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# The impact of eating patterns on lipids, sodium and other nutrients among the very elderly in the longest-lived population in Brazil

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**Abstract**

**Objectives:** Eating behavior is one of the most important factors associated with the longevity of populations. This study aimed to evaluate the eating behavior and food intake of lipids and sodium of adults over 80 years of age living in a community of the city of Veranopolis, the longest-lived population in Brazil. **Design:** Cross-sectional, population-based study. **Methods:** Eating behavior was evaluated through a 24-hour food recall record, with collection of duplicate samples of meals which were submitted to bromatological analysis. **Results:** The sample included 98 individuals (about 50% of the total population over 80 years of age). Mean age was 84.3±3.4 years, and 34 individuals were male. Mean daily energy value of the diet was 1,709 kcal/day, distributed as 62.6% carbohydrates, 15.5% protein (1.07 g protein/kg/day) and 21,.% lipids (7.2% monounsaturated, 4.7% polyunsaturated and 8.4% saturated fatty acids). The analysis of fatty acids in the diet showed that 30% were ingested as oleic acid and 21% as palmitic acid. Mean daily consumption of micronutrients were 3.19 g sodium, 2,213 mg potassium, 797 mg of calcium, and 215 mg magnesium. **Conclusion:** The results showed that the eating habits of this population are different from those in the Brazilian population as a whole. The diet was hypolipidic, with normal protein content, increased consumption of monounsaturated fat and moderate contents of salt. These findings give further support to the idea that longevity is influenced by an adequate and balanced diet, without excessive consumption of fat and salt.

Key words: Nutrition; Diet; Longevity

## Introduction

Over the past century there has been an accelerated increase in the number of older persons. In Brazil, the population of persons over 60 years of age increased from 4.1% in 1940 to 8.6% in 2000[1].

The longest-lived population in Brazil lives in Veranopolis. In the 1990s, life expectancy of this population at birth was 78 years, whereas in Brazil as a whole it was 67 years[2]. The Veranopolis Project is a multidisciplinary project aiming to evaluate habits and life style of its inhabitants, as well as the influence of eating habits on risk factors for chronic diseases. Professionals of multiple specialties, including geriatricians, cardiologists, psychiatrists, dieticians, physical educators, biologists, dentists, gerontologists and geneticists, participated in the project.

The present paper is a substudy of the Veranopolis Project and is the first study to evaluate the eating behavior of elderly over 80 years of age with bromatological analysis.

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## Methods

All over 80-year-old persons living in Veranopolis were invited to participate in this study through home visits. The final sample included 98 elderly (50% of the long-lived elderly at the time). The study was approved by the Research Ethics Committee of the Pontifícal Catholic University of Rio Grande do Sul (PUCRS). There were no exclusion criteria. All the participants signed an informed consent form.

The methods of Daily Meals Recording and Collection and of Analysis of Duplicate Meal Samples[3] were used for evaluation of eating habits. For the Meals Recording, the participants were instructed to record all food and drink taken in 24 h. Samples of all ingested food and drink, in equivalent amounts, were simultaneously stored in specific containers. After checking the equivalence between the Meals Recording and collected samples, the samples were deboned, grinded, mashed, weighed and frozen. The frozen samples were sent to the Chemistry Institute of PUCRS for bromatological analysis, as follows: a) Protein: Kjeldahl method, equipment Tecnal, AOAC-ACCC Method number 984.13, b) Lipids: Extraction with Soxhlet, AOAC Official Method 920.85, c) Fatty Acids: AOAC Official Method 963.22 Methyl Esters of Fatty Acids, d) Humidity and Dry Residues: AOAC Official Method 925.09 Solids (Total) and moisture in flour, e) Ashes: AOAC Official Method 923.03 Ash of Flour, f) Sodium, Potassium, Calcium and Magnesium: AOAC Official Method 984.27.

Height (m) and weight (kg) were determined for all patients. The Body Mass Index (BMI), classified according to Lipschitz[4], was evaluated as the weight in kilograms divided by the squared height in meters.

Pearson's correlation coefficient was used to estimate the relationship among the variables. The level of significance of differences between means was determined using Student's *t* test. Statistical analyses were performed with the SPSS software version 12.0 for Windows.

## Results

The sample included 98 persons, of whom 64 (65%) were female, with mean age of 84 years (ranging from 80 to 94 years). Weight and BMI are presented in Table 1. No significant differences were observed between genders regarding weight and BMI.

