Association of Fiber Intake and Cardiovascular Risk in Elderly Patients

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Introduction

According to the World Organization Health¹, the elderly population is expected to rise from 14.9 million (7.4% of the total) in 2013 to 58.4 million (26.7% of the total) in 2060, and the average life expectancy should increase from the current 75 years to 81 years¹.

In addition to physiological aging factors such as risk of chronic diseases, there are also lifestyle habits, which have great influence on the health status of individuals².

Cardiovascular disease (CVD) is a chronic disease and is the leading cause of mortality and loss of capacity. According to the World Health Organization¹, 30% of deaths result from cardiovascular disease¹.

Risk factors for developing CVD can be classified into non-modifiable (age, gender and family history) and modifiable (high blood pressure, hypercholesterolemia, physical inactivity and smoking). It is suggested that insulin resistance, which is a contributor to the metabolic syndrome, plays an important role in cardiovascular risk³.
Through food, the modifiable risk factors for the prevention of cardiovascular diseases can be controlled. Dietary fiber is an important component used and has a role in maintaining a healthy dietary pattern, adequate weight, healthy lipid profile and normalized blood pressure.

Despite all the benefits that fiber intake can bring, there is low consumption of this component. The dietary pattern of the Brazilian population has undergone significant changes, with increasing amounts of food with high content of simple carbohydrates or lipids and improper consumption of fruits, vegetables and fiber. This nutritional transition occurs due to variations in the population income, marketing campaigns, relative prices of food, level of urbanization, food supply structure, educational level and cultural influences.

Dietary fiber plays an important role in preventing CVD. As the elderly population has highest prevalence of these diseases, it is necessary to assess the fiber intake in this population to develop strategies that may encourage intake.

The objective of this study was to investigate the association between fiber intake and cardiovascular risk in elderly patients treated at the nutrition clinic of a university hospital.

Methods

This is a descriptive retrospective study carried out from September to October 2014. The records of patients treated in the nutrition clinic with at least two visits were surveyed. Of 85 patients, 40 elderly patients of both sexes whose medical records contained all the data required for the study were selected. Medical records with less than two visits were excluded.

For the classification of the study population the following were used: age, sex, physical inactivity, smoking and total energy value (TEV). Patients were stratified by body mass index (BMI) according to the World Health Organisation.

This study was approved by the Research Ethics Committee of Faculdade de Medicina da Universidade Federal Fluminense under no. CAAE 35030614.0.0000.5243. All patients signed an Informed Consent Form.

For the analysis of daily fiber intake, 24-hour dietary recall was used. To quantify the fiber, the following Food Composition Table was used: starchy tubers, cereals and cereal products, fruits, green vegetables, legumes, nuts and pulses. To determine the amount of food using the cooking measurements provided in the dietary recall, the Food Consumption Assessment Table using Cooking Measurements was employed.

According to the IV Brazilian Guidelines on dyslipidemia and prevention of atherosclerosis, the recommendation for total fibers is 20-30 g/day, of which 5-10 g are soluble fibers.

To investigate cardiovascular risk factors, the following clinical data were used: abdominal obesity (waist circumference >90 cm for men and >80 cm for women); hypertriglyceridemia (≥150 mg/dL); low HDL-cholesterol (high-density lipoprotein) (<40 mg/dL for men and <50 mg/dL for women); high LDL-cholesterol (low-density lipoprotein) (>100 mg/dL); high total cholesterol (>200 mg/dL); Castelli I index (>4.4); Castelli II index (>2.9); and fasting glucose (>100 mg/dL).

For statistical analysis, the software application GraphPadinStat® version 3.1 was used. The continuous variables were expressed as mean±standard deviation and the categorical variables were expressed as absolute and relative frequencies. To evaluate the statistical difference between the risk factors and the groups according to BMI, the ANOVA test was used. To correlate the TEV and fibers, the Pearson test or the Spearman test was used. To evaluate the association between physical inactivity, smoking and risk factors, the chi-square test was used. P<0.05 was considered significant.

Results

Forty patient records were evaluated, of which 80.0% (n=32) were females and 20% (n=8) were males. Classifying the participants according to BMI, the following was found: 10.0% (n=4) malnourished; 17.5% (n=7) eutrophic; 45.0% (n=18) overweight and 27.5%...
(n=11) obese. The mean age was 76.8±7.62 years with higher frequency (57.5%) between 70-79 years.

The distribution of the groups studied according to smoking and physical inactivity is presented in Table 1.

