Nutrición Hospitalaria
ISSN: 0212-1611
nutricion@grupoaran.com
Sociedad Española de Nutrición Parenteral y Enteral
España

Pereira Pinto Dias, Luciana; Raimondi de Souza, Simone; Sahade, Viviane; Cabral Cantanhede, Nayra Anielly; Albuquerque de Figueiredo Neto, José; Weber, Bernadete
Intake of fibers and its association with cardiometabolic risk factors in individuals on a secondary prevention for cardiovascular diseases: a multicenter study
Nutrición Hospitalaria, vol. 34, núm. 5, 2017, pp. 1146-1154
Sociedad Española de Nutrición Parenteral y Enteral
Madrid, España

Nutr Hosp. 2017; 34(5):1146-1154 ISSN 0212-1611 - CODEN NUHOEQ S.V.R. 318

ARÁN

Nutrición Hospitalaria

Trabajo Original

Epidemiología y dietética

Intake of fibers and its association with cardiometabolic risk factors in individuals on a secondary prevention for cardiovascular diseases: a multicenter study

Ingesta de fibras y su asociación con factores de riesgo cardiometabólico en individuos en prevención secundaria de enfermedades cardiovasculares: un estudio multicéntrico

Luciana Pereira Pinto Dias[1], Simone Raimondi de Souza[2], Viviane Sahade[3], Nayra Anielly Cabral Cantanhede[4], José Albuquerque de Figueiredo Neto[5] and Bernadete Weber[6]

[1]Post Graduate Program in Adult and Children's Health. Maranhão Federal University. São Luís, Brazil. [2]State Institute of Cardiology Aloysio de Castro/SES. Rio de Janeiro, Brazil. [3]School of Nutrition. University Hospital Prof. Edgard Santos. Bahia Federal University. Bahia, Brazil. [4]Course of Nutrition. Maranhão Federal University. São Luís, Brazil. [5]Post Graduate Program in Adult and Children's Health. Maranhão Federal University. São Luís, Brazil. [6]Hospital do Coração. São Paulo, Brazil

Abstract

Introduction: Among the non-pharmacologic measures for the prevention and treatment of cardiovascular diseases (CVD), which are the first cause of death worldwide, the adequate intake of dietary fibers (DF) has shown an important role.

Objective: To evaluate the association between the intake of DF and the cardio-metabolic risk factors in individuals on a secondary prevention for CVD.

Methods: Transversal study with basal data of the study's DICA Br participants belonging to collaborative centers in the states of Maranhão (MA), Bahia (BA) and Rio de Janeiro (RJ). Sociodemographic and clinical data were used, as well as the daily intake of DF in individuals of both sexes, with age ≥ 45 years and manifest evidence of arteriosclerosis. The association between the intake of dietary fibers and the cardio-metabolic risk factors was obtained through Poisson's regression model.

Results: With 141 evaluated individuals, high frequency of non-appropriateness of DF intake was observed. The participants in the centers of RJ (PR = 0.63; CI 95% = 0.49-0.80) and BA (PR = 0.79; CI 95% = 0.66-0.95), former smokers (PR = 0.59; CI 95% = 0.45-0.78) and non-smokers (PR = 0.62; CI 95% = 0.66-0.95) had fewer chances of having non appropriate intake of DF. On the other hand, overweight individuals showed 28.0% more chances of non-appropriate intake of DF.

Conclusion: Results showed that the majority of the observed population presented non-appropriate intake of DF and that this low intake was significantly associated with overweight, smoking and location of the collaborative center.

Key words:

Cardiovascular diseases. Risk factors. Dietary fiber.

Resumen

Introducción: entre las medidas no farmacológicas para la prevención y el tratamiento de enfermedades cardiovasculares (ECV), que representan la principal causa de muerte en el mundo, la ingesta adecuada de fibra dietética (FD) ha mostrado desempeñar un papel importante.

Objetivo: evaluar la asociación entre el consumo de FD y los factores de riesgo cardiometabólico en pacientes en prevención secundaria de ECV.

Métodos: estudio transversal con datos de referencia de los participantes en el estudio DICA Br pertenecientes a los centros examinadores en los estados de Maranhão (MA), Bahía (BA) y Río de Janeiro (RJ). Se utilizaron medidas sociodemográficas, clínicas, conductuales, antropométricas y el consumo diario de FD de individuos de ambos sexos, con edades ≥ 45 años y manifiesta evidencia de aterosclerosis. La asociación entre en el consumo de FD y los factores de riesgo cardiometabólico se obtuvo por el modelo de regresión de Poisson.

Resultados: fueron evaluados 141 sujetos y se observó alta frecuencia de consumo insuficiente de FA. Los participantes de los centros de RJ (RP = 0,63; IC 95% = 0,49-0,80), BA (RP = 0,79; IC 95%: 0,66-0,95), los ex fumadores (RP = 0,59; IC 95% = 0,78-0,45) y los no fumadores (OR = 0,62; IC 95%: 0,66-0,95) eran menos propensos a tener un consumo insuficiente FD. Las personas con sobrepeso mostraron un 28,0% más de probabilidades de tener una ingesta inadecuada de FD.

Conclusión: los resultados indicaron que la mayoría de la población observada presentaba una ingesta inadecuada de FD y que el consumo bajo se asoció significativamente con el sobrepeso, el tabaquismo y el centro de desarrollo.

