to health services and strategies that promote and encourage breastfeeding. On the other hand, Ramos *et al.*[23] and Demétrio *et al.* [26] pointed out that living in an urban area hinders breastfeeding.

Integrated actions covering prenatal care, delivery care, and post-delivery support work together to improve the quality of care provided to women who breastfeed[27].

Demétrio *et al.*[26] in a cohort from municipalities in the *Recôncavo* Region of *Bahia*, (BA) found that the median duration of exclusive breastfeeding is proportionally smaller in women who do not attend prenatal care. During prenatal care health professionals have a positive influence on breastfeeding duration, both as breastfeeding educators and promoters. In this study, the Northeast region presented the highest prevalence of exclusive breastfeeding among mothers who attended prenatal care. However, after adjustment for the confounders, this association lost significance.

According to the WHO, health agents increase exclusive breastfeeding duration more effectively than any other professional[28]. However, the present study found that exclusive breastfeeding prevalence was higher in both regions among mothers who had not been recently visited by Family Health Strategy professionals. After adjustment in multiple analysis, this factor was not associated with breastfeeding prevalence. Studies that assessed Family Health Strategy teams' knowledge about breastfeeding found that although the professionals were well informed about the advantages of breastfeeding, few knew how to manage breastfeeding appropriately in the clinical setting[29-31]. Hence, one has to assess the efficacy of these actions, since so far they have not been enough to promote exclusive breastfeeding in the two study regions.

The main variable associated with exclusive breastfeeding was child's age: in the second month, there was a 20% risk of introducing other foods; in the sixth month, the risk increased to 80%. Considering that the country has been advancing breastfeeding since 1981 with different breastfeeding-promoting actions, the data shown herein are concerning despite the increase in exclusive breastfeeding duration from 23.4 days to 54.1 days between 1999 and 2008[16]. The Neonatal Call[32] identified a median exclusive breastfeeding duration of 64 days (76 in the Legal Amazon and 58 in the Northeast) in children aged less than six months, confirming the exclusive breastfeeding prevalence curves shown in Attached 1.

However, this type of study is not enough to identify the causes of introducing foods early. The question is: why do mothers introduce foods early? Is it a cultural and/or social issue or is it encouraged by health professionals and/or services? Many variables associated with early weaning are cited in the literature and should be assessed by other types of studies, such as: lack of information about the importance of breastfeeding, overestimating the benefits of weaning foods, maternal work, cultural habits, and social representations, among others.

The main limitations of this study are: its cross-sectional nature does not allow differentiating between cause and effect; and the fact that data collection used a method subject to memory bias, despite its recognized advantages (the WHO warns that the 24 hours can overestimate the proportion of exclusively breastfed children since some children are given other fluids occasionally)[15,33]. The fact that the survey was conducted on the National Immunization Day (D-day) may also have been a limiting factor because it was not possible to survey a high percentage of the population on a single day: the vaccination period was extended, especially in hardly accessible regions, but this situation was somewhat remediated because surveys on vaccination day are still a widely used and recommended strategy in Brazil[34].

Although the study findings may represent the children from the study municipalities and other similar children, the 2.2% sampling error and 95.0%CI does not allow extrapolation to all children in the Brazilian Legal Amazon and Northeast regions.

CONCLUSION

In a heterogeneous country like Brazil, one should expect different regional breastfeeding practices, and this study confirmed that the factors associated with exclusive breastfeeding are influenced by the geographic region of the country. The factors associated with exclusive breastfeeding in children aged less than six months were child's age, mother's age, residence location, and being breastfed in the first hour of life, but distinctively by region.

Higher child's age was a risk factor for non-exclusive breastfeeding in both regions. In the study Legal Amazon municipalities, the probability of exclusive breastfeeding was greater among mothers aged 35 years or more. A similar situation was observed in the Brazilian Northeast. Breastfeeding in the first hour after birth and living in the state capital promote exclusive breastfeeding only in the Legal Amazon region.

These findings may be useful for defining differentiated breastfeeding promotion strategies according to the most common characteristics of each region. Strategies that should be assessed for promoting exclusive breastfeeding are the prenatal, delivery, and puerperal care that aim to reduce the early feeding of fluids or foods to children aged less than six months and to improve the processes that change hospital routines in the main maternity hospitals of the Legal Amazon and Northeast regions. Moreover, health professionals need to be better qualified with respect to managing exclusive breastfeeding until age six months as recommended by the WHO and MH, because of the strong reduction in the prevalence of exclusive breastfeeding.

CONTRIBUTORS

ACM NEVES helped to design the methods, tabulate the data, analyze the results, and write the manuscript. EC MOURA helped to design the methods, analyze the data, and review the manuscript. W SANTOS helped to tabulate the data and analyze the results. KMB CARVALHO helped to review the manuscript.

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ATTACHED 1

Sample distribution (n and %) and 95% confidence interval according to sociodemographic, prenatal, delivery, and puerperium variables. Study municipalities in the Legal Amazon and Northeast regions, Brazil, 2010

(1 of 2)

Variables	Region						Total		
	Legal Amazon			Northeast					
	n	%	95%CI	n	%	95%CI	n	%	95%CI
Child's age (months)									
0	543	13.1	(11.7-14.5)	626	12.2	(11.12-13.5)	1,169	12.6	(11.7-13.5)
1	778	18.9	(17.3-20.6)	960	20.7	(19.2-22.2)	1,738	20.0	(18.9-21.1)
2	735	18.0	(16.5-19.6)	889	17.4	(16.1-18.9)	1,624	17.7	(16.7-18.7)
3	750	18.1	(16.7-19.7)	890	18.2	(16.8-19.7)	1,640	18.2	(17.1-19.2)
4	646	16.6	(15.14-18.2)	773	15.7	(14.4-17.1)	1,419	16.1	(15.1-17.1)
5	664	15.3	(13.9-16.8)	806	15.8	(14.5-17.1)	1,470	15.6	(14.6-16.6)
Child's gender									
Male	2,122	51.4	(49.3-53.4)	2,492	50.9	(49.1-52.7)	4,614	51.1	(49.7-52.5)
Female	1,992	48.6	(46.6-50.7)	2,450	49.1	(47.3-50.9)	4,442	48.9	(47.5-50.3)
Child's birth weight									
Low	247	5.9	(5.0-6.9)	318	6.6	(5.7-7.5)	565	6.3	(5.7-7.0)
Normal	3,817	94.1	(93.1-95.0)	4,531	93.4	(92.5-94.3)	8,348	93.7	(93.0-94.3)
Mother's age (years)									
<20 years	899	22.2	(20.6-23.9)	984	20.6	(19.1-22.1)	1,883	21.2	(20.1-22.4)
20-34 years	2,905	71.4	(69.5-73.2)	3,424	70.0	(68.3-71.7)	6,329	70.6	(69.3-71.8)
≥35 years	270	6.4	(5.5-7.5)	458	9.4	(8.4-10.5)	728	8.2	(7.5-8.9)
Mother's education level									
0-7 years	1,070	26.9	(25.2-28.6)	1,342	26.9	(25.3-28.5)	2,412	26.9	(25.7-28.1)
8-10 years	1,266	31.6	(29.8-33.5)	1,357	28.2	(26.6-29.9)	2,623	29.6	(28.4-30.9)
≥11 years	1,745	41.5	(39.6-43.4)	2,200	44.9	(43.1-46.7)	3,945	43.5	(42.2-44.8)
Mother's race									
White	740	17.4	(16.0-19.0)	1,082	20.7	(19.3-22.1)	1,822	19.3	(18.3-20.4)
Brown/Black	3,210	79.0	(77.4-80.6)	3,667	76.3	(74.7-77.7)	6,877	77.4	(76.3-78.5)
Native/Yellow	147	3.5	(2.9-4.3)	175	3.1	(2.6-3.7)	322	3.3	(2.8-3.7)
Residence location									
Not capital	1,688	55.7	(55.7-55.7)	2,656	61.0	(61.0-61.0)	4,344	58.8	(58.8-58.8)
Capital	2,428	44.3	(44.3-44.3)	2,288	39.0	(39.0-39.0)	4,716	41.2	(41.2-41.2)
Prenatal care									
No	63	1.8	(1.3-2.5)	69	1.5	(1.1-2.0)	132	1.6	(1.3-2.0)
Yes	4,053	98.2	(97.5-98.7)	4,875	98.5	(98.0-98.9)	8,928	98.4	(98.0-98.7)
Prenatal service									
Public	3,254	82.5	(81.0-83.9)	3,852	80.1	(78.7-81.5)	7,106	81.1	(80.0-82.1)
Private	736	17.5	(16.1-19.0)	953	19.9	(18.5-21.3)	1,689	18.9	(17.9-20.0)
Prenatal advice on breastfeeding									
No	1,276	31.1	(29.3-33.0)	1,256	26.8	(25.2-28.4)	2,532	28.6	(27.4-29.8)
Yes	2,840	68.9	(67.0-70.7)	3,688	73.2	(71.6-74.8)	6,528	71.4	(70.2-72.6)
Delivery									
Surgical	1,923	47.7	(45.7-49.8)	2,398	49.1	(47.2-50.9)	4,321	48.5	(47.2-49.9)
Vaginal	2,048	52.3	(50.2-54.3)	2,376	50.9	(49.1-52.8)	4,424	51.5	(50.1-52.8)
Delivery facility									
Public	3,191	78.6	(77.0-80.1)	3,836	78.5	(77.0-80.0)	7,027	78.6	(77.5-79.6)
Private	783	19.3	(17.9-20.9)	883	19.1	(17.8-20.6)	1,666	19.2	(18.2-20.3)
Other	58	2.1	(1.5-2.8)	109	2.3	(1.9-2.8)	167	2.2	(1.9-2.6)

ATTACHED 1

Sample distribution (n and %) and 95% confidence interval according to sociodemographic, prenatal, delivery, and puerperium variables. Study municipalities in the Legal Amazon and Northeast regions, Brazil, 2010

(2 of 2)

Variables	Region						Total		
	Legal Amazon			Northeast					
	n	%	95%CI	n	%	95%CI	n	%	95%CI
Breastfeeding in the first hour of life									
No	1,198	30.8	(29.0-32.7)	1,780	40.1	(38.3-42.0)	2,978	36.3	(35.0-37.7)
Yes	2,755	69.2	(67.3-71.0)	2,980	59.9	(58.0-61.7)	5,735	63.7	62.3-65.0)
Rooming-in									
No	469	11.9	(10.6-13.5)	614	12.5	(11.3-13.8)	1,083	12.3	(11.4-13.3)
Yes	3,469	88.1	(86.5-89.4)	4,121	87.5	(86.2-88.7)	7,590	87.7	(86.7-88.6)
Recent visit from health/FHS agent									
No	2,229	54.9	(53.1-56.7)	2,189	45.6	(44.0-47.3)	4,418	49.5	(48.2-50.7)
Yes	1,834	45.1	(43.3-46.9)	2,708	54.4	(52.7-56.0)	4,542	50.5	(49.3-51.8)

Note: FHS: Family Health Strategy; 95%CI: Confidence Interval of 95% .

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ATTACHED 2

Exclusive breastfeeding prevalence (%) and 95% confidence interval according to sociodemographic. prenatal. delivery. and puerperium care. Study municipalities in the Legal Amazon and Northeast regions. Brazil, 2010

(1 of 2)

Variables	Region						Total		
	Legal Amazon			Northeast					
	%	95%CI	*p**	%	95%CI	*p**	%	95%CI	*p**
Child's age (months)			<0.001			<0.001			<0.001
0	72.0	(66.5-76.8)		66.3	(61.3-70.9)		68.7	(65.0-72.1)	
1	57.5	(52.8-62.0)		54.5	(50.3-58.7)		55.7	(52.5-58.8)	
2	49.9	(45.1-54.8)		42.7	(38.5-47.0)		45.7	(42.5-49.0)	
3	39.5	(35.3-43.9)		32.5	(28.6-36.6)		35.4	(32.5-38.4)	
4	26.4	(21.9-31.5)		20.4	(17.0-24.2)		23.0	(20.1-26.0)	
5	11.6	(9.0-14.8)		13.3	(10.3-17.1)		12.6	(10.5-15.1)	
Child's gender			0.595			0.310			0.267
Male	42.1	(39.3-44.9)		37.1	(34.7-39.7)		39.2	(37.3-41.1)	
Female	43.1	(40.3-46.0)		39.0	(36.5-41.5)		40.7	(38.8-42.6)	
Child's birth weight			0.736			0.116			0.133
Low	41.1	(33.2-49.5)		38.6	(36.7-40.5)		36.0	(31.0-41.4)	
Normal	42.6	(40.5-44.7)		32.8	(26.4-39.8)		40.2	(38.9-41.6)	
Mother's age (years)			0.014			0.004			<0.001
<20 years	37.4	(33.4-41.6)		33.5	(29.6-37.6)		35.2	(32.3-38.1)	
20-34 years	43.7	(41.3-46.1)		38.4	(36.3-40.6)		40.6	(39.0-42.2)	
≥35 years	48.1	(40.2-56.0)		45.6	(39.7-51.7)		46.4	(41.6-51.2)	
Mother's education level			0.409			0.114			0.064
0-7 years	40.3	(36.5-44.2)		35.7	(32.3-39.2)		37.6	(35.1-40.2)	
8-10 years	42.7	(39.1-46.2)		37.0	(33.8-40.4)		39.5	(37.1-42.0)	
≥11 years	43.7	(40.6-46.8)		40.1	(37.4-42.8)		41.5	(39.5-43.5)	
Mother's race			0.105			0.087			0.056
White	47.0	(42.2-51.9)		38.1	(34.3-42.1)		41.4	(38.4-44.5)	
Brown/Black	41.4	(39.2-43.7)		37.5	(35.4-39.5)		39.1	(37.6-40.7)	
Native/Yellow	45.0	(34.8-55.6)	0.074	48.5	(39.3-57.9)		46.9	(40.1-54.0)	
Residence location						0.680			0.312
Not capital	41.0	(37.9-44.2)		38.3	(35.8-40.9)		39.4	(37.4-41.4)	
Capital	44.5	(42.3-46.8)		37.6	(35.5-39.8)		40.7	(39.1-42.3)	
Prenatal care			0.537			<0.001			0.044
No	47.5	(32.2-63.4)		13.1	(6.5-24.5)		29.0	(20.2-39.8)	
Yes	42.5	(40.5-44.5)		38.4	(36.6-40.2)		40.1	(38.7-41.4)	
Prenatal service			0.845			0.127			0.303
Public	42.4	(40.2-44.7)		37.6	(35.5-39.6)		39.6	(38.1-41.1)	
Private	41.9	(37.5-46.5)		41.0	(37.1-45.0)		41.3	(38.4-44.4)	
Prenatal advice on breastfeeding			0.676			0.335			0.244
No	43.2	(39.7-46.8)		39.5	(36.1-42.9)		41.1	(38.7-43.6)	
Yes	42.3	(39.9-44.7)		37.5	(35.4-39.6)		39.4	(37.8-41.0)	
Delivery			0.662			0.087			0.113
Surgical	42.9	(40.0-45.9)		39.8	(37.2-42.4)		41.0	(39.1-43.0)	
Vaginal	42.0	(39.2-44.9)		36.6	(34.0-39.2)		38.8	(36.9-40.8)	

