

## The Lower Prevalence of Chronic Diseases Risk Factors in Vegetarian Brazilians Subjects – CARVOS Study

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### ABSTRACT

**Objective:** To investigate the association of meat consumption with self-reported chronic diseases (heart disease, hypertension, diabetes (type I or type II) and dyslipidemia), according to demographic, social and anthropometric variables.

**Methods:** This was a cross sectional study, conducted at the Heart Institute, University of São Paulo, with 549 adults ( $\geq 18$  years) who answered a questionnaire to select people for The CARVOS Study (Carotid Atherosclerosis, Aortic Stiffness and Risk Factors in Vegetarians and Omnivorous Subjects). The variables analyzed were: age, gender, education level, meat consumption, self-reported coronary heart disease, hypertension, diabetes (type I or type II) and dyslipidemia, smoking and body mass index (BMI) ( $\text{kg}/\text{m}^2$ ). Study subjects were classified as omnivorous (OMN=consumption of meat or fish four or more times/week) ( $n=228$ , 41.5 %), semi-vegetarians (SV=consumption of meat or fish 1-3 times/week) ( $n=97$ , 17.7%) and vegetarians (VEG=no consumption of meat or fish) ( $n=224$ , 40.8%). The differences between mean values was calculated by T-ANOVA test. To test the association between the variables, chi-square test and multiple logistic regression were used ( $p < 0.05$ ; CI = 95%).

**Results:** There was a greater prevalence of smokers among OM than SV and VEG respectively 56.5%, 14% and 29.4 %,  $p=0.009$ , and a higher prevalence of overweight (41.7%) in OMN in comparison with SV (29.2%) and VEG (29.0%),  $p=0.008$ . Being OM significantly increased the risk of referring hypertension, regardless of sex and age (OR 2.19; CI 95% 1.08-4.46), and was also associated with dyslipidemia, regardless of body mass index, smoking, sex and age (OR 1.78; CI 95% 1.03-3.08).

**Conclusion:** Higher meat consumption was associated with a greater prevalence of risk factors for hypertension and dyslipidemia chronic diseases.

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## Introduction

According to the American Dietetic Association (ADA), vegetarian diet does not include meat (including fowl) or seafood, or products containing those foods. Appropriately planned vegetarian diets, including total vegetarian or vegan diets, are healthful, nutritionally adequate, appropriate for individuals during all stages of the life cycle and may provide health benefits in the prevention and treatment of certain diseases [1].

The role of diet and nutrition as determinants of chronic diseases is well established and they therefore occupy a prominent position in prevention activities [2]. Many studies have demonstrated the associations between meat consumption and hypertension, risk for heart disease, metabolic disorders and mortality [3,4,5,6,7,8,9]. This effect is most important for the processed meat [10]. By other hand, the protective effect of a vegetarian diet, with lower content of saturated fat and higher content of fiber, vitamins and minerals, associated with healthy lifestyle and the maintenance of the adequate body weight could to offer protections against these chronic diseases [11, 12].

According to the American Dietetic Association, vegetarian populations have 31% less prevalence of heart disease, less than 50% prevalence of diabetes, 88% less colon cancer and 54% less prostate cancer [13], but evidence from Latin-America is scarce [3,4,5, 14].

Aiming to fill this scientific gap it becomes necessary to develop studies aimed to compare socio-demographic characteristics, lifestyle habits and health status among individuals from Brazil who follow different types of diets. The objective of this study was to test the association of meat consumption with reported chronic diseases (coronary heart disease, hypertension, diabetes (type I or type II) and dyslipidemia), according to demographic, social and anthropometric variables in sample of men from Sao Paulo, Brazil.