Palabras clave:

Enfermedades cardiovasculares. Factores de riesgo. Fibra dietética.

Received: 23/12/2016
Accepted: 15/04/2017

Dias LPP, Souza SR, Sahade V, Cantanhede NAC, Figueiredo Neto JA, Weber B. Intake of fibers and its association with cardiometabolic risk factors in individuals on a secondary prevention for cardiovascular diseases: a multicenter study. Nutr Hosp 2017;34:1146-1154

DOI: http://dx.doi.org/10.20960/nh.751

Correspondence:

Luciana Pereira Pinto Dias. Post Graduate Program in Adult and Children's Health. Maranhão Federal University. Av. dos Portugueses, 1966. Vila Bacanga, São Luís. Brazil
e-mail: diaspluciana@gmail.com

INTRODUCTION

In the last years, a decrease in the incidence of infectious and parasitic diseases and an increase in the occurrence of chronic and degenerative ones, particularly cardiovascular diseases (CVD), have been observed (1). More than 80% of CVD-related deaths occur in countries of average and low income (2); in 2016, around 350,000 people died because of CVD in Brazil (3).

The CVDs show different associated risk factors, from non-modifiable factors as age, sex and genetic heritage, to modifiable factors, like behavioral and social ones (4), as well as insufficient practice of physical activity and increase of ultra-processed foods intake(5). In view of these highlighted risk factors, it is suggested that changes in lifestyle can bring benefits, once great part of these factors are considered as modifiable (6).

Beneficial cardiovascular effects have been observed in populations that show high intake of foods that are source of fibers (7). Dietary fibers (DF), also named dietetic fibers, are defined as the edible part of plants or analogue carbohydrates that are resistant to the digestion and absorption in the small intestine, with complete or partial fermentation in the large intestine of individuals (8,9).

Epidemiologic studies have highlighted that a higher intake of DF reduces the risk of many chronic diseases, as coronary artery disease (CAD), cerebrovascular disease (CD), hypertension, diabetes mellitus (DM) and some gastrointestinal disorders (10,11). In addition, the increase in the intake of DF improves serum lipids levels, helps in the reduction of body weight and acts in the improvement of the immunological system (12).

Despite scientific evidence having shown the benefits of DF to human health, its intake is still insufficient in developing countries. According to data from the World Health Organization (WHO), only 5 to 25% of the population followed guidance on the adequate intake of foods that are rich in fibers (13). In Brazil, only 24.1% of the population had the quantity of fruit and vegetables recommended by the WHO/Food and Agriculture Organization of the United Nations (FAO) (14).

Although the adequate intake of DF is a relevant factor for the prevention and treatment of CVDs, as well as of its risk factors, yet, investigative studies on the frequency of intake of these food components by individuals, on a secondary prevention of CVDs, are scarce. Nevertheless, this study aimed to evaluate the association of fibers intake and the cardio-metabolic risk factors in individuals, on a secondary prevention for CVDs.

METHODS

Transversal study with basal data from the multicenter study *"Effect of the Cardio-protective Brazilian Food Program in the reduction of events and risk factors in the secondary prevention for cardiovascular disease: a randomized clinical trial (DICA Br)"*, which is coordinated by the Institute of Teaching and Research at the Hospital do Coração (HCor), in a partnership with the Program for Support to Institutional Development of the Unified Health System (PROAD-SUS) of the Brazilian Ministry of Health (15).

The collection of basal data used in this study was held from November 2013 to December 2015 in the reference centers in cardiology, in the cities of São Luis (MA), Salvador (BA) and Rio de Janeiro (RJ), which participate in the DICA Br. The study sampling, which was calculated through a sample of DICA Br, was non-probabilistic, of spontaneous demand and made by individuals meeting the requirements for inclusion and participating in all the phases of data collection.

Participants in this study were men and women with ages equal to or over 45 years; they showed evidences (current or from the last ten years) of manifest atherosclerosis, with the diagnosis of CAD, CD or peripheral artery disease by a trained doctor, and answered to two 24-hour recall (24HR). Individuals with psychiatric or neurocognitive conditions that impeded the collection of data, life expectancy lower than six months, pregnant or during lactation, with diagnoses of hepatic insufficiency, previous history of encephalopathy or anasarca, renal insufficiency with indication for dialysis and congestive cardiac insufficiency, previous transplantation of organs and gastroplasty, wheelchair users and with difficulties in receiving the diet orally were excluded from the study.

DICA Br was subjected and approved by the Committees of Ethics in Research and involved individuals from the three participating centers, with respective numbers of opinions 711,805 (MA), 335,403-0 (BA) and 1,159,132 (RJ), accordingly to resolution n. 466 on December 12, 2012, of the National Health Council. The consent to participate in the research was formalized through the signing on the free and informed consent form (FICF).

After agreeing in participating in the study, and having signed the FICF, participants were logged in the electronic Case Report Form (CRF) system and had previously booked clinical visits. In this study, data of the clinical visits at baseline and at 15 days were analyzed. For the baseline visit, collection of sociodemographic and anthropometric data and the first 24HR were performed. For the analysis of 15 days, the collection of biochemical exams and the second 24HR were carried out. All the data in this study were collected by researchers that had been previously trained through the methodology of data collection developed by DICA Br (15).