Regarding the risk factors, the results are shown in Table 2. The highest average value of waist circumference was found in the obese group (103.0±11.2 cm), followed by the overweight group (92.7±4.1 cm). The highest average levels of total cholesterol, triglycerides and LDL-cholesterol were observed in the eutrophic group: 194.5±48.5 mg/dL; 167.2±95.9 mg/dL; 130.0±37.7 mg/dL, respectively. Obese patients had lower average HDL-cholesterol levels (44.0±8.9 mg/dL) while the highest average fasting glucose level (109.8±29.1 mg/dL) was found in the overweight group.

Table 1
Smoking and physical inactivity in the study population, by groups

<table>
<thead>
<tr>
<th></th>
<th>Malnourished n (%)</th>
<th>Eutrophic n (%)</th>
<th>Overweight n (%)</th>
<th>Obese n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>2 (50.0%)</td>
<td>2 (28.57%)</td>
<td>1 (5.55%)</td>
<td>2 (18.18%)</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>3 (75.0%)</td>
<td>4 (57.14%)</td>
<td>15 (83.33%)</td>
<td>7 (63.64%)</td>
</tr>
</tbody>
</table>

Table 2
Risk factors found in the study population, by groups

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Malnourished</th>
<th>Eutrophic</th>
<th>Overweight</th>
<th>Obese</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist circumference (cm)</td>
<td>75.6±4.8</td>
<td>89.4±6.8</td>
<td>92.7±4.1</td>
<td>103.0±11.2</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Total cholesterol (mg/dL)</td>
<td>143.0±22.6</td>
<td>194.5±48.5</td>
<td>182.4±34.8</td>
<td>180.4±28.1</td>
<td>0.14</td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>68.7±6.4</td>
<td>167.2±95.9</td>
<td>154.0±110.3</td>
<td>121.5±56.6</td>
<td>&lt;0.04**</td>
</tr>
<tr>
<td>HDL (mg/dL)</td>
<td>45.0±11.3</td>
<td>52.1±14.2</td>
<td>48.2±13.1</td>
<td>44.0±8.9</td>
<td>0.72</td>
</tr>
<tr>
<td>LDL (mg/dL)</td>
<td>79.6±13.6</td>
<td>130.0±37.6</td>
<td>105.9±29.5</td>
<td>108.9±22.1</td>
<td>0.13</td>
</tr>
<tr>
<td>Fasting glucose (mg/dL)</td>
<td>96.7±15.5</td>
<td>93.3±11.3</td>
<td>109.8±29.1</td>
<td>106.2±29.0</td>
<td>0.68</td>
</tr>
<tr>
<td>Index Castelli I</td>
<td>2.9±1.0</td>
<td>4.4±2.0</td>
<td>3.8±1.1</td>
<td>3.9±0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>Index Castelli II</td>
<td>1.6±0.9</td>
<td>2.7±1.5</td>
<td>2.7±2.3</td>
<td>2.4±0.7</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Values expressed as mean±standard deviation
HDL – high density lipoprotein; LDL – low density lipoprotein
*Significant difference between malnourished and obese groups; eutrophic and obese; and overweight and obese.
**Significant difference between the malnourished and overweight group.

Table 3 shows the mean values of total dietary fiber, soluble, insoluble and TEV found in the population, per groups.

Statistical analysis showed a direct relationship between the fibers and the total energy value (p=0.002), i.e., the higher the TEV the greater the amount of fiber intake per day. The association between the amount of fibers and risk factors was also investigated. Statistical significance was not found in any of the parameters (Table 4).

The chi-square test allowed us to calculate the odds ratio (OR) between physical inactivity, smoking and risk
factors, shown in Table 5. All values found were non-significant.

Waist circumference was associated with physical inactivity, as well as fasting glucose and HDL. Triglycerides had a strong association for both smoking and for physical inactivity. These two factors may be related to the increase of this risk factor. Castelli indexes, total cholesterol and LDL proved to be strongly associated with smoking.

**Table 3**

<table>
<thead>
<tr>
<th></th>
<th>Malnourished</th>
<th>Eutrophic</th>
<th>Overweight</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fibers (g/day)</td>
<td>25.1±6.6</td>
<td>22.6±7.0</td>
<td>23.3±6.1</td>
<td>22.0±3.4</td>
</tr>
<tr>
<td>Insoluble fibers (g/dia)</td>
<td>14.0±3.4</td>
<td>12.7±3.8</td>
<td>13.9±4.0</td>
<td>12.8±1.7</td>
</tr>
<tr>
<td>Soluble fibers (g/day)</td>
<td>10.9±3.6</td>
<td>9.8±3.0</td>
<td>9.3±2.3</td>
<td>9.3±2.3</td>
</tr>
<tr>
<td>TEV (kcal/kg/day)</td>
<td>36.3±11.7</td>
<td>27.9±6.5</td>
<td>20.9±5.8</td>
<td>18.8±6.7</td>
</tr>
</tbody>
</table>