## Materials AND Methods

This study is the first phase of the CARVOS Study (Carotid Atherosclerosis, Aortic Stiffness and Risk Factors in Subjects Vegetarians and Omnivorous). In order to select omnivores, vegetarians and semi-vegetarians individuals to participate in CARVOS Study, between October 2012 and December 2013, 549 subjects from Sao Paulo city, filled out a questionnaire data about socio-demographics characteristics, lifestyle and health status. The present study included individuals who had all the data necessary for analysis. In the second phase of the CARVOS study 88 men out 549 subjects were selected in order to assess clinical and biochemical cardiovascular risk factors and the results will be publish in a future paper.

The self-reported questionnaire was composed in the first part by questions about the personal identification (age, gender and education level). The

second part contained questions regarding meat consumption. First it was asked if there was habitual consumption of meat, including all types of meat: pork, fish, chicken, then how many times a week any kind of meat was consumed, and finally to individuals who did not report eating meat, it was questioned how long a vegetarian diet had been followed.

Study subjects were classified as omnivorous (OMN=consumption of meat or fish four or more times/week), semi-vegetarians (SV=consumption of meat or fish 1-3 times/week) [3, 4] and vegetarians (VEG=no consumption of meat or fish).

To characterize the health status, it was asked if subjects ever received a medical diagnosis of coronary heart disease, hypertension, diabetes (type I or type II) and dyslipidemia.

The questionnaire contained questions about the weight (kg) and height (m), allowing the calculation of body mass index (BMI) from reported data, using the following formula: BMI: weight / height <sup>2</sup>

The smoking habit was identified by an affirmative answer to the question "Have you smoked in the last 30 days?".

The study was approved by the Research Ethics Committee of the Heart Institute of the Hospital das Clínicas of the Faculty of Medicine, University of São Paulo, and the participants signed an informed consent.

## Statistics Analysis

The variables analyzed were: age (continuous variable); gender; education level (primary school, secondary school or higher education); meat consumption (OMN, SV or VEG); reported chronic diseases: coronary heart disease (yes or no), hypertension (yes or no), diabetes mellitus (yes or no) and dyslipidemias (yes or no); smoking (yes or no) and body mass index (BMI) (under nutrition: <18.5 kg/m<sup>2</sup>, normal weight: 18.5-24.9 kg/m<sup>2</sup>, or excess body weight - > 25 kg/m<sup>2</sup>).

The distribution of individuals in relative and absolute frequencies is presented according to the categorical study variables (type of diet, gender, education level, smoking habit, BMI and presence of chronic diseases).

Continuous variables (age, body weight and body mass index) were presented according to their mean value and confidence 95% intervals (CI 95%).

To verify the differences between type of diet (omnivorous, vegetarian and semi-vegetarian) and the other categorical study variables (gender, education level, smoking, BMI and chronic diseases), the chi-square test we used. The differences between mean values were calculated by student's ANOVA test.

Multiple logistic regression was used to test the association between the variables. The magnitude of

effect was expressed by the values of OR (odds ratio) and respective 95% confidence intervals (CI 95%). Initially tested by univariate analysis, those variables with  $p < 0.20$  in ascending order of entry were included in the multiple regression. Only variables with  $p < 0.05$  remained in the model.

The reference categories in the regression models were vegetarianism, female gender and no smoking habit. Age and BMI were included as continuous variables in the multiple regression. The variables gender, age and educational level, were maintained for adjustment of multiple models to assess the association between type of diet and chronic diseases, regardless of their level of significance.

All calculations were carried out by using Stata version 10.0

## Results

**Table 1** shows the clinical characteristics of study. Five hundred and forty nine adults of both sexes with mean age of 34.2 y were studied. 228 were OMN (41.5%), 97 were SV (17.7%) and 224 VEG (40,8%). Most VEG followed this diet for a period  $\leq 5$  years (43.3%), 13,4% 5 to 10 years, 25% for over 10 years, and 18.3% since birth.