The analyzed variables were:

1. *Sociodemographic:* sex, age, education, economy class and the collaborative center of origin.
2. *Behavioral:* smoking (non-smoker, smoker and former smoker) and physical activity (sedentary, low activity, average activity and high activity) (15).
3. *Clinical:* systolic blood pressure (SBP) and diastolic blood pressure (DBP), measured according to the recommendations of the VI Brazilian Directives on Hypertension (16); medical patient's diagnosis of DM, hypertension, dyslipidemia and family history of CAD. Regarding biochemical exams, patients were advised to fast for 12 hours and to not drink alcoholic beverages in the previous 72 hours. Fasting glucose, total cholesterol (TC), triglycerides (TG) and high-density lipoprotein (HDL-c) were analyzed through the enzymatic colorimetric method of dry chemistry, and low-density lipoprotein (LDL-c), by using Friedewald formula. The following values

were considered as risk factors for CVD according to the criteria established by the Brazilian Society of Cardiology (17): fasting glucose ≥ 100 mg/dl, TC ≥ 200 mg/dl, TG ≥ 150 mg/dl, HDL-c < 50 mg/dl (women) and < 40mg/dl (men), LDL-c ≥ 100 mg/dl, SBP ≥ 130 mmHg and DBP ≥ 85 mmHg;

4. *Anthropometric:* weight (kg), height (m) and waist circumference (WC) (m) were measured according to techniques used in the SISVAN (National Nutrivigilance Scheme) study (18). WC cut-off points were those established by the WHO (19): increased risk for cardiac complications for men ≥ 94 cm and women ≥ 80 cm. BMI (kg/m^2) was calculated through the weight ratio through squared height and it was classified as weight excess when it was ≥ 25 kg/m^2 for adults (20) and ≥ 28 kg/m^2 for elderlies (21). Waist/height ratio (WHtR) (cut-off points: 0.52 for men and 0.53 for women) (22) and the conicity index (cut-off points: 1.25 for men and 1.18 for women) (23) were also used as indicators of central obesity.
5. *DF intake:* it was calculated through the collection of two 24HR that were done every 15 days, independently of the day of the week, with the help of a photograph album of foods in home measures developed for the DICA Br study. The computerized system Nutriquanti was used in the analysis of the 24HR (15). DF daily intake was classified as adequate (≥ 25 g/day) or inadequate (≤ 25 g/day) according to the Dietary Guide of the Brazilian Population from 2014, which follows the recommendation of nutrients from the WHO/FAO 2003 (13).

In the analysis of data, categorical variables were expressed in frequencies (absolute and relative). In order to check the relationship between categorical variables and sex, the Chi-squared test was used.

For the analysis of DF intake, the normality of the variable total fiber was analyzed through the Shapiro-Wilk and Kolmogorov-Smirnov tests. As the variable did not show normal distribution, the transformation of the variable was done, for better mathematical function and normality, in case, the quadratic function. Subsequently, the interpersonal and intrapersonal variance was analyzed through the analysis of variance (ANOVA), to adjust the distribution of nutrients and to remove the intrapersonal variability. After this adjustment, reconversion of the variable total fiber to its unit of origin was performed in order to obtain the adjusted average through the intrapersonal variability, in grams, which can be then used for further analysis.

The Poisson's regression model was used to evaluate the association between DF intake and cardio-metabolic risk factors. The independent variables that showed p-value lower than 0.20 were taken into consideration in the multivariate regression model. The selection of variables was made through the stepwise method, through elimination. The significance level was of 5% ($p < 0.05$). Data was analyzed in the statistical program STATA 12.0.

RESULTS

One hundred and forty one participants were evaluated; they came from the centers in MA (n = 40), RJ (n = 49) and BA (n = 52). Higher frequency of men (54.6%), aged ≥ 60 years (70.9%), with economic class C (48.2%) and elementary school studies (35.5%), ex-smokers (60.3%) and sedentary (68.8%), was observed. Economic class ($p = 0.032$), schooling ($p < 0.001$), smoking ($p = 0.008$) and physical activity ($p = 0.036$) showed significant difference among the sexes (Table I).

Weight excess (52%), CC (85.7%), Rcest (93.5%), conicity index (93.5%), SBP (46.7%) and SBP (29.8%) were higher in men. Fasting glucose > 100 mg/dl (68.7%), family history of CAD (60.9%) and negative diagnosis for DM (59.7%) were more frequent in women. Men showed higher prevalence of dyslipidemia (83.1%), DBP (87.0%) and adequate levels of total cholesterol < 200 mg/dl (81.8%), triglycerides < 150 mg/dl (66.3%) and LDL < 100 mg/dl (63.6%). However, both sexes showed low levels of HDL < 40 mg/dl (62.5%) and < 50 mg/dl (52%). Rcest ($p = 0.046$) and SBP ($p = 0.037$) showed significant difference among the sexes (Table II).

The prevalence of non-adequate intake of DF was higher in the studied sample. Among these individuals, male participants (51.9%), elderlies (70.7%), people with elementary school (35.8%), C economic class (53.7%), those who belonged to the center in Bahia (35.8%), former smokers (58.5%) and sedentary (67.9%) (Table III), overweight (60.4%), participants with altered WC (84.9%), altered WHtR (90.6%) and altered conicity index (86.8%), altered fasting glucose (62.3%), HDL-c below the recommended for both sexes (54.7%), altered SBP (51.9%) and DBP (51.9%) with family history of CAD (53.8%) and medical diagnosis of dyslipidemia (84.9%) and hypertension (89.6%) were highlighted (Table IV).