The daily consumption of calories, carbohydrates, proteins and lipids is shown in Table 2. Estimates of total energy value (TEV) in lipids showed larger consumption by men than by women in absolute, but not percent values.

The daily consumption of sodium, potassium, calcium and magnesium as determined by the bromatological analysis is presented in Table 2. Men consumed significantly more sodium and magnesium than women. No significant differences were observed for the consumption of potassium and calcium.

The percentage of the analyzed fatty acids is presented in Table 3. Men and women consumed similar amounts of these fatty acids.

## Discussion

The findings of this study give further support to the idea that longevity is influenced by an adequate and balanced diet, without excessive consumption of fat and salt.

It is well known that eating habits determine the response of the organism to a great number of environmental stimuli. A positive response translates into a longer, healthier life, whereas a negative response results in a shorter life span with the manifestation of several diseases. This relationship stresses the importance of investigating eating habits of long-lived populations.

Our sample included 98 elderly people, representing about half of the population of over 80-year-old persons of Veranopolis. The proportion of women and men in the sample was approximately 2:1, similar to results observed in other demographical studies showing a higher number

**Table 1. Characteristics of the population.**

| | Total (n=98) | Men (n=34) | Women (n=64) | p |
|---|---|---|---|---|
| Age (years±SD) | 84 ±3 | 84 ±3 | 84 ±4 | 0.68 |
| Weight (kg ±SD) | 64 ±13 | 69 ±11 | 62 ±13 | 0.39 |
| BMI (kg/m_±SD) | 26.0 ±5 | 25.0 ±4 | 26.6 ±5 | 0.08 |
| Nutritional status[1] | | | | |
| Underweight n (%) | 20 (20.4) | 5 (14.7) | 15 (23.4) | |
| Normal range n (%) | 43 (43.9) | 19 (55.9) | 24 (37.5) | |
| Overweight n (%) | 35 (35.7) | 10 (29.4) | 25 (39.1) | 0.21 |

[1]The nutritional status was determined using BMI results, according to Lipschitz[4]: underweight < 22 kg/m$^2$, normal range 22–27 kg/m$^2$ and overweight > 27 kg/m$^2$; SD: standard deviation.

**Table 2. Daily intake of energy, macro- and micronutrients according to bromatological analyses.**

| 24-hour intake (mean±SD) | Total (n=98) | Men (n=34) | Women (n=64) | p |
|---|---|---|---|---|
| Energy intake | | | | |
| TEV[1] (kcal) | 1709±566 | 1868±696 | 1625±466 | 0.07 |
| kcal / kg weight | 27.5±9.0 | 27.6±10.9 | 27.4±7.9 | 0.94 |
| Carbohydrates | | | | |
| Total (g) | 266±90 | 284±107 | 257±78 | 0.21 |
| Energy (kcal) | 1065±358 | 1135±429 | 1028±312 | 0.21 |
| Percent TEV (%) | 62.6±7.6 | 61.2±9.3 | 63.3±6.5 | 0.19 |
| Proteín | | | | |
| Total (g) | 67±31 | 74±40 | 63±25 | 0.16 |
| Energy (kcal) | 266±124 | 294±158 | 252±100 | 0.16 |
| Percent TEV (%) | 15.5±4.4 | 15.6±5 | 15.4±4.0 | 0.81 |
| Protein / kg weight (g/kg) | 1.07±0.50 | 1.08±0.60 | 1.07±0.45 | 0.86 |
| Lipids | | | | |
| Total (g) | 42±23 | 49±32 | 38±15 | 0.03 |
| Energy (kcal) | 378±204 | 439±289 | 345±131 | 0.03 |
| Percent TEV (%) | 21.9±6.9 | 23.2±9.3 | 21.3±5.3 | 0.27 |
| Fatty acids | | | | |
| Saturated (%TEV) | 8.4±3.2 | 8.9±1.1 | 8.1±2.3 | 0.34 |
| Monounsaturated (%TEV) | 7.2±2.4 | 7.7±3.2 | 6.9±1.9 | 0.21 |
| Polyunsaturated (%TEV) | 4.7±1.7 | 4.7±2.0 | 4.6±1.5 | 0.68 |
| Omega – 6 (%TEV) | 4.00±1.50 | 4.03±1.78 | 3.98±1.34 | 0.27 |
| Omega – 3 (%TEV) | 0.65±0.28 | 0.71±0.32 | 0.61±0.26 | 0.50 |
| Micronutrients | | | | |
| Sodium (g) | 3.19±1.38 | 3.72±1.59 | 2.90±1.18 | 0.01 |
| Potassium (mg) | 2213±2779 | 2177±1189 | 2233±3338 | 0.92 |
| Calcium (mg) | 797±360 | 810±434 | 790±317 | 0.82 |
| Magnesium (mg) | 215±104 | 249±146 | 196±68 | 0.05 |