Most men were vegetarians,  $p=0.004$ . There was a greater prevalence of smokers among OMN than SV and VEG ( $p=0.009$ ). Among the OMN was the highest percentage of individuals with excess body weight,  $p=0.008$  (Table 1). **Table 2** shows that the highest body weight and BMI average values were observed in OMN individuals ( $p<0.01$ ).

In this study, 2.9% of subjects reported coronary heart disease, 10.2% hypertension, 6.0% diabetes mellitus and 17.7% dyslipidemias. Comparing the three categories of meat consumption, it was observed differences between dyslipidemias, that was more frequently referred by OMN in comparison with VEG and SV (54.6% ( $n=53$ ) vs. 28.9 % ( $n=28$ ) and 16.5% ( $n=16$ );  $p=0.011$ ) (**Table 3**). In the univariate regression, being OMN significantly increased the risk of referring dyslipidemia (OR 2.12, CI 1.28-3.50), however no differences were found regarding diabetes or heart disease (**Table 4**).

In the multiple regression models, it was found that being OMN significantly increased the risk of referring hypertension, regardless of sex and age (OR 2.19; CI 95% 1.08-4.46), each year increases by 6% the chance to report this disease (OR 1.06; CI 95% 1.03-1.08). The frequent meat consumption was also associated with dyslipidemia, regardless of body mass index, smoking, sex and age. Being OMN increases the chance to report this disease by 78% (CI 95% 1.03-3.08), each  $\text{kg/m}^2$  of BMI in 12% (CI 95% 1.05-1.18), smoking in 154% (CI 95% 1.44-4.47), and each year in 2% (CI 95% 1.00-1.04) (**Table 5**).

## DISCUSSION

In this study on Brazilian adults who answered a questionnaire to select people for The CARVOS Study, several differences regarding the prevalence of reported chronic diseases were associated with the type of consumed diet.

The world wide and Brazilian panorama of chronic diseases became a new challenge for public health. Over the past decades, with the industrialization processes, urbanization and epidemiological transition, in which different societies experience a reduction in mortality from communicable diseases, a group of chronic diseases is emerging among them hypertension, diabetes mellitus and coronary heart disease, which are major causes of death worldwide, and hypertension, and dyslipidemias, which in addition to causing deaths are risk factors for other diseases[15,16]. According to that projections, the cardiovascular mortality would be nearly 23.6 million people in 2030 [17].

According to the World Health Organization 82 and 80% of deaths from cardiovascular disease and diabetes mellitus, respectively, occurred in developing countries [17,18,19]. This is confirmed in Brazil, where cardiovascular diseases are the leading causes of death among men and women [20].

This epidemiologic situation shows the importance of studies like this, since dietary habits play an important role in the development of several chronic diseases that are the greater causes of morbidity and mortality worldwide.

Unlike the majority of previous research on VEG and OMN, we analysed a SV group, because it is important to evaluate an intermediate standard diet.

In the present study, the highest percentage of excess of body weight individuals was observed in OMN. Similar results were observed In the Lima Study with Peruvian subjects, in which body weight average and BMI were lower among VEG and SV compared with OMN [3].

In the present study, being OMN was significantly associated with a greater chance of referring hypertension, regardless of sex and age. Recently Silva et al. [21] observed that the prevalence of hypertension (22.7%) among 264 Adventist in São Paulo was lower compared with that reported in Brazilian studies, possibly because life habits as vegetarianism.

The frequent meat consumption was also associated with dyslipidemia, regardless of body mass index, smoking, sex and age. Many studies have demonstrated differences in plasma lipids between VEG and OMN in others populations [22,23,24,25]. This is important since especial attention must be paid to the epidemiological peculiarity of Latin America, due different ethnic origins, diverse nutritional habits and lifestyles [26]. Previous studies have evaluated the

**Table 1.** Distribution of individuals according to meat consumption and demographic, social and anthropometric variables. São Paulo, Brazil, 2012.