The adjusted analysis showed that the variables collaborative center, adiposity and smoking continued to be associated with DF intake. It was also observed that participants from the centers in RJ (PR = 0.63; CI 95% = 0.49-0.80) and BA (PR = 0.79; CI 95% = 0.66-0.95), former smokers (PR = 0.59; CI 95% = 0.45-0.78) and the ones who had never smoked (PR = 0.62; CI 95% = 0.66-0.95) presented less possibilities of showing non-appropriate intake of DF, as compared to the ones from the center in MA and smokers, respectively. Overweight participants showed 28.0% more possibilities for non-appropriate intake of DF as compared to overweight ones (Table V).

DISCUSSION

The high prevalence of non-appropriate intake of DF which was observed in individuals in this study, who are on secondary treatment for CVD, suggests that insufficient intake of these nutrients can contribute to the worsening of these diseases. There were similar findings in the National Health and Nutrition Examination Survey (NHANES), where insufficient intake of DF in the studied sample, which included individuals with metabolic syndrome and obesity, was also observed (24).

Participants from the collaborative center in MA had more possibilities of non-appropriate intake of DF when compared to those from the centers in BA and RJ. Data from the National Research on Health 2013 showed lesser prevalence of fruit and vegetables intake in the

Table I. Relationship of socio-demographic and behavioral risk factors of individuals on secondary prevention for CVD in three collaborative centers of DICA Br. Maranhão, Rio de Janeiro and Bahia, 2016

Variables	Total n (%)	Female n (%)	Male n (%)	p-value*
Center				0.321
Maranhão	40 (28.4)	20 (31.2)	20 (25.9)	
Rio de Janeiro	49 (34.8)	18 (28.1)	31 (40.3)	
Bahia	52 (36.8)	26 (40.7)	26 (33.7)	
Age group (years)				0.884
45 to 59	41 (29.1)	19 (29.7)	22 (28.6)	
≥ 60	100 (70.9)	45 (70.3)	55 (71.4)	
Economy class				0.032
A	2 (1.4)	0 (0.0)	2 (2.6)	
B	30 (21.3)	9 (14.1)	21 (27.3)	
C	68 (48.2)	30 (46.9)	38 (49.4)	
D	28 (19.9)	15 (23.4)	13 (16.8)	
Missing	13 (9.2)	10 (15.6)	3 (3.9)	
Education				> 0.001
Illiterate	34 (24.1)	23 (35.9)	11 (14.3)	
Elementary school	50 (35.5)	17 (26.6)	33 (42.8)	
High school	32 (22.7)	9 (14.1)	23 (29.9)	
Superior course	14 (9.9)	5 (7.8)	9 (11.7)	
Missing	11 (7.8)	10 (15.6)	1 (1.3)	
Smoking				0.008
Non-smoker	53 (37.6)	1 (1.6)	2 (2.6)	
Smoker	3 (2.1)	30 (46.8)	55 (71.4)	
Former smoker	85 (60.3)	33 (51.6)	20 (26.0)	
Physical activity				0.036
Sedentary	97 (68.8)	51 (79.7)	46 (59.7)	
Light activity	32 (22.7)	3 (4.7)	8 (10.4)	
Average activity	11 (7.8)	9 (14.0)	23 (29.9)	
Missing	1 (0.7)	1 (1.6)	0 (0.0)	

**Chi-squared test.*

state of MA (34.6%) if compared to the state of RJ (40.4%), although it was a little higher in the state of BA (33.4%) (25).

Dietary patterns result from the combination of environmental, biological, social and cultural factors that can explain the differences observed in the distribution of dietary intake among these populations (26). Discrepancies in the intake of these foods are probably due to factors that are bound to their prices, access and availability (27), and they could be solved through the promotion of actions of nutritional and dietary education, as well as programs enabling the production, storage, distribution and selling of these foods in places where their intake is yet insufficient (25).

It is known that DF intake has been associated with better weight control (28), and it can be seen in the study carried out by Souza et al. (2016), who noticed a significant decrease in anthropometric patterns in patients who were supplemented with 40 g/day of oatmeal (source of soluble fiber and beta-glucan) for three months (29).

The reduction of body weight occurs because DF take the place of calories and nutrients in the diet (30), and increase the time of chewing, which result in the expansion of the stomach and the increase of satiety (31). In addition, they have lower energetic density as compared to foods that are rich in fat (32).