ATTACHED 2

Exclusive breastfeeding prevalence (%) and 95% confidence interval according to sociodemographic. prenatal. delivery. and puerperium care. Study municipalities in the Legal Amazon and Northeast regions. Brazil, 2010

(2 of 2)

Variables	Region						Total		
	Legal Amazon			Northeast					
	%	95%CI	p^*	%	95%CI	p^*	%	95%CI	p^*
Delivery facility			0.662			0.168			0.694
Public	43.2	(40.9-45.5)		37.3	(35.3-39.3)		39.7	(38.2-41.3)	
Private	39.8	(35.5-44.3)		41.6	(37.5-45.9)		40.9	(37.9-44.0)	
Other	37.1	(23.6-53.0)	0.362	37.6	(27.0-49.6)		37.4	(28.8-46.9)	
Breastfeeding in the first hour of life						0.190			0.003
No	37.9	(34.3-41.8)		36.6	(33.7-39.7)		37.1	(34.8-39.5)	
Yes	44.4	(42.0-46.9)		39.2	(36.9-41.5)		41.5	(39.8-43.2)	
Rooming-in			0.005			0.641			0.245
No	38.7	(32.6-45.1)		36.9	(31.8-42.4)		37.6	(33.7-41.8)	
Yes	42.9	(40.8-45.1)		38.3	(36.4-40.3)		40.2	38.8-41.7)	
Recent visit from health/FHS agent			0.213			0.024			0.001
No	44.4	(41.8-47.0)		40.3	(37.8-4)3.0		42.2	(40.4-44.1)	
Yes	40.0	(37.0-43.2)		36.2	(33.7-38.7)		37.6	(35.7-39.6)	
			0.033						

Note: *Chi-square test.

FHS: Family Health Strategy; 95%CI: Confidence Interval of 95% .

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ATTACHED 3

Exclusive breastfeeding Prevalence Ratio (PR) and respective 95%CI adjusted for all variables according to sociodemographic, prenatal, delivery, and puerperium variables. Study municipalities of the Legal Amazon and Northeast regions, Brazil, 2010

(1 of 2)

Variables	Legal Amazon			Northeast		
	PR	95%CI	*p*	PR	95%CI	*p*
Child's age (months)			0.000			0.000
0	1			1		
1	0.77	(0.69-0.87)		0.81	(0.73-0.91)	
2	0.68	(0.60-0.78)		0.65	(0.57-0.74)	
3	0.53	(0.46-0.62)		0.47	(0.40-0.55)	
4	0.37	(0.30-0.45)		0.30	(0.24-0.36)	
5	0.16	(0.12-0.21)		0.20	(0.15-0.27)	
Child's gender			0.266			0.598
Male	1			1		
Female	1.06	(0.96-1.16)		1.03	(0.93-1.13)	
Child's birth weight			0.910			0.437
Low	1			1		
Normal	1.01	(0.82-1.25)		1.09	(0.88-1.35)	
Mother's age (years)			0.012			0.001
<20 years	1			1		
20-34 years	1.14	(1.00-1.30)		1.14	(1.00-1.31)	
≥35 years	1.28	(1.03-1.58)		1.42	(1.17-1.71)	
Mother's education level (years)			0.470			0.128
0-7 years	1			1		
8-10 years	1.02	(0.89-1.16)		1.07	(0.93-1.22)	
≥11 years	1.06	(0.93-1.20)		1.10	(0.97-1.25)	
Mother's race			0.106			0.840
White	1			1		
Brown/Black	0.91	(0.80-1.04)		0.97	(0.86-1.09)	
Native/Yellow	0.83	(0.61-1.12)		1.18	(0.97-1.44)	
Residence location			0.004			0.725
Not capital	1			1		
Capital	1.17	(1.05-1.30)		0.98	(0.90-1.08)	
Received prenatal care						
No	1			1		
Yes	omitted			omitted		
Prenatal carel service			0.999			0.827
Public	1		0.999	1		
Private	1.00	(0.85-1.18)	0.663	1.02	(0.88-1.18)	
Prenatal advice on breastfeeding						0.986
No	1			1		
Yes	0.98	(0.88-1.08)	0.548	1.00	(0.90-1.12)	
Delivery						0.101
Surgical	1			1		
Vaginal	0.97	(0.87-1.08)	0.198	0.92	(0.83-1.02)	
Delivery facility						0.734
Public	1			1		
Private	0.89	(0.75-1.06)		1.03	(0.88-1.20)	
Other	0.76	(0.45-1.28)		1.05	(0.69-1.60)	

ATTACHED 3

Exclusive breastfeeding Prevalence Ratio (PR) and respective 95%CI adjusted for all variables according to sociodemographic, prenatal, delivery, and puerperium variables. Study municipalities of the Legal Amazon and Northeast regions, Brazil, 2010

(2 of 2)

Variables	Legal Amazon			Northeast		
	PR	95%CI	*p*	PR	95%CI	*p*
Breastfeeding in the first hour of life			0.012			0.063
No	1			1		
Yes	1.16	(1.03-1.30)		1.10	(0.99-1.21)	
Rooming-in			0.925			0.739
No	1			1		
Yes	1.01	(0.85-1.200)		0.98	(0.89-1.09)	
Recent visit from health/FHS agent			0.449			0.733
No	1			1		
Yes	0.96	(0.86-1.07)		0.98	(0.85-1.13)	

Note: FHS: Family Health Strategy; 95%CI: Confidence Interval of 95% .

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Effect of fatty Amazon fish consumption on lipid metabolism

Efeito do consumo de peixes amazônicos gordurosos sobre o metabolismo lipídico

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ABSTRACT

Objective

The present study aimed to evaluate the effect of feeding diets enriched with fatty fish from the Amazon basin on lipid metabolism.

Methods

Male Wistar rats were divided into four groups: control group treated with commercial chow; Mapará group was fed diet enriched with *Hypophthalmus edentatus*; Matrinxã group was fed diet enriched with *Brycon* spp.; and, Tambaqui group was fed diet enriched with *Colossoma macropomum*. Rats with approximately 240g±0.60 of body weight were fed *ad libitum* for 30 days, and then were sacrificed for collection of whole blood and tissues.

Results

The groups treated with enriched diets showed a significant reduction in body mass and lipogenesis in the epididymal and retroperitoneal adipose tissues and carcass when compared with the control group. However, lipogenesis in the liver showed an increase in Matrinxã group compared with the others groups. The levels of serum triglycerides in the treated groups with Amazonian fish were significantly lower than those of the control group. Moreover, total cholesterol concentration only decreased in the group *Matrinxã*. High Density Lipoprotein cholesterol levels increased significantly in the *Mapará* and *Tambaqui* compared with control group and Matrinxã group. The insulin and leptin levels increased significantly in all treatment groups.

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Conclusion

This study demonstrated that diets enriched with fatty fish from the Amazon basin changed the lipid metabolism by reducing serum triglycerides and increasing high density lipoprotein-cholesterol in rats fed with diets enriched with *Mapará*, *Matrinxã*, and *Tambaqui*.

Indexing terms: Amazon fishes. Diet. Lipid metabolism. Rats, wistar.

RESUMO

Objetivo

Este trabalho avaliou o efeito da alimentação com dietas enriquecidas com peixes gordurosos da região amazônica sobre o metabolismo lipídico.

Métodos

Ratos machos da linhagem Wistar foram separados em quatro grupos: grupo controle tratados com ração comercial; grupo Mapará, dieta enriquecida com Hypophthalmus edentatus*; grupo Matrinxã dieta enriquecida com Brycon* spp.*; grupo Tambaqui, dieta enriquecida com* Colossoma macropomum*. Animais com aproximadamente 240g±0,60 de massa corporal foram alimentados ad libitum por 30 dias e eutanasiados para coleta do sangue total e tecidos.*

Resultados

Os grupos tratados com dietas enriquecidas apresentaram uma redução significativa na massa corporal e da taxa de lipogênese nos tecidos adiposos epididimal, retroperitoneal e carcaça quando comparados ao grupo controle. No entanto, a taxa de lipogênese do fígado aumentou significativamente no grupo Mapará quando comparados aos demais grupos. A concentração sérica de trigilcerideos dos grupos tratados com os peixes amazônicos foi significativamente menor em relação ao grupo-controle. Por outro lado, o colesterol total redu-ziu significativamente apenas no grupo Mapará. Os níveis de lipoproteína de alta densidade aumentaram de forma significativa nas rações preparadas com Mapará e Tambaqui. Os niveis de insulina e leptina apresentaram aumento significativo em todos os tratamentos em relação ao grupo controle.

Conclusão

Este estudo demonstrou que o enriquecimento das dietas com peixes amazônicos gordurosos alterou o metabolismo lipídico em ratos diminuindo a concentração plasmática de triglicerídeos e, concomitantemente, elevando os teores de lipoproteína de alta densidade nos grupos alimentados com dietas enriquecidas com as espécies Mapará, Matrinxã e Tambaqui.

Termos de indexação: *Peixes amazônicos. Dietas. Metabolismo dos lipídeos. Ratos wistar.*

INTRODUCTION

Obesity is considered a global public health problem in developed and developing countries[1]. Obesity pathophysiology involves complex neuroendocrine and metabolic mechanisms[2]. The main processes involved in cardiac diseases are atheroma, thrombogenic, and dietary, and factors that affect lifestyle. High intake of saturated fats, cholesterol, and calories lead to obesity, and therefore, are factors that affect lipid metabolism[3]. The quantity and nature of the fat ingested daily influence the concentration of plasma cholesterol. High cholesterol levels in the blood are related to the incidence of atherosclerotic vascular diseases, especially coronary diseases[4]. On the other hand, high density lipid cholesterol plays an important role in maintaining the plasma cholesterol levels within a compatible range, since it removes free cholesterol from plasma[5]. The main function of High Density Lipoprotein (HDL) is to build temporary reserves for total lipids, cholesterol, and apoproteins, protecting against atherosclerosis[6]. Estadella *et al.*[7], showed that a high-fat or mixed diet promotes a smaller rate of lipogenesis in retroperitoneal adipose and epididymal rat tissues. The accumulation of fat in the tissues and insulin resistance has been associated with dyslipidemia,

higher plasma total cholesterol level, Low Density Lipoprotein-cholesterol (LDL-c), Very Low Density Lipoprotein-cholesterol (VLDL-c), triglycerides; and lower HDL-c.

The ability of some foods to reduce cholesterol levels has been investigated in the last decades. Fish lipids are among these components. Since the 1970s, studies have confirmed the role of omega-3 fatty acids, especially Eicosapentaenoic Acid (EPA), in controlling cholesterol and its fractions, and consequently, in preventing cardiovascular diseases[8]. Researchers have found that the daily intake of omega-3 fatty acids can reduce the levels of triglycerides from 25% to 30%[9]. Xin *et al.*[10] state that short-term fish oil supplementation can have a favorable influence on the frequency domain of the heart rate variability.

The nature and amount of dietary lipids protect against and/or promote cardiovascular problems, and considering the high seafood intake in the Brazilian North region, this study aimed to examine whether diets containing fatty fish from the Amazon region, such as: *mapará* (*Hypophthalmus edentatus*), *matrinxã* (*Brycon* spp.), and *tambaqui* (*Colossomoa macropomum*) affect lipid metabolism in Wistar rats.

METHODS

Animals

Forty adult male Wistar (*Rattus norvegicus*) rats weighing approximately 240±0.60 grams, from the animal facility of the *Universidade Federal do Amazonas* (UFAM) were divided into four groups according to diet: Control Group (CG), *Mapará* Group (GMAP), *Matrinxâ* Group (GMAT), and *Tambaqui* Group (GTAB). All animals were kept in individual cages under a temperature of 24°C to 28°C and 12/12-hour light-dark cycle. The animals had free access to food and water. The experimental period lasted 30 days. The study was approved by the Animal Ethics Committee of the UFAM under Protocol 00014/12.