	VEG % (n)	SV % (n)	OMN % (n)	p value
<b>Gender</b>				
Female	36.3 (140)	19.4 (75)	44.3 (171)	0.004 <sup>a</sup>
Male	51.5 (84)	13.5 (22)	35.0 (57)	
<b>Education</b>				
Primary school	40.0 (8)	30.0 (6)	30.0 (6)	0.363
Secondary school	43.7 (115)	16.7 (44)	39.6 (104)	
Higher education	38.0 (101)	17.7 (47)	44.3 (118)	
<b>Smoking</b>				
Yes	29.4 (25)	14.1 (12)	56.5 (48)	0.009 <sup>a</sup>
No	42.9 (199)	18.3 (85)	38.8 (180)	
<b>Body Mass Index</b>				
Undernutrition	6.3 (14)	6.2 (6)	1.7 (4)	0.008 <sup>a</sup>
Normal weight	64.7 (145)	64.6 (62)	56.6 (129)	
Excess body weight	29.0 (65)	29.2 (28)	41.7 (95)	

VEG=vegetarians  
SV=semi-vegetarians  
OMN=omnivorous

<sup>a</sup> p<0.05 (Chi-square test)

**Table 2.** Means and confidence interval (95%) of age, reported body weight and body mass index, according to meat consumption. São Paulo, Brazil, 2012.

	VEG (n=224)		SV (n=97)		OMN (n=228)	
	Mean	CI (95%)	Mean	CI (95%)	Mean	CI (95%)
Age	34.0	32.5-35.5	34.3	31.5-37.0	34.2	32.5-35.9
Body weight	66.1 <sup>a</sup>	64.5-68.1	65.0 <sup>a</sup>	62.1-67.8	69.0 <sup>b</sup>	67.1-70.8
Body mass index	23.4 <sup>c</sup>	22.8-24.0	23.3 <sup>c</sup>	22.5-24.1	24.8 <sup>d</sup>	24.3-25.4

Means with different letters are statistically significantly different between them (p<0.05, ANOVA test)

**Table 3.** Chronic diseases reported by vegetarians, semi-vegetarians and omnivores. São Paulo, Brazil, 2012.

	VEG % (n)	SV % (n)	OMN % (n)	p value
<b>Heart disease</b>				
Yes	31.3 (5)	25.0 (4)	43.8 (7)	0.641
No	41.1 (219)	17.5 (93)	41.5 (221)	
<b>Hypertension</b>				
Yes	28.6 (16)	21.4 (12)	50.0 (28)	0.145
No	42.2 (208)	17.2 (85)	40.6 (200)	
<b>Diabetes Mellitus</b>				
Yes	30.3 (10)	18.2 (6)	51.2 (17)	0.407
No	41.5 (214)	17.6 (91)	40.9 (211)	
<b>Dyslipidemias</b>				
Yes	28.9 (28)	16.5 (16)	54.6 (53)	0.011 <sup>a</sup>
No	43.4 (196)	17.9 (81)	38.7 (175)	

<sup>a</sup> p<0.05 (Chi-square test)

**Table 4.** Univariate association between meat consumption and reported chronic diseases. São Paulo, Brazil, 2012.

Chronic diseases reported	OR	CI (95%)	p value
<b>Heart disease</b>			
Vegetarians	1		
Semi-vegetarians	1.88	0.49-7.17	0.353
Omnivores	1.39	0.43-4.44	0.581
<b>Hypertension</b>			
Vegetarians	1		
Semi-vegetarians	1.84	0.83-4.04	0.132
Omnivores	1.82	0.96-3.47	0.068 <sup>a</sup>
<b>Diabetes Mellitus</b>			
Vegetarians	1		
Semi-vegetarians	1.41	0.50-4.00	0.517
Omnivores	1.72	0.77-3.85	0.184
<b>Dyslipidemias</b>			
Vegetarians	1		
Semi-vegetarians	1.38	0.71-2.69	0.341
Omnivores	2.12	1.28-3.50	0.003 <sup>b</sup>

a=  $p < 0.020$ ; b= $p < 0.05$  (Univariate regression)

**Table 5.** Multivariate associations with reported hypertension and dyslipidemia in the studied population. São Paulo, Brazil, 2012.