Table II. Relationship of anthropometric and clinical risk factors of individuals on secondary prevention for CVD in three collaborative centers of DICA Br. Maranhão, Rio de Janeiro and Bahia, 2016

Variables	Total n (%)	Female n (%)	Male n (%)	p-value*
Overweight				0.377
Yes	78 (55.3)	38 (59.4)	40 (52.0)	
No	63 (44.7)	26 (40.6)	37 (48.0)	
WC (cm)				0.475
Normal	23 (16.3)	12 (18.7)	11 (14.3)	
Altered	118 (83.7)	52 (81.3)	66 (85.7)	
WHtR				0.046
Normal	16 (11.4)	11 (17.2)	5 (6.5)	
Altered	125 (88.6)	53 (82.8)	72 (93.5)	
Conicity index				0.354
Normal	16 (11.4)	9 (14.1)	7 (9.1)	
Altered	125 (88.6)	55 (85.9)	70 (90.9)	
Fasting glucose (mg/dl)				0.157
< 100	53 (37.6)	20 (31.3)	33 (42.8)	
≥ 100	88 (62.4)	44 (68.7)	44 (57.2)	
TC (mg/dl)				0.160
< 200	109 (77.3)	46 (71.8)	63 (81.8)	
≥ 200	32 (22.7)	18 (28.2)	14 (18.2)	
TG (mg/dl)				0.162
< 150	86 (60.9)	35 (54.7)	51 (66.3)	
≥ 150	55 (39.1)	29 (45.3)	26 (33.7)	
HDL-c (mg/dl)				0.208
> 40 male and > 50 female	61 (43.3)	24 (37.5)	37 (48.0)	
< 40 male and < 50 female	80 (56.7)	40 (62.5)	40 (52.0)	
LDL-c (mg/dl)				0.207
< 100	83 (58.8)	34 (53.2)	49 (63.6)	
≥ 100	58 (41.2)	30 (46.8)	28 (36.4)	
SBP(mmHg)				0.348
Normal	70 (49.6)	29 (45.3)	41 (53.3)	
Altered	71 (50.4)	35 (54.7)	36 (46.7)	
DBP (mmHg)				0.568
Normal	70 (49.6)	42 (65.6)	54 (70.2)	
Altered	71 (50.4)	22 (34.4)	23 (29.8)	
Dyslipidemia				0.646
Yes	22 (15.6)	9 (14.1)	13 (16.9)	
No	119 (84.4)	55 (85.9)	64 (83.1)	
CAD-family				0.067
Yes	74 (52.5)	39 (60.9)	35 (45.5)	
No	67 (47.5)	25 (39.1)	42 (54.5)	
DM				0.885
Yes	56 (39.7)	31 (40.3)	25 (39.1)	
No	85 (60.3)	46 (59.7)	39 (60.9)	
Hypertension				0.037
Yes	129 (91.5)	62 (96.9)	67 (87.0)	
No	12 (8.5)	2 (3.1)	10 (13.0)	

**Chi-squared test. WC: Waist circumference; WHtR: Waist to height ratio; TC: Total cholesterol; TG: Triglycerides; HDL-c: High density lipoprotein; LDL-c: Low density lipoprotein; SBP: Systolic pressure; DBP: Diastolic pressure; CAD family: Family history of coronary artery disease; DM: Diabetes mellitus.*

Table III. Non-adjusted analysis of the association of the intake of DF with sociodemographic and behavioral risk factors of individuals on secondary prevention for CVD in three collaborative centers at DICA Br. Maranhão, Rio de Janeiro and Bahia, 2016

Variables	Intake of DF			p-value
	Adequate n (%)	Non appropriate n (%)	PR CI (95%)	
Sex				0.255
Male	22 (62.8)	55 (51.9)		
Female	13 (37.2)	51 (48.1)	1.11 (0.92; 1.34)	
Age group (years)				0.939
45 to 59	10 (28.6)	31 (29.3)		
≥ 60	25 (71.4)	75 (70.7)	0.99 (0.80; 0.53)	
Economy class				
A	0 (0.0)	2 (1.9)		
B	7 (20.0)	23 (21.7)	2.63 (0.63; 0.93)	0.009
C	11(31.4)	57 (53.7)	3.15 (0.77; 0.94)	0.002
D	15 (42.8)	13 (12.3)	3.77 (0.31; 0.69)	< 0.001
Missing	2 (5.7)	11 (10.4)	1.41 (0.67; 1.06)	0.159
Education				
Illiterate	10 (28.6)	24 (22.6)		
Elementary School	12 (34.3)	38 (35.8)	0.54 (0.82; 1.40)	0.589
High school	9 (25.7)	23 (21.7)	0.12 (0.75; 1.38)	0.908
Superior education	3 (8.6)	11 (11.4)	0.60 (0.78; 1.58)	0.549
Missing	1 (2.8)	10 (9.4)		
Collaborative center				
Maranhão	3 (8.6)	37 (34.9)		
Rio de Janeiro	18 (51.4)	31 (29.3)	0.68 (0.54; 0.65)	< 0.001
Bahia	14 (40.0)	38 (35.8)	0.79 (0.65; 0.95)	< 0.001
Smoking				
Non-smoker	12 (34.3)	41 (38.7)	0.72 (0.61; 0.85)	< 0.001
Smoker	0 (0.0)	3 (2.8)		
Former smoker	23 (65.7)	62 (58.5)	0.76 (0.67; 0.86)	< 0.001
Physical activity				
Sedentary	25 (71.4)	72 (67.9)		
Light activity	7 (20.0)	25 (23.6)	1.05 (0.85; 1.31)	0.646
Average activity	3 (8.6)	8 (7.5)	0.98 (0.67; 1.44)	0.917
Missing	0 (0.0)	1 (1.0)		

DF: Dietary fibers; PR: Prevalence ratio; CI: Confidence interval.

Along with these effects, DF get to the colon, where they are fermented in the intestinal flora and produce short chain fatty acids (acetate, propionate and butyrate) that contribute to the increase of intestinal flora, which favors the adequate functioning of the immunological system (33).