Preparation of the diets

The fish were transported to the *Coordenação de Pesquisas em Tecnologia do Alimento/ Instituto Nascional de Pesquisas da Amazônia* (CPTA-INPA) where they were filleted and submitted to mechanical muscle separation in a German Baader model 694 separator. The resultant meat was distributed in rectangular metal trays and frozen to -30°C. The frozen blocks weighting roughly 7kg and having a width of 5cm each were cut with an electric band saw in portions of roughly 500g and wrapped in polyethylene film. The frozen blocks were placed in isothermal boxes containing ice, transported to the Physiology Laboratory of UFAM and stored at -18±1°C. The Amazon fish-based diet consisted of Labina chow (72.5%), casein (12.5%), and mechanically separated meat of each species (15.0%). All components were ground and mixed. The final composition of each chow was approximately 22.0% proteins, 10.5% fats, 40.0% carbohydrates, and 16.0% fibers (Table 1). The caloric density determined by an adiabatic calorimeter (IKA-C400) was approximately 251.40kJ/g±0.30kJ/g (35.0% calories as fats) for each palatable high-fat diet, and 17.03kJ/g for the standard diet.

Experimental Procedure

Body weight and food intake

The rats' food intake and body mass were assessed daily for 30 days. Energy intake was determined by multiplying food intake by energy density. At the end of 30 days, the forty rats were sacrificed by decapitation and the total blood extracted. Next, this material was centrifuged at 7500rpm for 2 minutes in an Eppendorf Model 5415 centrifuge. After one hour, an intraperitoneal injection of 3mCi $^{3}H_{2}O$ in a volume of 0.3mL was given for determining the rate of lipogenesis *in vivo*. Total blood was collected. The carcass and the tissues liver, Retroperitoneal Adipose (RET),

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and Epididymal (EPI) were immediately weighed. *In vivo* lipogenesis was determined by the incorporation of ^3H_2O in saponified lipids according to the Robinson and Williamson method[11]. The tissue samples were digested in 3.0mL of 30% KOH and 3.0mL of ethanol during 2h at 70°C. After cooling, 2.0mL of H_2SO_4 12N was added and the lipids were extracted with 10.0mL of ether in petroleum[12]. This extract was washed with 2.0mL of distilled water and evaporated until dry. The radioactivity of 20µL of the serum in the samples was used to determine specific activity. The rate of lipogenesis was calculated as micromoles ^3H_2O of lipids incorporated by gram by hour. The lipid content of the tissue was determined by the gravimetric method[13]. The glycogen[14] content of the liver was determined by the anthrone method - H_2SO_4. Plasma was obtained by centrifugation and aliquots were used for measuring glucose, triglycerides, total lipids, cholesterol, high-density lipoprotein, insulin, and leptin. For these measurements, Doles (Brazil) kits were used. The concentration of insulin (Coat-A- Count DPC MedLab, CA, USA) and leptin (Linco Research, INC, MO, USA) were determined by radioimmunoassay kits.

Statistical analysis

The statistical tests were one-way Analysis of Variance (Anova) followed by the Tukey test. The differences were considered significant when $p<0.05$.

RESULTS

Diet composition

The percent macronutrient composition and fatty acids of the total lipid content of the CG, GMAP, GMAT, and GTAB diets are shown in Table 1; we see that the total protein content did not differ significantly between the groups. The percentage of carbohydrates in the CG group was statistically smaller than that of the groups fed Amazon fish, except for the group GMAP. Regarding fibers present in the percent composition of the diets, the CG had the lowest percentage. The GMAP group had higher fiber percentage than the groups GMAT and GTAB. The GMAP group had a higher lipid percentage than groups CG, GMAT, and GTAB. The CG fatty acids have a higher percentage of linolenic and linoleic acids. The GMAP was the only group with Docosahexaenoic (DHA) and EPA.

Table 1. Percent macronutrients (%) and total fatty acids in the Control (C) diet, diet enriched with ground *Mapará* (MAP), ground *Matrinxã* (MAT), and ground *Tambaqui* (TAB). *Manaus* (AM), Brazil, 2012.

Macronutrients	GC	GMAP	GMAT	GMAP
Proteins	22.4[a]	22.3[a]	22.6[a]	23.7[a]
Carbohydrates	39.1[a]	38.2[a]	41.3[c]	40.3[d]
Fibers	11.4[a]	16.7[b]	15.0[c]	16.0[d]
Lipids	4.8[a]	11.8[b]	10.0[c]	9.9[c]
Palmitic (16:9)	20.4[a]	23.93[b]	24.58[c]	24.8[c]
Oleic (18:1n-9)	27.4[a]	24.55[b]	27.9[a]	38.85[d]
Stearic (18:0)	5.12[a]	7.65[b]	6.93[a]	9.84[c]
Palmitoleic (16:1n-7)	-	3.56[b]	7.5[c]	1.72[d]
Linolenic (18:3n-3)	9.91[a]	3.76[b]	2.35[c]	2.66[c]
Linoleic (18:2n-6)	41.0[a]	11.11[b]	18.52[c]	18.62[c]
Myristic (14:0)	2.07[a]	0.56[b]	2.46[a]	0.66[b]
Docosahexaenoic (22:6n-3)	-	2.9	-	-
Eicosapentaenoic (20:5n-3)	-	2.4	-	-

Note: The values are expressed as means ± standard error mean. Values followed by the same letter do not differ according to the Tukey test ($p<0.05$).

Weight gain, energy value, metabolic efficiency, and fat content

Table 2 shows that the fat content of the carcass in the groups fed diets with 15% meat was smaller than that of the control. However, the fat content of the carcass of groups GMAT and GTAB did not differ from each other, but both were higher than GMAP. The measure of the masses of the adipose epididymal and retroperitoneal tissues and liver of the GMAT, GMAP, and GTAB groups were greater than those of the control group. The CG consumed less energy than the other groups. On the other hand, the GMAP group had greater total energy intake than the GTAB and GMAT. GTAB total energy intake was significantly higher than that of GMAT. The control group gained more weight than the groups GTAB and GMAP. The metabolic efficiency of the control group was lower than that of the other groups. On the other hand, the GTAB group had a metabolic efficiency greater than the GMAP and GMAT groups. The GMAT had a lower metabolic efficiency than the group GMAP.

Lipogenesis

In the CG's, GMAP's, and GTAB's livers, the rate of lipogenesis was similar (Table 3). However, the GMAT group had a higher rate of liver lipogenesis than the GMAP, GTAB, and CG groups. The lipogenesis rates of the GMAP, GMAT, and GTAB were lower than those of the CG group. The animals in the GMAP, GMAT, and GTAB groups had lower RET and EPI adipose tissue lipogenesis than the CG. However, the lipogenesis rate of the EPI adipose tissue of the GMAT group was higher than that of the groups GTAB and GMAP.

Table 2. Body weight gain (f), total energy intake (kJ), metabolic efficiency (kJ/g of body weight gain), fat content of the carcass (g/100g), Retroperitoneal (RET) adipose tissue mass, Epididymal (EPI) adipose tissue mass, and liver mass of rats fed control diet and diets enriched with Ground *Mapará* (GMAP); Ground *Matrinxã* (GMAT) or Ground *Tambaqui* (GTAB). *Manaus* (AM), Brazil, 2012.

Variables	CG		GMAP		GMAT		GTAB	
	M	SD	M	SD	M	SD	M	SD
Body weight gain	80.30	6.78[a]	66.98[b]	3.34[b]	70.08	5.24[c]	56.75	5.26[d]
Total energy intake	6840.4	153.9[a]	7910.6	183.2[b]	7284.3	183.3[c]	7441.1	188.5[d]
Metabolic efficiency	96.44	7.07[a]	119.72	4.43[b]	107.44	6.47[c]	144.17	14.52[d]
Fat content of the carcass	8.2	0.025[a]	3.78	1.56[c]	5.53	5.00[b]	4.01	0.89[b]
EPI mass	0.86	0.025[a]	1.04	0.0006[b]	1.04	0.0006[b]	1.02	0.008[b]
RET mass	0.65	0.06[a]	1.05[b]	0.007[b]	1.05	0.006[b]	0.99	0.027[b]
Liver mass	9.08	0.300[a]	11.59	0.007[b]	11.66	0.442[b]	11.05	0.250[b]

Note: The values are expressed as means ± standard error mean. Values followed by the same letter do not differ according to the Tukey test ($p<0.05$).

Table 3. In vivo lipogenesis rate (µmol ^3H_2O incorporated in lipids/g of tissues.h) in the Epididymal (EPI) and Retroperitoneal (RET) adipose tissues, liver, and carcass of the rats fed a control diet and diets enriched with Ground *Mapará* (GMAP); Ground *Matrinxã* (GMAT) or Ground *Tambaqui* (GTAB). *Manaus* (AM), Brazil, 2012.

Tissues	CG		GMAP		GMAT		GTAB	
	M	SD	M	SD	M	SD	M	SD
EPI	34.46	39.88[a]	3.42	0.79[b]	4.6	2.04[c]	3.28	0.82[b]
RET	12.92	9.9[a]	3.73	1.47[b]	3.64	0.84[b]	3.76	1.41[b]
Liver	8.24	2.22[a]	7.63	2.64[a]	15.52	8.82[b]	9.40	2.08[a]
Carcass	7.71	4.83[a]	1.30	0.43[b]	1.42	0.55[b]	1.67	0.32[b]

Note: The values are expressed as means ± standard error mean. Values followed by the same letter do not differ according to the Tukey test ($p<0.05$).

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Table 4. Serum levels of glucose, Triglycerides (TG), total lipids, total cholesterol, LDL-c, VLDL-c, HDL-c, total proteins expressed as (mg/dL) and leptin (ng/mL) of rats fed a control diet and diets enriched with Ground *Mapará* (GMAP); Ground *Matrinxã* (GMAT) or Ground *Tambaqui* (GTAB). *Manaus* (AM), Brazil, 2012.

Tissues	CG		GMAP		GMAT		GTAB	
	M	SD	M	SD	M	SD	M	SD
Glucose	139.87	8.87^{a}	154.28	7.60^{b}	134.24	4.20^{ac}	117.34	4.18^{d}
TG	60.43	4.08^{a}	40.55	3.62^{b}	44.62	4.98^{b}	38.96	4.49^{b}
Total cholesterol	76.28	4.44^{a}	67.33	5.84^{a}	59.39	3.80^{a}	65.68	4.33^{a}
HDL-c	8.79	0.81^{a}	13.67	1.11^{b}	7.08	0.96^{a}	11.44	1.38^{b}
Total proteins	4.68	0.42^{a}	4.81	0.43^{a}	4.29	0.14^{a}	4.23	0.17^{a}
Leptin	1.63	0.26^{a}	4.38	0.65^{ab}	3.90	0.42^{ac}	6.34	1.70^{c}
Insulin	11.75	1.32^{a}	14.14	2.56^{a}	14.12	2.01^{a}	11.30	1.07^{a}

Note: The values are expressed as means ± standard error mean. Values followed by the same letter do not differ according to the Tukey test (p<0.05).

TG: Triglyceride; HDL-c: High Density; Lipopropein-cholesterol; M: Mean; SD: Stardand Deviation.

Plasma metabolites

Table 4 shows that the total cholesterol and total protein contents did not change in the groups treated with the enriched diets with respect to the Control group. The groups GMAP, GMAT, and GTAB presented a significant reduction in plasma Triglyceride (TG) levels compared with the Control group. The groups GMAP and GTAB presented a significant increase in HDL-c when compared with the control and GMAT groups. Additionally, the plasma glucose of group GTAB decreased significantly when compared with the groups GMAT, GMAP, and CG. The increase in the glucose levels of the group GMAP was greater than that of the other groups. However, plasma insulin did not change significantly in any of the groups. Leptin in the CG was significantly lower than in the treated groups (Table 4).

DISCUSSION

In the literature the effect of high-fat diet on body weight is very controversial[15,16], especially of rats fed diets high in saturated fats and omega-6 polyunsaturated fats[17]. The degree of satiety promoted by high-fat diet depends on their physical and chemical properties (chain length, saturation, and conjugation), its carbohydrates, and its palatability[18]. These factors may influence the release of inhibitory gastrointestinal peptides such as cholecystokinin, enterostatin, and apoprotein A-IV[19,20] and also the digestion, absorption, and metabolic rates. Himaya *et al.*[21] reported that the time of satiety in high-fat diets is longer in diets high in carbohydrates because of the higher levels of plasma metabolite substrates such as glucose, TG, and fatty acids. These results may partly explain the fact that Wistar rats present lower intake of diets enriched with *mapará* (*Hypophthalmus edentatus*), the fish with the highest lipid content. On the other hand, the rats fed *matrinxã* (*Brycon* spp.) consumed as much food as the controls.

Other studies have reported that rats kept with diets enriched with polyunsaturated and saturated fish oil did not vary their food intake[22]. Interestingly, in past decades, this dietary practice of feeding high-fat diet was used as strategy to control obesity, but with little success, since in general this type of diet has high energy content leading to body weight gain[21]. This is in agreement with the group that was fed the diet enriched with *matrinxã*, which gained more weight than the other groups. The intake of each macronutrient seems to be under strict control to maintain oxidation and the balance status. In case of fats,

the adjustment is much less precise and higher intake does not stimulate proportional oxidation. The oxidation rate of fatty acids may also be another factor that controls food intake[23]. The accumulation of fats in tissues and the presence of insulin resistance has been associated with dyslipidemias, increase in the plasma level of total cholesterol, LDL-c, VLDL-c, IDL-c, TG, and low HDL-c. Hence, many studies have reported that obesity, dyslipidemia, diabetes type II, high blood pressure, and cardiovascular diseases lead to interrelated metabolic changes known as plurimetabolic syndrome[24]. Nieves *et al*.[25] indicate that the lipoprotein profile present seem to result primarily from the increase in central fat probably due to the development of insulin resistance. The reduction of abdominal fat by medication or lifestyle changes or dietary changes or more physical activity could contribute to improve the lipid profile, and avoid the development of atherosclerosis. Suprijana *et al*.[26] found a reduction in the levels of TG, total cholesterol, and lipoprotein fractions in rats fed diets enriched with fish oil, which was later observed also by Kim *et al*.[27].

