



## A Study of Vegetarian Diet and Cholesterol and Triglycerides Levels.

### KEYWORDS

Vegetarian diet, cholesterol, triglycerides.

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### ABSTRACT

**OBJECTIVE:** Compare levels of triglyceride (TG), total cholesterol (TC), low density lipoprotein (LDL) and high density lipoprotein (HDL) among vegetarians and omnivores.

**METHODS:** Blood samples were collected from 76 individuals both males and females separated in four different diet groups: omnivores, lacto-ovo vegetarians, lacto vegetarians, and restricted vegetarians (or vegans).

**RESULTS:** Significant difference was reported for TC, LDL and TG levels among the samples. Higher levels were reported by omnivores, with decreased levels for vegetarians as animal products were restricted, with lowest levels having been reported by vegans. Mean and standard deviation for TC were  $208.09 \pm 49.09$  mg/dl in the group of omnivores, and  $141.06 \pm 30.56$  mg/dl in the group of vegans ( $p < 0.001$ ).

**CONCLUSION:** Vegetarian diet was associated to lower levels of TG, TC and LDL as compared to the diet of omnivores.

### Introduction

Literature brings evidence of the association between cholesterol high serum levels and the prevalence of arterial diseases, especially atherosclerosis, which may lead, among other problems, to myocardial infarction and cerebral vascular accidents<sup>1-6</sup>. Recent evidence has suggested that increased cholesterol levels have also been found to be a risk factor for Alzheimer disease<sup>7,8</sup>.

The three types of vegetarian diets are: restricted or total: with no animal product in their food (this type is also called vegan); lacto vegetarians: from animal products, only milk and by-products are included; and lacto-ovo, which also allows the inclusion of eggs<sup>23</sup>.

This paper objective was to compare the ratio between triglycerides (TG), total cholesterol (TC) and their fractions (LDL and HDL) among vegetarians, to compare them with omnivores.

### Methods

A cross-sectional study was carried out. Seventy-six voluntary individuals participated. Most of them were residents in the area the research took place. From those, 22 were omnivores, and 54 were vegetarians. Vegetarians were divided into 3 groups: 19 lacto-ovo vegetarians, 17 lacto vegetarians, and 18 total vegetarians.

Participants filled out a questionnaire with the following personal information: name, gender, age, type of diet, physical exercise practice, alcohol consumption, smoking habits, weight and height, the use of statins. Blood was then collected after fasting was confirmed for at least 12 hours. Blood collection was carried out in compliance with standard procedures for blood samples.

Sample analysis was carried out at the Hospital Complex Central Laboratory. Concentration measures for TC, TG and HDL were obtained through enzyme biochemical method; LDL concentrations were calculated based on

those values and following Friedwalds formula.

As for statistical analysis, two criteria were used to decide on the use of ANOVA: data with NORMAL distribution and variances among homogeneous samples. Should those two criteria not be met, Kruskal-Wallis would be used. Fischer exact test was used for smoking habits analysis since the contingency table had one cell expected to be lower than 5, which contra-indicates the use of  $\chi^2$ .

### Results

Table 1 shows data on the characteristics of samples following factors under investigation. The samples are shown to be similar in regard to gender, age, physical exercise and BMI. However, there are significant differences in alcohol consumption ( $p < 0.001$ ), with higher level among omnivores (4 in 22) as compared to vegetarians (9 in 54, being 6 among lacto vegetarians, 3 among lacto-ovo and none among vegans). The same was shown for the use of tobacco, but only 5 individuals referred use, being 4 in the omnivore group and 1 in the lacto vegetarian group. No reference was made to the use of statins in any of the groups.