Despite these benefits, in this study overweight individuals had higher possibilities of non-appropriate DF intake when compared to normal-weight ones. This finding are in line with the results of the review by Karl and Saltzman 2012 (34), in which most of the epidemiologic studies showed the association between higher intakes of DF in individuals with lower BMI. On the other hand, studies by Gimeno et al. in 2011 (35) and Azevedo et al. in 2014 (36) showed that the intake of fruits and vegetables was more frequent among overweight individuals if compared to eutrophic ones.

Table IV. Non-adjusted analysis of the association of the intake of DF with sociodemographic and behavioral risk factors of individuals on secondary prevention for CVD in three collaborative centers at DICA Br. Maranhão, Rio de Janeiro and Bahia, 2016

Variables	Intake of DF			p-value
	Adequate n (%)	Non-appropriate n (%)	PR CI (95%)	
Overweight				0.046
Yes	14 (40.0)	64 (60.4)	1.23 (1.00; 1.50)	
No	21 (60.0)	42 (39.6)		
WC (cm)				0.533
Normal	7 (20.0)	16 (15.1)		
Altered	28 (80.0)	90 (84.9)	1.09 (0.82; 1.46)	
WHtR				0.304
Normal	6 (17.2)	10 (9.4)		
Altered	29 (82.8)	96 (90.6)	1.23 (0.83; 1.82)	
Conicity index				0.081
Normal	2 (5.7)	14 (13.2)		
Altered	33 (94.3)	92 (86.8)	0.83 (0.68; 1.02)	
Fasting glucose (mg/dl)				0.950
< 100	13 (37.2)	40 (37.7)		
≥ 100	22 (62.8)	66 (62.3)	0.99 (0.82; 1.20)	
TC (mg/dl)				0.979
< 200	27 (77.2)	82 (77.4)	0.03 (0.79; 1.25)	
≥ 200	8 (22.8)	24 (22.6)		
TG (mg/dl)				0.105
< 150	17 (48.6)	69 (65.1)		
≥ 150	18 (51.4)	37 (34.9)	0.83 (0.67; 1.03)	
HDL-c (mg/dl)				0.394
> 40 male and > 50 female	13 (37.2)	48 (45.3)		
< 40 male and < 50female	22 (62.8)	58 (54.7)	0.92 (0.76; 1.11)	
LDL-c (mg/dl)				0.813
< 100	20 (57.2)	63 (59.4)	0.97 (0.80; 1.18)	
≥ 100	15 (42.8)	43 (40.6)		
SBP (mmHg)				0.529
Normal	19 (54.3)	51 (48.1)		
Altered	16 (45.7)	55 (51.9)	1.06 (0.87; 1.28)	
DBP (mmHg)				0.529
Normal	19 (54.3)	51 (48.1)		
Altered	16 (45.7)	55 (51.9)	1.06 (0.87; 1.28)	
Dyslipidemia				0.781
Yes	29 (82.8)	90 (84.9)	1.04 (0.78; 1.37)	
No	6 (17.2)	16 (15.1)		
CAD-family				0.596
Yes	17 (48.6)	57 (53.8)	1.05 (0.87; 1.27)	
No	18 (51.4)	49 (46.2)		
DM				0.418
Yes	16 (45.7)	40 (37.7)	0.92 (0.75; 1.12)	
No	19 (54.3)	66 (62.3)		
Hypertension				0.032
Yes	34 (97.2)	95 (89.6)	0.80 (0.66; 0.98)	
No	1 (2.8)	11 (10.4)		

DF: Dietary fibers; PR: Prevalence ratio; CI: Confidence interval; WC: Waist circumference; WHtR: Waist to height ratio; TC: Total cholesterol; TG: Triglycerides; HDL-c: High density lipoprotein; LDL-c: Low density lipoprotein; SBP: Systolic pressure; DBP: Diastolic pressure; CAD family: Family history of coronary artery disease; DM: Diabetes mellitus.

Table V. Adjusted analysis of the association of the intake of DF with sociodemographic and behavioral risk factors of individuals on secondary prevention for CVD in three collaborative centers of DICA Br. Maranhão, Rio de Janeiro and Bahia, 2016

Variables	Intake of DF			p-value
	Adequate n (%)	Non-appropriate n (%)	PR CI (95%)	
Collaborative center				
Maranhão	3 (8.6)	37 (34.9)		
Rio de Janeiro	18 (51.4)	31 (29.3)	0.63 (0.49; 0.80)	< 0.001
Bahia	14 (40.0)	38 (35.8)	0.79 (0.66; 0.95)	0.013
Overweight				0.012
Yes	14 (40.0)	64 (60.4)	1.28 (1.06; 1.56)	
No	21 (60.0)	42 (39.6)		
Smoking				
Non-smoker	12 (34.3)	41 (38.7)	0.62 (0.66; 0.95)	< 0.001
Smoker	0 (0.0)	3 (2.8)		
Former smoker	23 (65.7)	62 (58.5)	0.59 (0.45; 0.78)	< 0.001

DF: Dietary fibers; PR: Prevalence ratio; CI: Confidence interval.

The inappropriate intake of DF by overweight patients suggests that the adequacy of intake of these nutrients requires a global approach, and other factors that may be interacting in this dynamics, as targeted therapeutic diet guidance and higher access to foods that are sources of fibers, should be taken into consideration.