Similarly, the results observed in this study show that the intake of fatty Amazon fish reduced TG and cholesterol levels. The effects caused by high-fat diets on the metabolism of animals may be influenced by the type of lipids[28], gender, and treatment period[17,23]. Patients treated with fish oil rich in omega-6 fatty acids have experienced lower total cholesterol, LDL-c, TG, and VLDL[29], and higher HDL-c[29,30]. Similarly, the total cholesterol and TG of the rats fed diets enriched with Amazon fish decreased and the HDL of rats fed diets enriched with *mapará* and *tambaqui* increased - these fish contain omega-6 and omega-3 fatty acids. The plasma glucose levels did not differ significantly from those of the control group, which was also observed by Simão *et al.*[31] and Wilkson *et al.*[32] while supplementing a human diet with fish oil. Mortiz *et al.*[33] stated that rats fed with chow enriched with fish oil tended to have lower blood glucose, total cholesterol, and LDL-c and higher TG than the control group. Many works have showed that lipid metabolism is regulated by leptin, a protein hormone produced mainly by adipose tissue[34]. According to Nogalska *et al.*[35] higher expression of the leptin gene partially clarifies the low lysogenic activity of the white adipose tissue of old animals. This finding corroborates our studies which showed low lipogenesis in the adipose tissues and concomitant leptin increase in the rats fed enriched chow.

In conclusion, this study found that diets enriched with fatty Amazon fish changed the lipid metabolism of rats effectively lowering plasma lipids (cholesterol, TG, and LDL) and increasing HDL. These results suggest that regular consumption of fish with these characteristics is beneficial.

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CONTRIBUTORS

FCA SOUZA is the first author; she designed, coordinated and organized all experiments. She carried out an exhaustive review of the literature. In addition, performed statistical analyses and interpretation and was responsible for writing the article. NP GARCIA participated to the experimental design, data analysis in laboratory and participated in the writing of the article. RSA SALES participated to the exhaustive laboratory analysis, particularly for the preparation of the diet and experimental procedures. JPL AGUIAR performed several laboratory analysis, interpretation and participated in the writing of the article. WLP DUNCAN participated in the statistical analysis, writing and reviewing the manuscript. RP CARVALHO is the investigator responsible for the overall study.

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REVISÃO | *REVIEW*

Research potential of food and nutrition in the Family Health Strategy: A structured review

Potencialidades da pesquisa em alimentação e nutrição na Estratégia de Saúde da Família: uma revisão estruturada

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ABSTRACT

Objective

Determine the profile of research groups and publications with food and nutrition-related actions promoted by the Family Health Strategy in Brazil since 1994.

Methods

Two procedures were used: structured review and research group search. The former searched the databases Web of Science, Medline, Lilacs, SciELO and Embase, and followed the principles that guide systematic reviews in the Cochrane Collaboration. The references of the selected articles were also consulted. The research groups were searched in the Research Group Directory of the National Council for Scientific and Technological Development.

Results

A total of 54 articles published between 2002 and 2012 in 20 different journals were identified. Ten of these were retrieved from the references section of other articles. Focusing mostly on children from the Southeast region, these studies were coordinated by dieticians, nurses, and physicians. Diabetes *Mellitus*, high blood pressure, and breastfeeding were the most common topics (n=23). The quantitative methodology was employed by 42 articles, most about diagnoses. Only five research groups studied the Family Health Strategy, despite the growing number of studies in the area over the years.

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Conclusion

Despite the growing scientific production, the findings of this structured review indicate that few studies focused on food and nutrition in the Family Health Strategy, probably because of the existence of few research groups in the country. More comprehensive and consistent studies on the topic are needed.

Indexing terms: Family health. Feeding. Nutrition public health. Primary health care. Research groups. Review literature as topic.

RESUMO

Objetivo

Traçar o perfil dos grupos de pesquisa e das publicações que apresentem ações relacionadas à alimentação e nutrição no âmbito da Estratégia Saúde da Família no Brasil a partir do ano de 1994.

Métodos

Dois procedimentos foram explorados: a revisão estruturada e a busca de grupos de pesquisa. A primeira explorou as bases Web of Science, Medline, *Lilacs, SciELO e* Embase*, seguiu os princípios que orientam as revisões sistemáticas da Colaboração Cochrane. Foram ainda consultadas as referências dos artigos selecionados. A busca de grupos de pesquisa foi feita por meio do Diretório de Grupos de Pesquisa do Conselho Nacional de Desenvolvimento Científico e Tecnológico.*

Resultados

Foram encontrados 54 artigos originais, sendo 10 identificados na lista de referências, publicados entre os anos de 2002 a 2012 em 20 diferentes periódicos. Sua maior parte foi realizada na Região Sudeste, sob coordenação de nutricionistas, enfermeiros e médicos, com crianças como sujeitos de pesquisa. Diabetes Mellitus, Hipertensão e Aleitamento materno foram os temas mais encontrados (n=23). Foram identificados 42 artigos de pesquisa quantitativa, em sua maioria sobre diagnóstico. Foram encontrados apenas cinco grupos de pesquisa com o tema na Estratégia Saúde da Família, apesar do aumento de pesquisas na área ao longo dos anos.

Conclusão

Apesar da produção crescente, os achados desta revisão estruturada indicaram poucos estudos com foco em alimentação e nutrição no contexto da Saúde da Família, provavelmente devido à existência de poucos grupos de pesquisa no País. É necessário fomentar estudos sobre o tema de maneira mais ampla e consistente.

Termos de indexação: *Saúde da família. Alimentação. Nutrição em saúde pública. Atenção primária à saúde. Grupos de pesquisa. Literatura de revisão como assunto.*

INTRODUCTION

In the last four decades, the Brazilian population changed its nutritional profile, decreasing the prevalence of childhood malnutrition (although it still persists in low-income families from the Brazilian North Region), the adolescent and adult underweight prevalences, and the stunting prevalence; and increasing the overweight and obesity prevalences in the country, especially in the last decade[1]. The coexistence of these problems with the persistence of high prevalences of nutritional deficiencies in children under five years of age and women of childbearing age, such as hypovitaminosis A (17.4% and 12.3%) and anemia (20.9% and 29.4%)[2] characterizes the nutritional transition and the double disease burden[3].

This situation can be explained by the social and economic transformations that influenced lifestyles, changing the food environment and reducing physical activity. The *Pesquisa de Orçamentos Familiares* (POF, Family Budget Survey) of 2008-2009[4] found the addition of low-nutrient high-energy foods into the traditional Brazilian diet: more than 90% of the population had low produce (fruits and non-starchy vegetables) intake and 60% to 80% of the population had excessive sugar, sodium, and saturated fat intakes[4].

On the other hand, the implementation of policies, and encouragement and support programs promoted breastfeeding, increasing the number of breastfed children and the duration of exclusive and total breastfeeding[2].

In parallel, the prevalences of moderate and severe food insecurity decreased between the 2004 *Pesquisa Nacional por Amostras em Domicílios* (PNAD, National Household Sample Survey) and the 2009 PNAD, being 6.5% and 5.0%, respectively, in the latter[5]. This decrease was confirmed by the 2008-2009 POF, which found a subtle increase in household satisfaction with the amount and quality of the foods (64.4% and 35.0%) in relation to the 2002-2003 POF (53.0% and 26.5%)[6].

Along with poor food choices, the 2008 PNAD found that only 28.2% of the population aged more than 14 years was physically active[6]. The *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* (Vigitel) 2011 found a leisure-time physical activity rate in adults of 30.0% and a transportation-related physical activity rate of 17.0%[7].

Given the complexity of the Brazilian nutritional scenario, which tends to increase the incidence and prevalence of chronic Non-Communicable Diseases (NCD)[8,9], health care personnel need to be trained to ensure the comprehensiveness of care[10-12]. Food and nutrition actions are also capable of favoring the inclusion of health promotion in the political agenda and contribute to this goal[10-12].

In this line, the Brazilian State officially advanced by passing the National Health Promotion Policy[13] in 2006 to promote quality of life and reduce health vulnerability and risk; the National Primary Health Care Policy also in 2006[14], which prioritized the Family Health Strategy as the definitive proposal for redirecting the health system; and the National Food and Nutrition Policy, in 1999, revised in 2010[15], to improve the population's diet, nutrition, and health by promoting healthy food practices, food and nutrition surveillance, and preventing and comprehensive care.

Given the various determinants and the combination or overlap of food and nutrition-related problems, preventive actions should attempt an integral and efficiency care instead of the conventional and fragmented practices[11,16]. Furthermore, the institutional nutrition network in the *Sistema Único de Saúde* (SUS, Unified Health Care System) became stronger, turning primary care into a potential space for the development of actions that encourage and support healthy eating habits and physical activity[12].

In the context of comprehensive health care, the Family Health Strategy emerges in 1994 as an innovative proposal to reorganize the health-care model, a proposal capable of establishing a set of political, social, and economic health-promoting ideas that require: uninterrupted intersectoral partnership; interdisciplinary coordination of actions to treat and prevent disease, and promote health; higher education encouraging multidisciplinary care; and health education emphasized as a reflection-action strategy for promoting citizenship and solidarity[17].

These challenges indicate the importance of proposing the Family Health Strategy as a new model of care and a potential and coherent space for the inclusion and establishment of food and nutrition actions with a cross-sectional approach[10]. Hence, this study proposes to trace the profile of the research groups and publications focusing on nationwide food and nutrition-related interventions, diagnosis, or assessment in the context of the Family Health Strategy since 1994.

METHODS

Structured review

A Structured Review was conducted according to the systematic review principles of

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the Cochrane Collaboration, which uses predefined methods for identifying, selecting, and critically assessing studies, and collecting and analyzing data[18]. Systematic reviews should follow seven steps. The present review followed the first six listed below:

a) Formulating the question: What types of studies include food and nutrition actions in the context of Family Health Strategy?

b) Study search and selection: The searched databases were the Web of Science, *Biblioteca Virtual em Saúde* (BVS) (*Lilacs, Medline*, and *SciELO*) and Embase. Original studies conducted in Brazil from 1994 to December 2012 published in any language. The following keywords and their combinations were used for searching the title or abstract: in Portuguese, *nutrição/alimentação; Atenção Primária à Saúde/Atenção Básica à Saúde; Estratégia Saúde da Família/Programa Saúde da Família*; and in English, nutrition/food; health primary care; family health. The selection of these terms relied on the health science descriptors available at the BVS, and similar terms in the other databases. The keywords used for the food and nutrition area were generic to enable the retrieval of journals with diverse characterizable actions.

c) Critical study assessment: The articles were initially selected by title and abstract, resulting in 151 articles. Next, the methodology was read to make sure the study met the inclusion criteria, namely studies in the Family Health Strategy context that approached food and nutrition actions. These are defined as a set of individual, family, and group actions at the primary care level of the health care system that aim to promote health, prevent and treat disease, and provide rehabilitation[10] attributed to dieticians. These actions may also compose the actions answered by the health care team[10].

Therefore, manuscripts that focused on other health-related themes were also selected, providing they had some specific or cross-sectional actions related to food and nutrition, such as infant care, infant growth and development monitoring; prenatal care monitoring weight gain; and references to the food intake and counseling, anthropometry, or adherence to non-pharmaceutical treatment of individuals with high blood pressure or diabetes.

Dissertations or theses were not included and the study journals should have at least a Qualis Capes classification of B3 for the area of Collective Health. Studies of populations not covered by the Family Health Strategy were not included, such as: studies based on samples of Primary Health Care Units Clientele, household census, traditional care, vaccination campaigns, polyclinics, Specialized Reference Units, Family Development Center, institutions, and projects linked to universities. The same exclusion criteria were used for studies of families covered only by the *Pastoral da Criança*, private health care insurance, or specific municipal programs such as the *Programa de Suplementação Alimentar* (Food Supplementation Program), and *Programa do Desnutrido* (Program for the Malnourished), among others. This further selection resulted in 44 articles that met the study criteria; another 10 articles were retrieved from their references section, totaling 54 studies.

d) Data collection: The following variables were collected: author, journal, and publication year; location; population, classified according to the municipality size (small, medium, large, and metropolis) provided by the *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute of Geography and Statistics)[19]; Family Health Strategy presence in the municipality according to the Unified Health Care System database[20]; and Family Health Strategy coverage stratified by percentage brackets I - 0% to 20%; II - 20% to 50%, III - 50% to 70%, IV - >70%[21]. Other study variables were the Municipal Human Development Indices (HDI-M)[22], classified as medium (0.5 to 0.79) or high (≥0.80); study design, methods, sample size, and target population; study objective/theme; education of the first author retrieved from the *Plataforma Lattes* (Lattes Plataform) available at the *Conselho Nacional de*

Desenvolvimento Científico e Tecnológico's (CNPq, National Council for Scientific and Technological Development) site[23]; the degree of nutritional intervention (diagnosis, health promotion, disease prevention, ambulatory care/treatment/care) or management (control, organization, planning, and supervision) according to the definition provided by the Ministry of Health's *Matriz de Ações de Alimentação e Nutrição* na Atenção Básica de Saúde (Matrix of Food and Nutrition Actions)[10].

e) Data analysis and presentation: the selected studies have different profiles and were grouped and classified according to their design, nutritional care action, and municipal management actions. These data are shown in tables.

f) Data interpretation: after result analysis and tabulation, we discussed the action profiles and applicability; food and nutrition in the context of Family Health Strategy in different types of Brazilian municipalities; the limitations and potentials of such services; and the human resources.