Chronic diseases reported	OR	CI (95%)	p value
<b>Hypertension<sup>a</sup></b>			p<0.001
Vegetarians	1		
Semi-vegetarians	2.12	0.89 - 5.07	
Omnivores	2.19	1.08 - 4.46	
Age (continuous variable)	1.06	1.03 - 1.08	
Female	1		
Male	1.61	0.86 - 3.01	
Primary school	1		
Secondary school	0.60	0.16 - 2.17	
Higher education	0.58	0.16 - 2.04	
<b>Dyslipidemias<sup>b</sup></b>			p<0.001
Vegetarians	1		
Semi-vegetarians	1.43	0.70 - 2.93	
Omnivores	1.78	1.03 - 3.08	
Body mass index (continuous variable)	1.12	1.05 - 1.18	
No smoking	1		
Smoking	2.54	1.45 - 4.47	
Age (continuous variable)	1.02	1.00 - 1.04	
Female	1		
Male	1.09	0.6 - 1.84	
Primary school	1		
Secondary school	0.72	0.24 - 2.16	
Higher education	0.71	0.24 - 2.12	

associations of vegetarian diet with chronic diseases in Latin America. In the Sao Paulo Study [4,5] on 136 volunteers from the Adventist Church of Sao Paulo were divided into 3 groups (VEG, SV and OMN), VEG exhibited lower prevalence of arterial hypertension and hypercholesterolemia, and lower plasma concentrations of total cholesterol and LDL-C compared to OMN. The SV group showed values intermediate between the VEG and OMN groups. These findings suggest that SV diet indeed is in a "bridge" condition between VEG and OMN and itself could be associated to a better condition with respect to OMN.

Recently Dourado et al. [27] confirmed better lipid profile among 29 vegetarians compared with 50 omnivorous subjects in the north-east of Brazil, confirming the association between meat intake and reported dyslipidemia found in this study.

Thus, in accordance with the previous data from Peruvians [3] and another studies carried out in Brazil [4,5,21], the present study indicates that a VEG diet is associated with a better coronary heart disease risk profile. This similarity with results from studies in other populations that used other methodology strengthens the internal consistency of our data.

This study has several limitations. First, its cross sectional design does not implicate in causality. Second, we used referred data instead of measuring the study variables. However, there is evidence of a good concordance between referred and determined data to identify the prevalence of chronic diseases [28]. Despite these limitations our study is compatible with previous data and suggest that a vegetarian diet could be associated with a better health.

The lower intake of meat per week, found in the SV group, does not seem to be as harmful according to the results observed. However, the SV group has a significantly lower size, affecting statistical analysis, compromising these results.

Even with the small number of participants in this study, we found several associations, it is speculated that with even larger sample size could have been checked more obvious associations between meat consumption and even those with other diseases. Nevertheless it must be recognized that many dietary factors are related to the development of chronic diseases evaluated in this study, such as the amount of sodium in the diet and fat from other foods, however, these factors were not assessed in this study.

Recognizing the association between meat intake and risk of chronic diseases, allows interventions to be appropriately targeted, providing great benefit to public health, especially regarding the possibility of prevention of diseases with high prevalence, improving the quality of life and decreasing mortality.

## CONCLUSION

High meat consumption was associated with a greater prevalence of smoking, excess of body weight and chronic diseases. Being omnivore was positively associated with reported hypertension, regardless of sex and age, and with dyslipidemias, regardless of body mass index, smoking, sex and age.

This study increases the evidence of association between frequent meat consumption and chronic diseases, and it is expect to stimulate the development of other studies in different regions of the world, and to support public programs about nutrition for the prevention of diseases.

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