Values expressed as mean±standard deviation
TEV – total energy value

**Table 4**

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>R</th>
<th>CI 95%</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist circumference (cm)</td>
<td>-0.18</td>
<td>-0.47 - 0.15</td>
<td>0.27</td>
</tr>
<tr>
<td>Total cholesterol (mg/dL)</td>
<td>0.089</td>
<td>-0.23 - 0.38</td>
<td>0.58</td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>-0.01</td>
<td>-0.32 - 0.30</td>
<td>0.94</td>
</tr>
<tr>
<td>HDL (mg/dL)</td>
<td>0.047</td>
<td>-0.26 - 0.35</td>
<td>0.77</td>
</tr>
<tr>
<td>LDL (mg/dL)</td>
<td>0.12</td>
<td>-0.20 - 0.43</td>
<td>0.44</td>
</tr>
<tr>
<td>Fasting glucose (mg/dL)</td>
<td>0.20</td>
<td>-0.13 - 0.48</td>
<td>0.22</td>
</tr>
<tr>
<td>Castelli I Index</td>
<td>0.07</td>
<td>-0.246 - 0.37</td>
<td>0.28</td>
</tr>
<tr>
<td>Castelli II Index</td>
<td>0.021</td>
<td>-0.30 - 0.34</td>
<td>0.32</td>
</tr>
</tbody>
</table>

HDL – high density lipoprotein; LDL – low density lipoprotein
### Table 5

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Smoking</th>
<th>p-value</th>
<th>Physical inactivity</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist circumference</td>
<td>0.2</td>
<td>0.08</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>0.9</td>
<td>1.00</td>
<td>1.5</td>
<td>0.70</td>
</tr>
<tr>
<td>HDL</td>
<td>0.3</td>
<td>0.41</td>
<td>1.0</td>
<td>1.00</td>
</tr>
<tr>
<td>LDL</td>
<td>1.4</td>
<td>1.00</td>
<td>0.8</td>
<td>1.00</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>1.5</td>
<td>0.68</td>
<td>0.4</td>
<td>0.45</td>
</tr>
<tr>
<td>Fasting glucose</td>
<td>0.5</td>
<td>0.68</td>
<td>0.9</td>
<td>1.00</td>
</tr>
<tr>
<td>Castelli I Index</td>
<td>1.5</td>
<td>0.64</td>
<td>2.2</td>
<td>0.42</td>
</tr>
<tr>
<td>Castelli II Index</td>
<td>1.8</td>
<td>0.61</td>
<td>3.6</td>
<td>0.18</td>
</tr>
</tbody>
</table>

HDL – high density lipoprotein; DL – low density lipoprotein

### Discussion

Prevalence of overweight (45.0%), followed by obesity (27.5%) was found. Similar results were found in other studies. A possible explanation for weight gain in aging are physiological changes that promote gain of body fat to the detriment of muscle mass, little or no physical activity and genetics, associated with the household environment.

The environment in which we live is seen as obesogenic because it encourages people to have unhealthy behaviors. Urbanization and globalization influence the eating habits and physical inactivity, as well as lack of time, convenience and accessibility. Besides this, the media and the means of communication increase the consumption of unhealthy foods contributing to the prevalence of excess weight.

Regarding smoking, the elderly reported that they were not smoking at the time. Former smokers were found (17.5%). Other studies showed low smoking rates in the elderly, but this reduction in older age smokers may be a survival bias, since smoking leads to high mortality rates. Cigarette smoking affects cardiovascular function causing endothelial dysfunction, such as reduced vasodilation, and can induce the process of atherosclerosis. Moreover, the study revealed that smokers have modified eating habits due to the action of nicotine in the central nervous system, inducing them to decrease the consumption of vegetables and fruits. They also increase the consumption of salt, alcohol, coffee and food treats in an attempt to eliminate the taste of tobacco.

Physical inactivity has a great influence on health and the risk of cardiovascular diseases. In this study, its prevalence was 72.50%, which was similar to what has been described. The hypothesis for the number of physically active old people to be reduced is due to some obstacles, such as lack of proper education and places.

More public policies for physical activity in old age are required, such as the creation of Gym Facilities for the Elderly, offering proper education and places to practice exercises safely and free-of-charge.

Another risk factor related to CVD is central obesity. As expected, overweight and obesity groups presented mean values of waist circumference higher than the other groups (malnourished and eutrophic). All risk factors were significantly associated with the obese group (Table 2).