The seventh step regards improving and updating the manuscript after publication, which does not apply to the present study.

Identification of the research groups that investigate about food and nutrition in the Family Health Strategy

Conselho Nacional de Desenvolvimento Científico e Tecnológico's[24], *Diretórios dos Grupos de Pesquisa* (DGP, Research Group Directory) search tools were used for finding the groups that work on this theme. The tools search not only the database but also census data (2000, 2002, 2004, 2006, 2008, and 2010). For both searches, the following search options were marked: group name, group repercussions, name of the research line, and keywords of the research line. The searched keywords were: collective health/public health; basic care/primary care; family health/community agents together with the terms food/nutrition (*saúde coletiva/saúde pública, atenção básica/atenção primária, saúde da família/agentes comunitários, combinadas com os termos alimentação/nutrição*). This procedure allowed searching the focus of this review more accurately, beyond the academic area that conceived the study, given that food and nutrition investigations may occur in other academic areas.

To complement the search in the above database, the groups were also searched using an alternative method. The full name of the authors of the articles selected in the structured review was used for finding other groups in which they worked as leaders or researchers.

The groups were selected by reading all the information provided on the group's web page and the objectives of one or more research lines. Studies on the following subjects were excluded: studies on animal food or nutrition, chemical composition of foods, clinical nutrition, food service management, and sports nutrition. When at least one of the research lines regarded the theme, the group was selected.

The following data were collected from the groups that studied primary care or Family Health Strategy with a focus on food and nutrition: year of establishment, predominant area, institution, research lines, and keywords.

RESULTS

Research on food and nutrition in the Family Health Strategy

Fifty-four original articles on some type of Family Health Strategy action related to food and nutrition were analyzed, two in English and all others in Portuguese. Although the search included all studies published since 1994, the 54 selected studies were published between 2002 and 2012, and most (n=40, 74%) were published in the last six years.

Only forty studies reported the data collection period, and these studies were mostly published from one to six years after completion

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of data collection. Only one study was published twelve years after completion of data collection.

The articles were found in twenty different journals, seventeen of which were Brazilian. Thirty-three (61.0%) studies were published in public health, collective health, or epidemiology journals. Five were nursing journals, accounting for 24.1% of the publications (n=13). Only four studies were from two different nutrition journals, and another four studies were from specific medical journals.

Most studies were done in the Brazilian Southeast (n=27, 50%), especially in the states of *Minas Gerais* and *São Paulo*. However, the other Brazilian regions were also represented: Northeast with eighteen studies (33%), South with seven studies (13%), Central-West with one study (2%), and North with one study (2%). A total of 44 municipalities were studied, and three studies included more than one municipality (1º=10; 2º=4, and 3º=2). Two articles did not mention the study municipalities. The population in these municipalities varied from three thousand to ten million inhabitants. Seven municipalities were metropolis (>900 thousand inhabitants), eighteen were large (100 thousand to 900 thousand inhabitants), two were medium-sized (50 thousand to 100 thousand inhabitants), and seventeen were small, with less than 20 thousand inhabitants.

The municipalities' Human Development Index (HDI-M) ranged from medium (0.500-0.799, n=34) to high (≥0.800, n=10)[22]. According to Datasus, 31 municipalities had Family Health Strategy coverage higher than 50%; and of these, 20 had Family Health Strategy coverage higher than 70%[20].

The academic education of the first author of the reviewed studies included: dieticians with 16 studies; nurses with 14 studies; physicians with 12 studies; psychologists with 3 studies; physical therapists, dental surgeons, and physical educators with 2 studies each; biologist, occupational therapist, and pharmacist with one study each.

Most studies focused on a specific population, such as children (n=14), health professionals (n=12), older adults (n=5), pregnant women (n=3), mothers (n=3), adults (n=2), and women of childbearing age (n=2). Some studies included more than one type of population, such as adults and older adults (n=8), mothers and children (n=2), mothers and professionals (n=1), and professionals and pregnant women (n=1). One study focused on a child's father.

Some themes can be categorized according to the articles' objectives and the matrix of food and nutrition actions in primary care[10]. High blood pressure or diabetes mellitus was the most common topic (n=12, 22.2%), followed by breastfeeding (n=11), nutritional status assessment (anthropometry, n=9), child health or childcare (n=7), prenatal care (n=6), micronutrient inadequacies (n=5), labor (n=2), welfare program (n=1), and general food and nutrition (n=1). Articles about the *Sistema de Vigilância Alimentar e Nutricional* (Sisvan, Food and Nutrition Surveillance System) were not found.

The methods used in the study articles varied: structured or semi-structured interviews with users or professionals; self-administered questionnaires; venous or finger-stick blood tests; stool test; direct anthropometry; direct blood pressure measurement; food intake assessment; field diary; direct observation of health unit structure; and use of scales and tests to measure child development and older adult motor development. The interventions included: iron supplementation; physical activity; Family Health Strategy-related; provision of individual, group, and home care; a strategy called *Atenção Integrada às Doenças Prevalentes na Infância* (AIDPI, Integrated Management of Childhood Illness); and Breastfeeding - Friendly Primary and Prenatal Care Units. The educational intervention proposals used dialogue discourse, demonstration, service practices, lectures, group dynamics, and case studies.

Tables 1, 2, and 3 show the studies. Table 1 lists quantitative or mostly quantitative studies

Table 1. Profile of the quantitative or mostly quantitative studies on disease diagnosis and prevention, and health promotion and care. Brazil, 2003 to 2012.

(1 of 2)

Author, year	Municípalities (n), Region	Size[a]	FHS cover[b]	HDI-M[c]	Sample	Topic	Purpose[d]	Education of the 1° author
Borges & Philippi (2003)[25]	(1), SE	M	II	High	41 lactating women	Breastfeeding	D	Nurse
Ferreira *et al.* (2003)[26]	(1), NE	L	III	Medium	293 children aged 6 to 23 months	Micronutrient inadequacy	DP	Nurse
Sousa & Araújo (2004)[27]	(1), NE	L	III	Medium	371 children aged 6 to 60 months	Micronutrient inadequacy	D	Nurse
Mano & Pierin (2005)[28]	(1), SE	M	II	High	226 records of hypertensives in the FHS or not	HBP/DM	D	Nurse
Parada *et al.* (2005)[29]	(1), SE	S	IV	Medium	166 children aged <1 year	Breastfeeding	D	Nurse
Barbosa *et al.* (2006)[30]	(1), NE	L	IV	Medium	284 older adults	Micronutrient inadequacy	D	Dietician
Maria-Mengel & Linhares (2007)[31]	(1), SE	L	I	High	120 children aged 6 to 44 months	Child health/ care	D	Psychologist
Melo *et al.* (2007)[32]	(1), NE	L	II	Medium	115 pregnant women	Nutritional status	D	Physician
Nascimento *et al.* (2007)[33]	(1), NE	L	IV	Medium	315 older adults	Micronutrient inadequacy	D	Dietician
Alves *et al.* (2008)[34]	(1), NE	M	III	Medium	68 children aged 5 to 10 years with BMI ≥85th	Nutritional status	DP	Physician
Azeredo *et al.* (2008)[35]	(1), SE	S	IV	Medium	36 professionals and 137 mothers of children aged < 24 months	Breastfeeding	D	Dietician
Assunção & Ursine (2008)[36]	(1), SE	M	III	High	164 diabetics aged >18 years	HBP/DM	NCT	Physical therapist
Cotta *et al.* (2009)[37]	(1), SE	S	IV	Medium	150 hypertensives, 5 diabetics, and 25 with DM and HBP	HBP/DM	D	Occupational therapist
Girotto *et al.* (2009)[38]	(1), S	L	III	High	385 hypertensive adults and older adults	HBP/DM	D	Pharmacist
Azeredo *et al.* (2010)[39]	(1), SE	MS	III	High	103 anemic children	Micronutrient inadequacy	DP	Dietician
Brecailo *et al.* (2010)[40]	(1), S	L	III	Medium	426 children aged <2 years	Breastfeeding	D	Dietician
Felisbino-Mendes *et al.* (2010)[41]	(1), SE	S	IV	Medium	1332 children aged <10 years	Nutritional status	D	Nurse
Silva *et al.* (2010)[42]	(1), SE	L	I	High	43 diabetic older adults	HBP/DM	D	Nurse
Cristovão *et al.* (2011)[43]	(1), SE	M	II	High	298 adult women	Nutritional status	D	Nurse
Garcia *et al.* (2011)[44]	(1), N	S	IV	Medium	164 children aged 6 to 24 months	Nutritional status	D	Dietician

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Table 1. Profile of the quantitative or mostly quantitative studies on disease diagnosis and prevention, and health promotion and care. Brazil, 2003 to 2012.

(2 of 2)

Author, year	Municípalities (n), Region	Size[a]	FHS cover[b]	HDI-M[c]	Sample	Topic	Purpose[d]	Education of the 1º author
Cunha *et al.* (2012)[45]	(1), CW	S	IV	Medium	80 enrolled in the *HiperDia*	HBP/DM	D	Physical educator/ therapist
Marinho *et al.* (2012)[46]	(1), NE	L	IV	Medium	419 non-diabetic adults	Nutritional status	D	Nurse
Ribeiro *et al.* (2012)[47]	(1), SE	S	IV	Medium	27 hypertensive women	HBP	HP	Dietician
Soares *et al.* (2012)[48]	(1), NE	L	III	Medium	235 older adults	Nutritional status	D	Physical therapist
Ferreira-Marim *et al.* (2012)[49]	(1), SE	L	I	High	155 preschoolers aged 2 to 5 years	Nutritional status	D	Dietician
Vianna *et al.* (2012)[50]	(1), SE	S	IV	Medium	70 older adults	Nutritional status	DP	Physical educator

Note: [a]Size of the municipality. Source: *Instituto Brasileiro de Geografia e Estatística*, 2007[19]; S: Small; MS: Medium-Sized; L: Large, M: Metropolis; [b]Source: DATASUS, 2007; FHS cover: Family Health Strategy coverage as follows: I - 0% to 20%; II - 20 to 50%, III - 50 to 70%, IV - >70%; [c]Source: *Programa das Nações Unidas para o Desenvolvimento*, 2000. HDI-M: Human Development Index of the Municipality classified as medium (0.5 to 0.799) and high (≥0.80); [d]Focus of the food and nutrition actions according to the source Brasil, 2009.
D: Diagnosis; HP: Health Promotion; DP: Disease Prevention; NCT: Nutritional Ambulatory Care/Care/Treatment; HBP: High Blood Pressure; DM: Diabetes *Mellitus;* SE: Southeast; NE: Northeast; CW: Central West; S: South; N: North.

that performed nutritional care actions, such as diagnosis, health promotion, disease prevention, and ambulatory care/care/treatment. Table 2 also lists quantitative studies, but only those that performed food and nutrition actions typical of local or municipal management. Table 3 shows the qualitative studies and the actions include both nutritional care and management.

Forty-two quantitative studies were found, two mostly quantitative with some qualitative data. Of these, 26 referred to nutritional care actions (Table 1) and 16 to local or municipal management actions (Table 2).

The studies in Table 1 are either interventional (n=5), cross-sectional (n=20), or cohort (n=1). The five intervention studies assessed effectiveness[26,34,39,47,50].

Three articles with retrospective information involved the organization of secondary data, one of which combined primary and secondary data. These articles collected data from medical records and health information systems, namely from the *Sistema de Informação da Atenção Básica* (SIAB, Primary Care Information System).

Thirteen studies in Table 1 studied location-specific populations, such as subjects living in a district or users of a health service, and another thirteen studies regarded other types of specific populations, such as a sample of Family Health Strategy professionals representative of the municipal Family Health Strategy professional population.

Most quantitative studies (n=20) used nutritional status diagnosis (intake assessment, anthropometric assessment, breastfeeding duration, micronutrient deficiencies) for assessing nutritional care actions. Although mostly quantitative, two studies also presented psychosocial and cultural data (perceived situations, professional practices, and cultural practices). Four investigated disease-prevention methods (prophylactic iron supplementation and practice of physical activity in older adults or obese children), one promoted health (nutritional education for hypertensives),

Table 2. Profile of the quantitative studies that approach food and nutrition actions promoted by municipal or local administration. Brazil, 2002 to 2012.