### (Table 1 comes here)

Table 2 describes samples of lipid serum level per diet. Significant difference was reported for TC, LDL and TG levels among the samples. Higher values were reported by omnivores, with decreased levels as animal products were restricted, with lowest levels having been reported by vegans. Mean and standard deviation for TC were  $208.09 \pm 49.09$  mg/dl in the group of omnivores, and  $141.06 \pm 30.56$  mg/dl in the group of vegans ( $p < 0.001$ ). LDL values for omnivores and vegans were respectively:  $123.43 \pm 42.67$  mg/dl and  $69.28 \pm 29.53$  mg/dl ( $p < 0.001$ ). For TG, those values were  $155.68 \pm 119.84$  mg/dl and  $81.67 \pm 81.90$  mg/dl ( $p < 0.01$ ).

### (Table 2 comes here)

As for HDL level no difference was reported between the

samples, but HDL/TC ratio was significantly higher among vegans ( $p = 0.01$ ).

Table 3 shows results of regression analysis between lipid serum level, associated factors, and type of diet. Even after adjustment for different confusion variables (as indicated in each model), the three groups of vegetarians reported significantly lower TC, LDL, and TG levels; vegans additionally reported significantly higher HDL/TC ratio. So, variables such as alcohol consumption, physical exercise and BMI were not included, since they were not shown to be statistically significant for data in Tables 1 and 2.

(Table 3 comes here)

Discussion

Literature gives evidence that vegetarian diet seems to play a role in vascular protection. Results from the present study were similar to those of a number of other studies, which did not, however, investigate the subdivision among vegetarians.

In a study with African Americans, Melby et al<sup>17</sup> investigated the lipid profile of 66 vegetarians, 56 semi-vegetarians and 45 omnivores. They found that vegetarians reported the lowest TC, LDL, and TG levels. In a study with individuals in Peru, Navarro et al<sup>15</sup> found the lowest TC and LDL serum concentration among vegetarians. In his doctorate dissertation the same author confirmed lowest TC and LDL levels among vegetarian Adventists in São Paulo.

Harman and Parnell<sup>18</sup>, in their turn, while investigating Seventh Day Adventists in New Zealand, did not find differences between the lipid profile of vegetarians and omnivores, although lipid levels for both groups showed to be lower than what could be observed for the population in general in that country. In the authors point of view, life style associated to religion, lower stress levels, no alcohol or caffeine consumption, as well as smoking prohibition could explain low lipid levels in those groups.

While studying 233 vegetarians paired with 233 non-vegetarians and taking into account residence location, sex, age, marital status, body weight, height and occupation, West and Haies<sup>21</sup> have observed that TC was significantly lower in the first group, whereas in the second group TC level increased as meat consumption increased.

In our sample, vegans reported significantly lower levels as compared to omnivores in regard to TC, LDL, and TG, and significantly higher ratio HDL/TC (Table 2), even after age, gender and smoking habits had been adjusted (Table 3). As for lacto-ovo vegetarians and lacto-vegetarians, TC, LDL, and TG levels have been found to be significantly lower (Table 2 and 3). So, our results point towards the association between low lipid levels and vegetarian diet - in agreement with the authors mentioned earlier. However, they disagree with Clifton and Nestel<sup>10</sup>, who consider the metabolic component as determining factor for serum cholesterol levels.

Based on such observations, one could speculate on the use of vegetarian diet especially vegan as coadjuvant action in preventing or treating dyslipidemias. Nonetheless, it is important to point out that the present study investigated vegetarian diet under one single focus - lipids in a sample from the general population. Other counterpoints have been reported, though. Among them, the most common and the most widely investigated is cobalamin deficiency, which leads to megaloblastic anemia<sup>24,25</sup>. Iron deficiency

may also be associated, thus masking the megaloblastic anemia condition<sup>24</sup>. There are also reports of higher prevalence of hypospadias<sup>26</sup> and higher levels of homocysteine among vegetarians as compared to omnivores<sup>27</sup>. Additionally, congenital hypothyroidism cases have been reported in children breast fed exclusively with vegan mothers milk (in regions where not all salts are iodated)<sup>28</sup>, as well as bilateral optical neuropathy, severe sight impairment, and other visual problems in vegan patients (there has been significant improvement of the condition after multivitamin supplement administration)<sup>29</sup>. Taking all that into account, further studies are required before indicating the vegetarian diet for prevention and/or therapeutic purposes.