Dyslipidemia is one of the major risk factors for the development of CVD. In this study, satisfactory mean values of total cholesterol were found in all groups (Table 2), as opposed to the high values found in the literature. These low figures can be explained by the fact that patients followed-up by the health services are more knowledgeable about their health and, consequently, have better eating habits. The study did not aim to evaluate all macronutrients of food. However, it was
found that patients generally have acceptable eating habits when it comes to fiber and calories, causing a positive impact on biochemical evaluation.

Although the total cholesterol levels are satisfactory, that is, according to recommended levels, this did not occur with LDL values, which were higher in all groups (Table 2) and in other studies\textsuperscript{14,21,22}.

As for HDL, the results were lower than recommended for women. HDL is seen as a protective factor for CVD and low serum levels may be harmful. This low value may be associated with the physical inactivity found in the study group\textsuperscript{21}.

The Castelli I and II indexes are calculations that show the cardiovascular risks related to lipids. In the study population, the values were within recommended levels, as opposed to what is described in the literature\textsuperscript{23}. However, in the study cited\textsuperscript{21}, total cholesterol, LDL and HDL values were also out of the expected pattern, then the indexes were also abnormal. In this study, as the average of the index components was adequate, except for LDL, it was expected that the indexes were also adequate.

The triglyceride levels were borderline\textsuperscript{23,24}, with a significant difference only for the malnourished group (Table 2) and this difference can be explained because malnourished patients have reduced lipid biosynthesis, consequently, decreased lipid levels in the blood\textsuperscript{23}. In another study\textsuperscript{26}, higher triglycerides were found in elderly individuals with overweight, as opposed to this study, in which the highest average value was in the group of eutrophic individuals. Patients who already have changes in weight and are encouraged to change this situation tend to improve the quality of diet, which may interfere with biochemical markers, as in triglycerides, even though this has not yet been reflected in significant weight loss\textsuperscript{27}.

Regarding fasting glucose, it is known that it is associated with increased cardiovascular risk and related to atherosclerosis. There was no statistically significant difference between the groups, but the overweight and obese group had mean values above recommended. It is known that overweight is associated with insulin resistance, contributing to increased plasma glucose\textsuperscript{28}.

The amount of total and soluble fibers was within the recommended values. It was found that the higher the calorie intake the greater the consumption of fibers, since in the population studied, fiber intake was adequate. However, the quality of all meal components must be analyzed for a better assessment. In studies\textsuperscript{3,4,16,29}, in general, it is common to find adults and elderly individuals with low intake of this macronutrient for a number of reasons that inhibit their consumption, such as price, convenience, difficult chewing and flavor\textsuperscript{30}.

This study showed that, from the analysis of 24-hour dietary recall, the elderly consumed fruits, vegetables and green vegetables on a daily basis, which could contribute to the adequate intake of dietary fibers. Although no statistical significance was found between fiber intake and risk factors, adequate intake of fiber plays a significant role in reducing risk factors for CVD. This fact confirms the importance of follow-up conducted by nutritionists, so as to induce beneficial changes in elderly diets. The absence of significance may be explained by the homogeneity of intake and the size of the study population.

The intake of kcal/kg/day was also determined according to each BMI classification. The malnourished group presented an (average) energy intake of 36.3±11.7 kcal/kg/day, suggesting an attempt to promote weight gain, whereas the obese group had an (average) energy intake of 18.8±6.7 kcal/kg/day, suggesting a strategy to promote weight loss. This appropriateness was probably because the participants attended different clinics, such medical and nutritional, as well as other healthcare professionals. Patients going to healthcare services where there is a multidisciplinary team tend to have a broader knowledge of their health and empowerment to put their knowledge into practice\textsuperscript{31}.

Another correlation made in the study was between risk factors with physical inactivity and smoking. Studies have shown that elderly individuals who do not exercise tend to have high waist circumference and fasting glucose and low HDL. It is known how much physical activity acts on the prevention of CVD. Physical activity contributes to the loss of body fat and, therefore, to a reduction in waist circumference in addition to improvement in HDL and triglycerides levels\textsuperscript{32}. Regular physical activity has great influence on glycemic control, improving insulin sensitivity and helping to maintain adequate levels of plasma glucose\textsuperscript{32}.

As for smoking, strong association was observed with lipid fractions and cardiovascular risk. In smokers, there is increased total serum cholesterol, LDL and triglycerides, as well as increased oxidation of LDL and the risk for atherosclerosis\textsuperscript{33}. The findings corroborate the results.
obtained in this study, demonstrating their association (Table 5).

**Conclusion**

There was no association between fiber intake and cardiovascular risk factors in the elderly individuals of this study.

**References**