In addition, in this study, former smokers and non-smokers showed fewer chances of presenting non-appropriate intake of DF, if compared to smokers. Similarly, Campos et al. in 2010 (37) and Harland and Garton in 2008 (38) showed an inverse association between fruits and vegetables intake and smoking. Smokers' predisposition to present low DF intake may be explained by the action of nicotine in the central nervous system, which inducts smokers to decrease the intake of vegetables and fruits and increase the intake of salt, alcoholic drinks, coffee and sweets in a tentative to eliminate the flavor of tobacco (39).

Among the limitations of this study, the following may be highlighted: transversal delineation, and impossibility to determine the cause and effect of DF intake in the population as a whole; reduced number of individuals in the sample; absence of data on insulin levels (it is known that this type of biochemical dosage is closely related to the percentage of fat mass; however, as this study is funded by the Ministry of Health, the financial resources were not sufficient to carry out this analysis); and the usage of R24H, which can have caused and obliquity of memory, although this nourish investigation consists on a toll of low cost and easy application which makes it a reference method to quantify nutrients in the diet.

CONCLUSION

The results of this study show that the non-adequate intake of DF in the evaluated sample was high and was associated with the location of the collaborative center, as well as with overweight and smoking. Nevertheless, it is worth noting the importance of the elaboration and implementation of programs for the promotion of healthy eating habits that aim to increase the intake of DF in order to help in the prevention, treatment and reduction of CVDs risk factors, considering regional differences, food availability and individuals' eating habits.

ACKNOWLEDGMENTS

This study was supported by the Hospital do Coração (HCor) in a partnership with the Program for Support to Institutional Development of the Unified Health System (PROAD-SUS) of the Brazilian Ministry of Health, and by the Maranhão Research Support Fund (FAPEMA) for support to research through edicts BM-03351/14 and Articles -010/2017. We thank the participants and the researchers of the collaborating centers of the Dica Br study for their collaboration.

REFERENCES

1. Araújo JD. Polarização epidemiológica no Brasil. Epidemiol Serv Saúde (Brasília) 2012;21(4):533-8.
2. World Health Organization. Global health estimates: Deaths by cause, age, sex and country, 2000-2012. Geneva: WHO; 2014.
3. Sociedade Brasileira de Cardiologia. Available at: http://cientifico.cardiol.br/. Accessed on: March 27th 2017.
4. Mansur AP, Favarato D. Mortalidade por doenças cardiovasculares no Brasil e na região metropolitana de São Paulo: atualização 2011. Arquivo Brasileiro de Cardiologia 2012;99:755-61.
5. Schmidt MI, Duncan BB, Azevedo e Silva G, Menezes AM, Monteiro CA, Barreto SM, et al. Chronic non-communicable diseases in Brazil: Burden and current challenges. Lancet 2011;377:49-6.
6. Organização Mundial de Saúde; Organização Pan-Americana da Saúde. Prevenção de doenças crônicas: um investimento vital. 2010. Available at:

http://www.transdoreso.org/pdf/prevencao_doenca_cronica.pdf. Accessed on: March 20th 2016.
7. Hu FB, Willett WC. Optimal diets for prevention of coronary heart disease. JAMA 2002;288:2569-78.
8. Park Y, Subar AF, Hollenbeck A, Schatzkin A. Dietary fiber intake and mortality in the NIH-AARP Diet and Health Study. Arch Intern Med 2011;171:1061-8.
9. Howlett JF, Betteridge VA, Champ M, Craig SAS, Meheust A, Jones JM. The definition of dietary fiber - Discussions at the Ninth Vahouny Fiber Symposium: Building scientific agreement. Food Nutr Res 2010;54:57-0.
10. Threapleton De, Greenwood DC, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, et al. Dietary fiber intake and risk of cardiovascular disease: Systematic review and meta-analysis. BMJ 2013;47:68-79.
11. Buil-Cosiales P, Zazpe I, Toledo E, Corella D, Salas-Salvadó J, Díez-Espino J, et al. Fiber intake and all-cause mortality in the Prevención con Dieta Mediterranea (PREDIMED) study. Am J Clin Nutr 2014;100:1498-507.
12. Bernaud FSR, Rodrigues TC. Fibra alimentar: ingestão adequada e efeitos sobre a saúde do metabolismo. Arq Bras Endocrinol Metab 2013;57: 397-405.
13. World Health Organization (WHO). World Health Organization. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation. Geneva: WHO; 2003. WHO Technical Report Series 916.
14. Brasil. Secretaria de Vigilância em Saúde. VIGITEL Brasil 2014: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Brasília: Ministério da Saúde; 2015. p. 154.
15. Weber B, Bersch-Ferreira AC, Torreglosa CR, Ross-Fernandes MB, Da Silva JT, Galante AP, et al. The Brazilian Cardioprotective Nutritional Program to reduce events and risk factors in secondary prevention for cardiovascular disease: Study protocol (The BALANCE Program Trial). Am Heart J 2016;171:73-81.
16. Sociedade Brasileira de Cardiologia; Sociedade Brasileira de Hipertensão; Sociedade Brasileira de Nefrologia. VI Diretrizes Brasileiras de Hipertensão. Arquivos Brasileiros de Cardiologia 2010;95:1-51.
17. Sociedade Brasileira De Cardiologia. I Diretriz Brasileira de Prevenção Cardiovascular. Arquivos Brasileiros de Cardiologia 2013;101.
18. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Orientações para a coleta e análise de dados antropométricos em serviços de saúde: Norma Técnica do Sistema de Vigilância Alimentar e Nutricional - SISVAN. Brasília: Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica; 2011. p. 76.
19. World Health Organization. Waist circumference and waist-hip ratio: Report of a WHO expert consultation, Geneva, 8-11, December 2008. Available at: http://whqlibdoc.who.int/publications/2011/9789241501491_eng.pdf. Accessed on: Aug 12th 2014.
20. World Health Organization. Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee. Geneva: World Health Organization; 1995. WHO Technical Report Series 854.
21. Opas-Organização Pan-Americana. XXXVI Reunión del Comitê Acessor de Investigaciones em Salud. Encuestra Multicêntrica. Salud Beinestar y Envejecimento (SABE) em América Latina e el Caribe. Informe preliminar. Available at: http://www.opas.org/program/sabe.htm. Accessed on: Aug 12th 2014.
22. Pitanga FJG, Lessa I. Indicadores antropométricos de obesidade como discriminadores de risco coronariano elevado em mulheres. Rev Bras Cineantropom Desempenho Hum 2006;8:14-21.
23. Pitanga FJG. Antropometria na avaliação da obesidade abdominal e risco coronariano. Rev Bras Cineantropom Desempenho Hum 2011;13:238-41.
24. Grooms KN, Ommerborn MJ, Pham Do Q, Djoussé L, Clark Cr. Dietary fiber intake and cardiometabolic risks among US adults, NHANES 1999-2010. Am J Med 2013;126:59-67.
25. Jaime PC, Rizzato Stopa S, Porto Oliveira T, Vieira ML, Landman Szwarcwarld C, Carvalho Malta D, et al. Prevalência e distribuição sociodemográfica de marcadores de alimentação saudável, Pesquisa Nacional de Saúde, Brasil 2013. Epidemiol Serv Saúde 2015;24:267-76.
26. Contreras J, Gracia M. Alimentação, sociedade e cultura. Rio de Janeiro: Fiocruz; 2011.
27. Duran AC, Diez-Roux AV, Latorre MRDO, Jaime PC. Neighborhood socioeconomic characteristics and differences in the availability of healthy food stores and restaurants in São Paulo, Brazil. Health Place 2013;23:39-47.
28. Giacco R, Della Pepa G, Luongo D, Riccardi G. Whole grain intake in relation to body weight: From epidemiological evidence to clinical trials. Nutr Metab Cardiovasc 2011;21:1-8.
29. Souza SR, Oliveira GMM, Luiz RR, Rosa G. Effects of oat bran and nutrition counseling on the lipid and glucose profile and anthropometric parameters of hypercholesterolemia patients. Nutr Hosp 2016;33:123-30.
30. Hans Hauner H, Bechthold A, Boeing H, Brönstrup A, Buyken A, Leschik-Bonnet E, et al. Evidence-based guideline of the German Nutrition Society: Carbohydrate intake and prevention of nutrition-related diseases. Ann Nutr Metab 2012;60:1-58.
31. Hur IY, Reicks M. Relationship between whole-grain intake, chronic disease risk indicators, and weight status among adolescents in the National Health and Nutrition Examination Survey, 1999-2004. J Am Diet Assoc 2012;12: 46-55.
32. Liu S, Stampfer MJ, Hu FB, Giovannucci E, Rimm E, Manson JE, et al. Whole-grain consumption and risk of coronary heart disease: Results from the Nurses' Health study. Am J Clin Nutr 1999;70:412-9.
33. Rivellese AA, Giacco R, Costabile G. Dietary carbohydrates for diabetics. Curr Atheroscler Rep 2012;14:563-9.
34. Karl JP, Saltzman E. The role of whole grains in body weight regulation. Adv Nutr 2012;3:697-707.
35. Gimeno SGA, Mondini L, Alves de Moraes S, Martins de Freitas IC. Padrões de consumo de alimentos e fatores associados em adultos de Ribeirão Preto, São Paulo, Brasil: Projeto OBEDIARP. Cad Saúde Pública (Rio de Janeiro) 2011;27:533-45.
36. De Castro Azevedo EC, Rodrigues da Silva FM, Alcides da Silva D, Poliana Coelho C. Consumo alimentar de risco e proteção para as doenças crônicas não transmissíveis e sua associação com a gordura corporal: Um estudo com funcionários da área de saúde de uma universidade pública de Recife (PE), Brasil. Ciênc Saúde Coletiva (Rio de Janeiro), 2014;19:1613-22.
37. Campos VC, Bastos JL, Gauche H, Boing AF, Assis MAA. Fatores associados ao consumo adequado de frutas, legumes e verduras em adultos de Florianópolis. Rev Bras Epidemiol 2010;13:352-62.
38. Harland JI, Garton IE. Whole-grain intake as a marker of healthy body weight and adiposity. Public Health Nutr 2008;11:54-63.
39. Chiolero A, Faeh D, Paccaud F, Cornuz J. Consequences of smoking for body weight, body fat distribution, and insulin resistance. Am J Clin Nut 2008;87:1-9.