Author, year	Municípalities	Size[a]	FHS cover[b]	HDI-M[c]	Sample	Topic	Purpose[d]	Education of the 1° author
Cesar *et al.* (2002)[51]	(2), SE	2 S	2 IV	2 Medium	409 children	Child health/ care	control	Physician
Ciconi *et al.* (2004)[52]	(1), SE	L	II	Medium	61 professionals	Breastfeeding	organization	Biologist
Dubeux *et al.* (2004)[53]	(1), NE	L	II	Medium	40 teams	Breastfeeding	control	Dental surgeon
Faleiros *et al.* (2005)[54]	(1), S	L	II	High	112 children	Breastfeeding	control	Physician
Roncalli & Lima (2006)[55]	(4), NE	-	-	-	2 144 children < 5 years w/ and w/o FHS	Child health/ care	control	Dental surgeon
Araújo & Guimarães (2007)[56]	(1), NE	M	I	High	135 adults/ older adults with HBP	HBP/DM	control	Physician
Caldeira *et al.* (2007)[57]	(1), SE	L	II	Medium	Professionals: 41 with higher education and 152 with high school	Breastfeeding	organization and control	Physician
Lima *et al.* (2007)[58]	(1), SE	S	IV	Medium	49 postpartum women and 26 newborns	Child health/ care	control	Nurse
Caldeira *et al.* (2008)[59]	(1), SE	L	II	Medium	About 1400 mothers	Breastfeeding	organization	Physician
Cesar *et al.* (2008)[60]	(1), S	L	II	Medium	361 pregnant women	Prenatal care	control	Physician
Costa *et al.* (2009)[61]	(1), SE	S	IV	Medium	33 pregnant women and 35 professionals	Prenatal care	organization and control	Dietician
Lima *et al.* (2009)[62]	(1), SE	M	I	High	472 hypertensives	HBP/DM	planning and control	Physician
Niquini *et al.* (2010)[63]	(1), SE	M	I	High	7 FHCU e 230 pregnant women	Prenatal care	organization	Dietician
Niquini *et al.* (2012)[64]	(1), SE	M	I	High	230 pregnant women	Prenatal care	control	Dietician
Cervato-Mancuso *et al.* (2012)[65]	(1), SE	M	II	High	123 dieticians from primary care and 51 from NASF	Professional practice	planning and organization	Dietician
Cesar *et al.* (2012)[66]	(1), S	L	II	Medium	2395 mothers	Prenatal care	control	Physician

Note: [a]Size of the municipality. Source: *Instituto Brasileiro de Geografia e Estatística,* 2007[19]; S: Small; MS: Medium-Sized; L: Large, M: Metropolis; [b]Source: DATASUS, 2007; FHS cover: Family Health Strategy coverage as follows: I - 0% to 20%; II - 20 to 50%, III - 50 to 70%, IV - >70%; [c]Source: Programa das Nações Unidas para o Desenvolvimento, 2000. HDI-M: Human Development Index of the Municipality classified as medium (0.5 to 0.799) and high (≥0.80); [d]The local/municipal management consists of the following elements: planning, organization, management, and control. FHCU: Family Health Care Unit; NASF: Family Health Support Center; HBP: High Blood Pressure; DM: Diabetes *Mellitus*; SE: Southeast; NE: Northeast; CW: Central West; S: South; N: North.

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Table 3. Characterization of the qualitative studies on diagnosis, health promotion/care, and management. Brazil, 2003 to 2012.

Author, year	Municípalities	Size[a]	FHS cover[b]	HDI-M[c]	Sample	Topic	Purpose[d]	Education of the 1º author
Felisberto *et al*. (2002)[67]	(10), NE	6 S; 1 MS; 3L	2 III and 8 IV	10 Medium	10 coordinators and 146 professionals	Child health/ care	MT - control	Physician
Fernandez *et al.* (2005)[68]	(1), SE	M	II	High	8 physicians, 8 nurses, 45 CA, 16 nurse assistants	Food and nutrition	MT - organization	Dietician
Alves e Nunes (2006)[69]	(3), NE	-	-	-	50 appointments with 10 FHS physicians	HBP/DM	HP	Psychologist
Bustamante e Trad (2007)[70]	(1), NE	M	I	High	6 families with small children	Child health/ care	D	Psychologist
Slomp *et al.* (2007)[71]	(1), S	L	III	Medium	90 newborns	Child health/ care	NCT	Nurse
Frota *et al.* (2009)[72]	(1), NE	S	IV	Medium	15 mothers with children aged <1 year	Breastfeeding	D	Nurse
Pontes *et al.* (2009)[73]	(1), NE	M	III	Medium	17 couples and parents of children aged 6 to 8 months	Breastfeeding	D	Nurse
Silva *et al.* (2009)[74]	(1), SE	L	II	Medium	15 physicians	Prenatal/child care	NCT	Physician
Araújo *et al.* (2010)[75]	(1), NE	S	IV	Medium	11 nurses	HBP/DM	NCT	Nurse
Pinto & Bosi (2010)[76]	(1), NE	M	I	Medium	8 obese adult females	Nutritional status	D	Dietician
Ramos & Cuervo (2012)[77]	(1), S	M	I	High	11 PHCU or FHCU coordinators and 12 professionals	Welfare program/HRAF	MT - planning and organization	Dietician
Camossa *et al.* (2012)[78]	(1), SE	L	II	High	21 professionals from 2 teams, 6 residents and 1 manager	Professional practice	MT - planning and organization	Dietician

Note: [a]Size of the municipality. Source: *Instituto Brasileiro de Geografia e Estatística*, 2007[19]; S: Small; MS: Medium-Sized; L: Large, M: Metropolis; [b]Source: DATASUS, 2007; FHS cover: Family Health Strategy coverage as follows: I - 0% to 20%; II - 20% to 50%, III - 50% to 70%, IV - >70%; [c]Source: *Programa das Nações Unidas para o Desenvolvimento*, 2000. HDI-M: Human Development Index of the Municipality classified as medium (0.5 to 0.799) and high (≥0.80); [d]Focus of the food and nutrition actions according to the source Brasil, 2009.
D: Diagnosis; HP: Health Promotion; DP: Disease Prevention; NCT: Nutritional Ambulatory Care/Care/Treatment; The local/Municipal Management (MT) consists of the following elements: planning, organization, management, and control; HBP: High Blood Pressure; DM: Diabetes *Mellitus*; PHCU: Primary Health Care Unit; FHCU: Family Health Care Unit; HRAF: Human Right to Adequate Food; CA: Community Agents; SE: Southeast; NE: Northeast; CW: Central West; S: South; N: North.

and one provided ambulatory care/care/treatment (assistance to diabetics).

Table 2 shows studies with management-attribution actions. Sixteen studies were quantitative, of which four were intervention studies, ten were cross-sectional studies, one was a cohort study, and one was a community-based trial study. Five of these studies regarded secondary data (two were retrospective) obtained from the child health booklet (which contains a child's health, vaccination, and nutritional data called *Cardeneta da Criança*), medical records,

national health establishment registry, Municipal Health Department and pregnant women's record (*Cartão da Gestante*).

Most studies on management (n=15) consisted of assessments: five studies made impact assessments[51,54-56,60]; one assessed effectiveness[59]; nine made service assessments, of which one analyzed structure, process, and result[61]; three studies approached only two of these dimensions[53,57,62]; and five assessed only one of these dimensions[52,58,63-65]. The only study that did not involve an assessment analyzed the dietician's work in a municipality, and whether the municipality had an adequate number of dieticians[66].

Eleven studies included samples representative of the municipality[51-53,57,59-61,63-66], four included specific samples (Health Care Center or Sanitation District)[54,56,58,62], and one with regional representativeness included samples of four municipalities of two Brazilian Northeast states[55].

Regarding management actions (Table 2), nine publications regarded control; three regarded specific organization actions; two regarded organization and control actions; and two regarded planning and control actions.

Table 3 shows the twelve qualitative studies that combined different nutritional care and management actions. Despite their qualitative nature, two had representative samples: the first included coordinators and professionals from ten municipalities in a Brazilian-Northeast state[67]; and the second included physicians from a municipality[74].

Few studies in this table consisted of assessments. One study assessed structure[68]; two assessed process[69,77], and one assessed structure and process[67].

One of these studies used secondary data sources, namely birth certificates and medical records[71].

Some articles of the tables 1, 2, and 3 analyzed when the Family Health Strategy was

Table 4. Distribution of the research groups by keywords. Brazil, 2000-2012.

Keywords	2000	2002	2004	2006	2008	2010	Database*
CH + Nut	7	19	24	24	21	34	42
CH + Diet	0	2	9	11	10	18	27
CH + Nut + Diet	0	2	8	11	9	18	27
PH + Nut	6	16	23	26	27	33	35
PH + Diet	0	6	10	12	12	14	21
PH + Nut + Diet	0	5	9	10	10	12	19
BC + Nut	0	1	2	2	6	8	9
BC + Diet	0	1	2	2	5	6	5
BC + Nut + Diet	0	1	2	2	4	5	5
PC + Nut	0	2	2	1	1	5	10
PC + Diet	0	2	2	4	3	5	10
PC + Nut + Diet	0	0	0	1	1	3	7
FHS + Nut	2	3	4	9	11	11	10
FHS + Diet	0	1	1	6	8	6	7
FHS + Nut + Diet	0	0	0	3	5	4	5
CA + Nut	0	0	1	1	1	1	1
CA + Diet	0	0	0	0	0	0	1
CA + Nut + Diet	0	0	0	0	0	0	1

Note: *number of research groups found in the database during the search period.
Nut: Nutrition (*Nutrição*); Diet: Diet (*Alimentação*); CH: Collective Health (*Saúde Coletiva*); PH: Public Health (Saúde Pública); BA: Basic Care (Atenção Básica); PC: Primary Care (Atenção Primária); FHS: Family Health Strategy (Estratégia Saúde da Família); CA: Community Agents (Agentes Comunitários).

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implemented in the study municipalities: 1997[35,39], 1998[74], 2000[29,52], 2001[51,70], and 2002[40,54,62].

Research groups

Table 4 shows the distribution of the research groups according to the RGD from 2000 on and the great increase in the area's research capacity. The groups who explicitly cited primary care as a study field of food and nutrition numbered two in 2000, eight in 2002, eleven in 2004, 18 in 2006, 22 in 2008, 24 in 2010, and 26 when the database was consulted. Some groups focused at least one research line in food and nutrition within the Family Health Strategy: one in 2002, two in 2004, three in 2006, four in 2008, seven in 2010, and four in the database.

On the other hand, the search based on tracking the authors' names found another 30 groups that studied food and nutrition in primary care, totaling 54 groups when added to the groups found by keywords, and only two more groups focusing on the Family Health Strategy, totaling five research groups. The research lines of these groups regarding primary care and Family Health Strategy totaled 82 and 8, respectively.

Table 5 shows the characteristics of the research groups found in the database by keywords and author tracking. The year of establishment of the groups that focused on primary care varied considerably, but these groups became more common after 2000. Meanwhile, the groups that focused on Family Health Strategy appeared somewhat recently.

Most groups' institutions are located in the Brazilian Southeast (n=25), Northeast (n=16), and South (n=11) regions, and most of the groups were from the areas of nutrition (n=25), collective/public health (n=18), and medicine (n=11).

Table 5. Distribution of the research groups during the search period according to year of establishment, institution location by Brazilian region, and prevailing academic area. Brazil, 2012.

	Year of establishment (n)		Brazilian region of the institution		Prevailing academic area	
	PHC	FHS	PHC	FHS	PHC	FHS
Base corrente	1976 (1)	1999 (1)	SE (22)	SE (3)	Nutrition (23)	Collective health (2)
	1982 (1)	2002 (1)	NE (15)	CW (1)	Collective health (16)	Nutrition (2)
	1989 (1)	2007 (1)	S (11)	NE (1)	Medicine (10)	Medicine (1)
	1990 (2)	2009 (2)	CW (5)		Others (5)	
	1992 (2)		N (1)			
	1995 (1)					
	1996 (1)					
	1997 (1)					
	1999 (1)					
	2000 (7)					
	2001 (1)					
	2002 (1)					
	2004 (6)					
	2005 (3)					
	2006 (5)					
	2007 (2)					
	2008 (3)					
	2009 (2)					
	2010 (4)					
	2011 (5)					
	2012 (4)					
Total	54	5	54	5	54	5

Note: PHC: Primary Health Care; FHS: Family Health Strategy; SE: Southeast; NE: Northeast; CW: Central West; S: South; N: North.

DISCUSSION

The present results indicated a scarcity of studies on food and nutrition within the scope of the Family Health Strategy. However, other studies may exist since this review aimed to search only in the renowned journals. It is also possible that the Family Health Strategy management in some municipalities conducts only routine diagnoses and assessments, published in technical, not scientific, publications.

The Family Health Strategy was implemented in the municipalities from four to eight years after the agreement between the Ministry of Health and the states and municipalities for the construction of a new model (1994). Family Health Strategy coverage also varied greatly, from 14.5% to 94.0% in the referenced municipalities. Yet, high coverage does not ensure complete implementation of all the actions related to primary care's basic strategy areas[79].

Family Health Strategy coverage is increasing much more rapidly in small Brazilian municipalities than in medium-sized and large municipalities. The advantage of the small municipalities is that they do not have a previously structured service network[68,80]. On the other hand, not only do larger municipalities require more organizational, political, and financial resources to reach good coverage, but they also provide care to individuals from other municipalities[21,80,81]. In fact, the 13 municipalities with less than 50% Family Health Strategy coverage were large cities or metropolises, and 17 of the 21 municipalities with more than 70% Family Health Strategy coverage were small.

In general, the municipalities with the lowest HDI-M had high Family Health Strategy coverage; low HDI-M is a primary requirement for the Ministry of Health to implement the strategy[21].

Most studies were conducted in Brazilian Southeast municipalities mostly with low Family Health Strategy coverage. The Northeast region follows with the highest number of studies and highest mean Family Health Strategy coverage[21]. Since the approach regards food and nutrition and Family Health Strategy, the highest number of research groups in the Brazilian Southeast may explain the numerous articles. Search in the DGP confirmed the prevalence of the Southeast in the number of institutions with groups studying primary health care and the Family Health Strategy (Table 5). Nevertheless, numerous groups are also located in the Brazilian Northeast and South.

The information retrieved from the group and research line search confirm the scarcity of studies. Although a significant number of groups study food and nutrition in primary care, the number of groups that focus specifically on the Family Health Strategy is still small. However, focus on Family Health Strategy should be awakened and improved in view of the growing implementation of *Núcleo de Apoio a Saúde da Família* (NASF, Family Health Support Centers) and employment of dieticians in Brazilian municipalities after Ordinance nº 154/2008 was passed[82].