Concluding, vegetarian diet was associated to lower levels of TG, TC and LDL as compared to the diet of omnivores.

Tables:

Table 1: Sample characteristics: factors under investigation

| Factor                     | Omnivores<br>N=22 | Lacto-ovo<br>Vegetarians<br>N=19 | Lacto<br>Vegetarians<br>N=17 | Vegans<br>N=18 | P      |
|----------------------------|-------------------|----------------------------------|------------------------------|----------------|--------|
| Gender (M/F)               | 7/15              | 6/13                             | 5/12                         | 10/8           | 0.31   |
| Age (years)                | 37.9615.56        | 37.10                            | 35.76                        | 29.94          | 0.20   |
| Smokers (no/yes)           | 18/4              | 19/0                             | 16/1                         | 18/0           | 0.057  |
| Alcohol users (no/yes)     | 8/14              | 16/3                             | 11/6                         | 18/0           | <0.001 |
| Physical exercise (no/yes) | 10/12             | 10/9                             | 5/12                         | 4/14           | 0.198  |
| BMI (kg/m2)                | 25                | 23.5                             | 25.97                        | 21.79          | 0.18   |

Table 2: Sample characteristics: sample levels (mg/dl) no of lipids under investigation

| Lipid                       | Omnivores | Lacto-ovo<br>Vegetarians | Lacto<br>Vegetarians | Vegans | P      |
|-----------------------------|-----------|--------------------------|----------------------|--------|--------|
| Total cholesterol           | 208.09    | 175.32                   | 164.82               | 141.06 | <0.001 |
| HDL                         | 56.23     | 55.47                    | 57.71                | 55.67  | 0.96   |
| HDL/Total cholesterol ratio | 0.29      | 0.32                     | 0.37                 | 0.41   | 0.01   |
| LDL                         | 123.43    | 101.47                   | 87.71                | 69.28  | <0.001 |
| Triglycerides               | 155.68    | 93.95                    | 94.71                | 81.67  | <0.001 |

Table 3: Regression analysis between serum lipid levels and associated factors following types of diet\*

| Description           | Total cholesterol | HDL            | HDL/Total cholesterol ratio | LDL            | Triglycerides     |
|-----------------------|-------------------|----------------|-----------------------------|----------------|-------------------|
| Lacto-ovo vegetarians | -31.41            | -4.15          | 0.009                       | -22.22         | -59.35            |
| b                     |                   |                |                             |                |                   |
| CI 95%                | -54.09 to -8.73   | -13.44 to 5.14 | -0.06 to 0.08               | -42.80 to 1.64 | -105.78 to -12.92 |
| p                     | 0.007             | 0.376          | 0.793                       | 0.035          | 0.013             |

|                               |                  |                |                        |                  |                   |
|-------------------------------|------------------|----------------|------------------------|------------------|-------------------|
| Lacto vegetarians             |                  |                |                        |                  |                   |
| b                             | -39.74           | -1.03          | 0.06                   | -34.21           | -54.08            |
| CI 95%                        | -63.16 to 16.32  | -10.40 to 8.34 | -0.004 to 0.13         | -55.43 to 12.99  | -102.05 to 6.12   |
| p                             | 0.001            | 0.827          | 0.066                  | 0.002            | 0.028             |
| Vegans                        | 5                |                |                        |                  |                   |
| b                             | -54.14           | -1.73          | 0.07                   | -44.92           | -62.35            |
| CI 95%                        | -77.79 to -30.49 | -11.37 to 7.92 | 0.0004 to 0.139        | -66.24 to -23.59 | -111.55 to -13.16 |
| p                             | 0.000            | 0.722          | 0.049                  | 0.000            | 0.014             |
| R <sup>2</sup> of final model | 0.45             | 0.20           | 0.33                   | 0.40             | 0.32              |
| Final model adjusted for      | Age              | Gender and age | Age and smoking habits | Age              | Gender and age    |

\*omnivore diet was defined as the comparison group, b-regression coefficient, CI 95%=95% confidence interval.

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