Research Group Directory-based search has some limitations. Group selection depends on the detailed description of the researchers and respective keywords, and the latter are often used by many research lines. Therefore, it is possible that some groups appear as focusing on primary care when in fact they focus on Family Health Strategy. Another possibility is that some research groups left some fields blank when filling out the form, so they do not appear in any research line.

Time is also a limiting factor even in census-based searches because sometimes a group is inactivated and recertified by an institution, skipping a census. Also, it is not possible to distinguish between ongoing and completed studies in each research line unless the information is updated by the researchers.

Despite these weaknesses and need of improvement, this research tool is critical for disclosing the Brazilian food and nutrition research potential.

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Most studies are quantitative, indicating the prevalence of the positivistic approach over the understanding approach as a way of making the area of collective health scientifically legitimate[83]. However, there were many qualitative or mixed studies with solid methods, showing the academic effort (here, specifically the Brazilian) of making increasingly deep analyses in the health area[83].

Nevertheless, the food and nutrition actions in most studies were small and local, as shown by Tables 1, 2, and 3. This situation may impact professional practice. Although dieticians lead many studies, the number of nurses and physicians coordinating studies on food and nutrition was significant.

Among others, nurses have been protagonists in the establishment of the Family Health Strategy. But nurses accumulate many roles, including organizing the teamwork, and administrative and management activities[75]. Hence, the food and nutrition actions they create eventually appear[75]. Boog *et al.*[84] mention that physicians and nurses find performing nutrition education activities challenging because they do not have the right background for this task and cannot deal with the subjective aspects associated with food intake.

Few studies mention dieticians in the Family Health Strategy teams or supporting them[35,42,47,77], despite the fact that other studies have suggested their inclusion in such teams or their working in parallel[56,78,85]. Nurses' and physicians' limited education in food and nutrition, nurses' excessive workload in the Family Health Strategy, and the absence of a dietician may suggest the reason for food and nutrition actions appearing diluted in face of other actions more in line with the nurse's or physician's work.

The most common study topics and populations were diabetes mellitus/diabetics and high blood pressure/hypertensives. These individuals were often targeted by actions focusing on anthropometric assessment, salt/sugar restriction recommendations, and prescriptive recommendations made mainly by physicians or nurses[38,42,46,56,69,75]. Although not provided routinely, education on healthier lifestyles and food habits was cited as the most effective primary control strategy, and sometimes the only control strategy[28,38,42,46,62]. In spite of the importance of chronic NCD in the Brazilian nosological landscape, the studies that covered NCD comprehensively and from the viewpoint of multiple sectors were scarce.

Breastfeeding and child care were the second most common topics. Mother and child care has been a governmental priority in public health since the 1940s, and the people's priority since the 1980s, when the people demanded the creation and establishment of health policies[86]. In 2006 child's health officially becomes a strategic area of the National Primary Health Care Policy[14]. Health professionals[10] are responsible for health-promoting and disease-preventing food and nutrition actions, including the promotion of breastfeeding, possibly increasing interest on this topic.

However, woman's health care is not yet comparable to the quality of child's health care. The number of prenatal visits, and the quality and extent of this kind of care are yet inadequate, contributing to the persistently high mother mortality rates[86]. Few studies focused on this life stage.

None of the studies sampled adolescents, probably because the public health policies for this population were only introduced in primary care recently. In 2007 the Ministry of Health, together with the Ministry of Education, made possible the institution of health-related actions through the *Programa de Saúde na Escola* (PSE, School Health Program)[87] and created a care guide and record in 2009[88]. The *Semana Anual de Mobilização Saúde na Escola* (Annual Week for School Health Mobilization) began in 2012 with the topic 'preventing obesity', representing the launching of PSE actions[89]. This may encourage researchers to conduct Family Health Strategy food and nutrition studies on this population.

Although they constitute the National Policy for Food and Nutrition guidelines[15], the theme Sisvan was not approached by any study and the themes on welfare programs (*Programas de Transferência de Renda*) and the Human Right to Adequate Food (HRAF) were approached in only one study. The current context is the persistence of food insecurity[5]; health professionals' feeling of helplessness, little knowledge about their work, and the perceived inability to establish intersectoral cooperation when they come across this reality[90]; and the organizational challenge of coordinating the welfare programs and the programs that encourage access to social rights[91]. On the other hand, the Family Health Strategy has reach and allows professionals to access population needs[15] that require further investigation.

Nearly all articles on management regarded assessment, so they were also interconnected with either control (service operation, degree of action implementation, and monitoring of the indicators of the target population) or organization (training and structure)[10]. Few studies approached planning and management aspects. These four elements must be balanced for the proper planning and coordination of nutritional care by the different care levels, units, and teams[10].

The other intervention levels defined by the Matrix[10] were mostly on nutritional diagnosis. This situation indicates how food and nutrition actions are restricted to immediate health problem resolution and not comprehensive enough to promote consistent health-promoting changes. Hence, nobody has yet used the principle of comprehensiveness care as a guide to health education actions that consider subjects emancipators and allow action coordination to flow intersectorally[17].

Although focusing on primary care, a recent article[92] mapped, systematized, and assessed the scientific production in nutrition, and its findings were similar to the present findings. The said article reviewed 117 studies; most used quantitative research methods (n=106); were published in the last decade (n=75); involved the Brazilian Southeast and South regions (n=69); focused on nutritional diagnosis (n=43); and sampled children (n=45). Studies on HRAF and welfare programs were not found.

CONCLUSION

Studies on food and nutrition in the Family Health Strategy are occasional, and probably were conducted by a few research groups that explore the theme. Food and nutrition actions are limited and local. Greater interest lies in child health-related studies. Generally, most studies on the management of food and nutrition actions explored their control and organization, and studies on nutritional care focused on nutritional diagnosis.

In conclusion, authorities should foment studies that propose more widespread and consistent food and nutrition actions in the Family Health Strategy, especially family- and group-oriented actions that foster the principles of comprehensive health care.

CONTRIBUTORS

IAL VASCONCELOS sought the articles and research groups in the Research Group Directory, wrote the article, and organized the references. LMP SANTOS supervised the work, reviewed the published articles, guided the Research Group Directory search, and helped to write and review the manuscript.

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INSTRUÇÕES AOS AUTORES

Escopo e política

A **Revista de Nutrição/*Brazilian Journal of Nutrition*** é um periódico especializado que publica artigos que contribuem para o estudo da Nutrição em suas diversas subáreas e interfaces. Com periodicidade bimestral, está aberta a contribuições da comunidade científica nacional e internacional.

Os manuscritos podem ser rejeitados sem comentários detalhados após análise inicial, por pelo menos dois editores da Revista de Nutrição, se os artigos forem considerados inadequados ou de prioridade científica insuficiente para publicação na Revista.

O Conselho Editorial não se responsabiliza por conceitos e imagens emitidas em artigos assinados.

Categoria dos artigos

A Revista aceita artigos inéditos em português, espanhol ou inglês, com título, resumo e termos de indexação no idioma original e em inglês, nas seguintes categorias:

Original: contribuições destinadas à divulgação de resultados de pesquisas inéditas, tendo em vista a relevância do tema, o alcance e o conhecimento gerado para a área da pesquisa (limite máximo de 5 mil palavras).

Especial: artigos a convite sobre temas atuais (limite máximo de 6 mil palavras).

Revisão (a convite): síntese de conhecimentos disponíveis sobre determinado tema, mediante análise e interpretação de bibliografia pertinente, de modo a conter uma análise crítica e comparativa dos trabalhos na área, que discuta os limites e alcances metodológicos, permitindo indicar perspectivas de continuidade de estudos naquela linha de pesquisa (limite máximo de 6 mil palavras). Serão publicados até dois trabalhos por fascículo.

Comunicação: relato de informações sobre temas relevantes, apoiado em pesquisas recentes, cujo mote seja subsidiar o trabalho de profissionais que atuam na área, servindo de apresentação ou atualização sobre o tema (limite máximo de 4 mil palavras).

Nota Científica: dados inéditos parciais de uma pesquisa em andamento (limite máximo de 4 mil palavras).

Ensaio: trabalhos que possam trazer reflexão e discussão de assunto que gere questionamentos e hipóteses para futuras pesquisas (limite máximo de 5 mil palavras).

Seção Temática (a convite): seção destinada à publicação de 2 a 3 artigos coordenados entre si, de diferentes autores, e versando sobre tema de interesse atual (máximo de 10 mil palavras no total).

Categoria e a área temática do artigo

Os autores devem indicar a categoria do artigo e a área temática, a saber: alimentação e ciências sociais, avaliação nutricional, bioquímica nutricional, dietética, educação nutricional, epidemiologia e estatística, micronutrientes, nutrição clínica, nutrição experimental, nutrição e geriatria, nutrição materno-infantil, nutrição em produção de refeições, políticas de alimentação e nutrição e saúde coletiva.

Pesquisas envolvendo seres vivos

Resultados de pesquisas relacionadas a seres humanos e animais devem ser acompanhados de cópia de aprovação do parecer de um Comitê de Ética em pesquisa.

Registros de Ensaios Clínicos

Artigos com resultados de pesquisas clínicas devem apresentar um número de identificação em um dos Registros de Ensaios Clínicos validados pelos critérios da Organização Mundial da Saúde (OMS) e do *Intemational Committee of Medical Journal Editors* (ICMJE), cujos endereços estão disponíveis no site do ICMJE. O número de identificação deverá ser registrado ao final do resumo.

Procedimentos editoriais

Autoria

A indicação dos nomes dos autores logo abaixo do título do artigo é limitada a 6. O crédito de autoria deverá ser baseado em contribuições substanciais, tais como concepção e desenho, ou análise e interpretação dos dados. Não se justifica a inclusão de nomes de autores cuja contribuição não se enquadre nos critérios acima.

Os manuscritos devem conter, na página de identificação, explicitamente, a contribuição de cada um dos autores.

Processo de julgamento dos manuscritos

Todos os outros manuscritos só iniciarão o processo de tramitação se estiverem de acordo com as Instruções aos Autores. Caso contrário, serão devolvidos para adequação às normas, inclusão de carta ou de outros documentos eventualmente necessários.

Recomenda-se fortemente que o(s) autor(es) busque(m) assessoria linguística profissional (revisores e/ou tradutores certificados em língua portuguesa e inglesa) antes

de submeter(em) originais que possam conter incorreções e/ou inadequações morfológicas, sintáticas, idiomáticas ou de estilo. Devem ainda evitar o uso da primeira pessoa "meu estudo...", ou da primeira pessoa do plural "percebemos....", pois em texto científico o discurso deve ser impessoal, sem juízo de valor e na terceira pessoa do singular.

Originais identificados com incorreções e/ou inadequações morfológicas ou sintáticas **serão devolvidos antes mesmo de serem submetidos à avaliação** quanto ao mérito do trabalho e à conveniência de sua publicação.

Pré-análise: a avaliação é feita pelos Editores Científicos com base na originalidade, pertinência, qualidade acadêmica e relevância do manuscrito para a nutrição.

Aprovados nesta fase, os manuscritos serão encaminhados aos revisores *ad hoc* selecionados pelos editores. Cada manuscrito será enviado para dois revisores de reconhecida competência na temática abordada, podendo um deles ser escolhido a partir da indicação dos autores. Em caso de desacordo, o original será enviado para uma terceira avaliação.

Os autores devem indicar três possíveis revisores para o manuscrito. Opcionalmente, podem indicar três revisores para os quais não gostaria que seu trabalho fosse enviado.

Todo processo de avaliação dos manuscritos terminará na segunda e última versão.

O processo de avaliação por pares é o sistema de *blind review*, procedimento sigiloso quanto à identidade tanto dos autores quanto dos revisores. Por isso os autores deverão empregar todos os meios possíveis para evitar a identificação de autoria do manuscrito.

Os pareceres dos revisores comportam três possibilidades: a) aprovação; b) recomendação de nova análise c) recusa. Em quaisquer desses casos, o autor será comunicado.

Os pareceres são analisados pelos editores, que propõem ao Editor Científico a aprovação ou não do manuscrito.

Manuscritos recusados, mas com a possibilidade de reformulação, poderão retornar como novo trabalho, iniciando outro processo de julgamento.

Conflito de interesse

No caso da identificação de conflito de interesse da parte dos revisores, o Comitê Editorial encaminhará o manuscrito a outro revisor *ad hoc*.

Manuscritos aceitos: manuscritos aceitos poderão retornar aos autores para aprovação de eventuais alterações, no processo de editoração e normalização, de acordo com o estilo da Revista.

Provas: serão enviadas provas tipográficas aos autores para a correção de erros de impressão. As provas devem retornar ao Núcleo de Editoração na data estipulada. Outras mudanças no manuscrito original não serão aceitas nesta fase.

Publicação em inglês: em caso de aprovação, os artigos indicados pelo Conselho Editorial serão publicados na versão em inglês. Nestes casos para que o manuscrito seja publicado, os autores deverão providenciar sua versão completa (tal como aprovado) para o inglês, arcando com os custos de sua tradução. Para assegurar a qualidade e uniformidade dos textos traduzidos para a Língua Inglesa, esse trabalho deverá ser realizado, necessariamente, por um tradutor altamente capacitado e com experiência comprovada na versão de textos científicos, indicados e credenciados junto à Revista.

Preparo do manuscrito

Submissão de trabalhos

Serão aceitos trabalhos acompanhados de carta assinada por todos os autores, com descrição do tipo de trabalho e da área temática, declaração de que o trabalho está sendo submetido apenas à Revista de Nutrição e de concordância com a cessão de direitos autorais e uma carta sobre a principal contribuição do estudo para a área.

Caso haja utilização de figuras ou tabelas publicadas em outras fontes, deve-se anexar documento que ateste a permissão para seu uso.

Enviar os manuscritos via *site* <http://www.scielo.br/rn>, preparados em espaço entrelinhas 1,5, com fonte *Arial* 11. O arquivo deverá ser gravado em editor de texto similar ou superior à versão 97-2003 do *Word* (*Windows*).

É fundamental que o escopo do artigo **não contenha qualquer forma de identificação da autoria**, o que inclui referência a trabalhos anteriores do(s) autor(es), da instituição de origem, por exemplo.

O texto deverá contemplar o número de palavras de acordo com a categoria do artigo. As folhas deverão ter numeração personalizada desde a folha de rosto (que deverá apresentar o número 1). O papel deverá ser de tamanho A4, com formatação de margens superior e inferior (no mínimo 2,5cm), esquerda e direita (no mínimo 3cm).

Os artigos devem ter, aproximadamente, 30 referências, exceto no caso de artigos de revisão, que podem apresentar em torno de 50. Sempre que uma referência possuir o número de *Digital Object Identifier* (DOI), este deve ser informado.

O texto do artigo deverá empregar fonte colorida (cor azul) ou sublinhar, para todas as alterações, juntamente com uma carta ao editor, reiterando o interesse em publicar nesta Revista e informando quais alterações foram processadas no manuscrito. Se houver discordância quanto às recomendações dos revisores, o(s) autor(es) deverão apresentar os argumentos que justificam sua posição.

O título e o código do manuscrito deverão ser especificados.

Versão reformulada: a versão reformulada deverá ser encaminhada via <http://www.scielo.br/rn>. **O(s) autor(es) deverá(ão) enviar apenas a última versão do trabalho**.

Página de rosto deve conter

a) título completo - deve ser conciso, evitando excesso de palavras, como "avaliação do....", "considerações acerca de..." 'estudo exploratório....";

b) *short title* com até 40 caracteres (incluindo espaços), em português (ou espanhol) e inglês;

c) nome de todos os autores por extenso, indicando a filiação institucional de cada um. Será aceita uma única titulação e filiação por autor. O(s) autor(es) deverá(ão), portanto, escolher, entre suas titulações e filiações institucionais, aquela que julgar(em) a mais importante;

d) todos os dados da titulação e da filiação deverão ser apresentados por extenso, sem siglas;

e) indicação dos endereços completos de todas as universidades às quais estão vinculados os autores;

f) indicação de endereço para correspondência com o autor para a tramitação do original, incluindo fax, telefone e endereço eletrônico.

Observação: esta deverá ser a única parte do texto com a identificação dos autores.

Resumo: todos os artigos submetidos em português ou espanhol deverão ter resumo no idioma original e em inglês, com um mínimo de 150 palavras e máximo de 250 palavras.

Os artigos submetidos em inglês deverão vir acompanhados de resumo em português, além do *abstract* em inglês.

Para os artigos originais, os resumos devem ser estruturados destacando objetivos, métodos básicos adotados, informação sobre o local, população e amostragem da pesquisa, resultados e conclusões mais relevantes, considerando os objetivos do trabalho, e indicando formas de continuidade do estudo.

Para as demais categorias, o formato dos resumos deve ser o narrativo, mas com as mesmas informações.

O texto não deve conter citações e abreviaturas. Destacar no mínimo três e no máximo seis termos de indexação, utilizando os descritores em Ciência da Saúde - DeCS - da Bireme <http://decs.bvs.br>.

Texto: com exceção dos manuscritos apresentados como Revisão, Comunicação, Nota Científica e Ensaio, os trabalhos deverão seguir a estrutura formal para trabalhos científicos:

Introdução: deve conter revisão da literatura atualizada e pertinente ao tema, adequada à apresentação do problema, e que destaque sua relevância. Não deve ser extensa, a não ser em manuscritos submetidos como Artigo de Revisão.

Métodos: deve conter descrição clara e sucinta do método empregado, acompanhada da correspondente citação bibliográfica, incluindo: procedimentos adotados; universo e amostra; instrumentos de medida e, se aplicável, método de validação; tratamento estatístico.

Em relação à análise estatística, os autores devem demonstrar que os procedimentos utilizados foram não somente apropriados para testar as hipóteses do estudo, mas também corretamente interpretados. Os níveis de significância estatística (ex. $p<0,05$; $p<0,01$; $p<0,001$) devem ser mencionados.

Informar que a pesquisa foi aprovada por Comitê de Ética credenciado junto ao Conselho Nacional de Saúde e fornecer o número do processo.

Ao relatar experimentos com animais, indicar se as diretrizes de conselhos de pesquisa institucionais ou nacionais - ou se qualquer lei nacional relativa aos cuidados e ao uso de animais de laboratório - foram seguidas.

Resultados: sempre que possível, os resultados devem ser apresentados em tabelas ou figuras, elaboradas de forma a serem auto-explicativas e com análise estatística. Evitar repetir dados no texto.

Tabelas, quadros e figuras devem ser limitados a cinco no conjunto e numerados consecutiva e independentemente com algarismos arábicos, de acordo com a ordem de menção dos dados, e devem vir em folhas individuais e separadas, com indicação de sua localização no texto. **É imprescindível a informação do local e ano do estudo**. A cada um se deve atribuir um título breve. Os quadros e tabelas terão as bordas laterais abertas.

O(s) autor(es) se responsabiliza(m) pela qualidade das figuras (desenhos, ilustrações, tabelas, quadros e gráficos), que deverão ser elaboradas em tamanhos de uma ou duas colunas (7 e 15cm, respectivamente); **não é permitido o formato paisagem**. Figuras digitalizadas deverão ter extensão jpeg e resolução mínima de 400 dpi.

Gráficos e desenhos deverão ser gerados em programas de desenho vetorial (*Microsoft Excel*, *CorelDraw*, *Adobe Illustrator* etc.), acompanhados de seus parâmetros quantitativos, em forma de tabela e com nome de todas as variáveis.

A publicação de imagens coloridas, após avaliação da viabilidade técnica de sua reprodução, será custeada pelo(s) autor(es). Em caso de manifestação de interesse por parte do(s) autor(es), a Revista de Nutrição providenciará um orçamento dos custos envolvidos, que poderão variar de acordo com o número de imagens, sua distribuição em páginas diferentes e a publicação concomitante de material em cores por parte de outro(s) autor(es).

Uma vez apresentado ao(s) autor(es) o orçamento dos custos correspondentes ao material de seu interesse, este(s) deverá(ão) efetuar depósito bancário. As informações para o depósito serão fornecidas oportunamente.

Discussão: deve explorar, adequada e objetivamente, os resultados, discutidos à luz de outras observações já registradas na literatura.

Conclusão: apresentar as conclusões relevantes, considerando os objetivos do trabalho, e indicar formas de continuidade do estudo. **Não serão aceitas citações bibliográficas nesta seção**.

Agradecimentos: podem ser registrados agradecimentos, em parágrafo não superior a três linhas, dirigidos a instituições ou indivíduos que prestaram efetiva colaboração para o trabalho.

Anexos: deverão ser incluídos apenas quando imprescindíveis à compreensão do texto. Caberá aos editores julgar a necessidade de sua publicação.

Abreviaturas e siglas: deverão ser utilizadas de forma padronizada, restringindo-se apenas àquelas usadas convencionalmente ou sancionadas pelo uso, acompanhadas do significado, por extenso, quando da primeira citação no texto. Não devem ser usadas no título e no resumo.

Referências de acordo com o estilo *Vancouver*

Referências: devem ser numeradas consecutivamente, seguindo a ordem em que foram mencionadas pela primeira vez no texto, conforme o estilo *Vancouver*.

Nas referências com dois até o limite de seis autores, citam-se todos os autores; acima de seis autores, citam-se os seis primeiros autores, seguido de *et al*.

As abreviaturas dos títulos dos periódicos citados deverão estar de acordo com o *Index Medicus*.

Não serão aceitas citações/referências de **monografias** de conclusão de curso de graduação, **de trabalhos** de Congressos, Simpósios, *Workshops*, Encontros, entre outros, e de **textos não publicados** (aulas, entre outros).

Se um trabalho não publicado, de autoria de um dos autores do manuscrito, for citado (ou seja, um artigo *in press*), será necessário incluir a carta de aceitação da revista que publicará o referido artigo.

Se dados não publicados obtidos por outros pesquisadores forem citados pelo manuscrito, será necessário incluir uma carta de autorização, do uso dos mesmos por seus autores.

Citações bibliográficas no texto: deverão ser expostas em ordem numérica, em algarismos arábicos, meia linha acima e após a citação, e devem constar da lista de referências. Se forem dois autores, citam-se ambos ligados pelo "&"; se forem mais de dois, cita-se o primeiro autor, seguido da expressão *et al*.

A exatidão e a adequação das referências a trabalhos que tenham sido consultados e mencionados no texto do artigo são de responsabilidade do autor. Todos os autores cujos trabalhos forem citados no texto deverão ser listados na seção de Referências.

Exemplos

Artigo com um autor

Burlandy L. A construção da política de segurança alimentar e nutricional no Brasil: estratégias e desafios para a promoção da intersetorialidade no âmbito federal de governo. Ciênc Saúde Coletiva. 2009; 14(3):851-60. doi: 10.1590/S1413-81232009000300020.

Artigo com mais de seis autores

Oliveira JS, Lira PIC, Veras ICL, Maia SR, Lemos MCC, Andrade SLL, *et al*. Estado nutricional e insegurança alimentar de adolescentes e adultos em duas localidades de baixo índice de desenvolvimento humano. Rev Nutr. 2009; 22(4): 453-66. doi: 10.1590/S1415-52732009000400002.

Livro

Alberts B, Lewis J, Raff MC. Biologia molecular da célula. 5ª ed. Porto Alegre: Artmed; 2010.

Capítulos de livros

Aciolly E. Banco de leite. In Aciolly E. Nutrição em obstetrícia e pediatria. 2ª ed. Rio de Janeiro: Guanabara Koogan; 2009. Unidade 4.

Dissertações e teses

Duran ACFL. Qualidade da dieta de adultos vivendo com HIV/AIDS e seus fatores associados [mestrado]. São Paulo: Universidade de São Paulo; 2009.

Artigo em suporte eletrônico

Sichieri R, Moura EC. Análise multinível das variações no índice de massa corporal entre adultos, Brasil, 2006. Rev Saúde Pública. 2009 [acesso 2009 dez 18]; 43(Supl 2):

90-7. Disponível em: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-89102009000900012&lng=pt&nrm=iso>. doi: 10.1590/S0034-89102009000900012.

Livro em suporte eletrônico

Brasil. Alimentação saudável para pessoa idosa: um manual para o profissional da saúde. Brasília: Ministério da Saúde; 2009 [acesso 2010 jan 13]. Disponível em: <http://200.18.252.57/services/e-books/alimentacao_saudavel_idosa_profissionais_saude.pdf>.

Capítulo de livro em suporte eletrônico

Emergency contraceptive pills (ECPs). In World Health Organization. Medical eligibility criteria for contraceptive use. 4th ed. Geneva: WHO; 2009 [cited 2010 Jan 14]. Available from: <http://whqlibdoc.who.int/publications/2009/9789241563888_eng.pdf>.

Texto em formato eletrônico

Sociedade Brasileira de Nutrição Parental e Enteral. Assuntos de interesse do farmacêutico atuante na terapia nutricional. 2008/2009 [acesso 2010 jan 14]. Disponível em: <http://www.sbnpe.com.br/ctdpg.php?pg=13&ct=A>.

Para outros exemplos recomendamos consultar as normas do *Committee of Medical Journals Editors* (Grupo Vancouver) <http://www.icmje.org>.

Lista de checagem

- Declaração de responsabilidade e transferência de direitos autorais assinada por cada autor.

- Verificar se o texto, incluindo resumos, tabelas e referências, está reproduzido com letras fonte *Arial,* corpo 11 e entrelinhas 1,5 e com formatação de margens superior e inferior (no mínimo 2,5cm), esquerda e direita (no mínimo 3cm).

- Indicação da categoria e área temática do artigo.

- Verificar se estão completas as informações de legendas das figuras e tabelas.

- Preparar página de rosto com as informações solicitadas.

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GUIDE FOR AUTHORS

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The **Brazilian Journal of Nutrition** is a specialized periodical that publishes articles that contribute to the study of Nutrition in its many sub-areas and interfaces. It is published bimonthly and open to contributions of the national and international scientific communities.

Submitted manuscripts may be rejected without detailed comments after initial review by at least two **Brazilian Journal of Nutrition** editors if the manuscripts are considered inappropriate or of insufficient scientific priority for publication in the Journal.

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Book

Alberts B, Lewis J, Raff MC. Biologia molecular da célula. 5ª ed. Porto Alegre: Artmed; 2010.

Book chapters

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Dissertations and theses

Duran ACFL. Qualidade da dieta de adultos vivendo com HIV/AIDS e seus fatores associados [mestrado]. São Paulo: Universidade de São Paulo; 2009.

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Electronic book chapters

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Electronic texts

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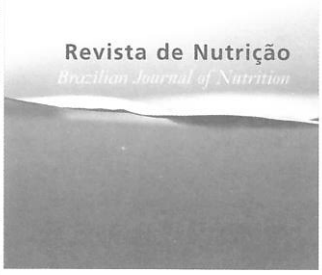

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