[1]Total energy value; SD: standard deviation.

**Table 3. Daily intake of different types of fatty acids: (% of total lipids).**

| Usual name | Total* (n=98) | Men* (n=34) | Women* (n=64) | p |
|---|---|---|---|---|
| Saturated | | | | |
| 8:0 Caprylic acid | 0.45±0.23 | 0.44±0.236 | 0.46±0.23 | 0.61 |
| 10:0 Capric acid | 0.89±0.43 | 0.93±0.47 | 0.86±0.41 | 0.47 |
| 12:0 Lauric acid | 1.11±0.54 | 1.12±0.58 | 1.10±0.52 | 0.82 |
| 14:0 Myristic acid | 4.25±1.56 | 4.31±1.64 | 4.23±1.53 | 0.86 |
| 16:0 Palmitic acid | 21.04±2.52 | 20.94±3.22 | 21.09±2.07 | 0.80 |
| 18:0 Stearic acid | 9.95±2.38 | 9.52±2.11 | 10.18±2.49 | 0.19 |
| 20:0 Arachidic acid | 0.30±0.31 | 0.35±0.48 | 0.27±0.17 | 0.21 |
| Monounsaturated | | | | |
| 16:1 Palmitoleic acid | 3.03±0.65 | 3.13±0.72 | 2.97±0.61 | 0.23 |
| 18:1 Oleic acid | 30.00±3.63 | 30.28±4.36 | 29.86±3.21 | 0.59 |
| Polyunsaturated | | | | |
| Omega-6 | | | | |
| 18:2 Linoleic acid | 18.27±5.78 | 17.67±6.12 | 18.58±5.62 | 0.46 |
| 20:4 Arachidonic acid | 0.49±0.33 | 0.53±0.37 | 0.47±0.30 | 0.42 |
| Omega-3 | | | | |
| 18:3 Linolenic acid | 2.63±1.01 | 2.77±1.06 | 2.55±0.98 | 0.31 |
| 20:5 Eicosapentaenoic acid (EPA) | 0.33±0.46 | 0.31±0.30 | 0.35±0.53 | 0.72 |
| 22:6 Docosahexaenoic acid (DHA) | 0.06±0.32 | 0.11±0.53 | 0.03±0.10 | 0.34 |

*Results presented as mean±SD.

of women in aged populations and evidencing the higher life expectancy of women.

Many experimental studies with animals indicate a beneficial effect of a diet with restricted energy intake[5]. The elderly in our sample did not have a diet with restricted calories, although no excess intake of energy was observed.

When specific macronutrients were analyzed, we observed that proteins were within equivalent standards recommended for this age group, ranging from 0.9 to 1.1 g prot/kg/day[6]. This level of protein consumption is adequate for a positive balance in nitrogen and to allow the establishment of efficient inflammatory and immunological responses to environmental stimuli, favoring longevity.

The consumption of fat is related to increase risks of coronary disease, cerebrovascular accidents and colon cancer[7]. Our results showed that the elderly ingested only 20% lipids in their daily diet, a much smaller proportion than that reported for other populations[8].

The relationship between dietary fats and CVD, especially coronary heart disease, has been extensively investigated, with strong and consistent associations emerging from a wide body of evidence accrued by animal experiments and metabolic studies, as well as observational studies and clinical trials conducted in diverse human populations[9].

Nutritional guidelines for maintaining a healthy lifestyle, preventing cardiovascular diseases and increasing longevity stress the importance of a limited consumption of saturated fatty acids, which can lead to increased concentration of LDL-C. Among saturated fatty acids, palmitic and myristic fatty acids are more related to the increased risk of coronary heart disease (CHD)[9,10]. Our results showed that palmitic acid was the most prevalent saturated fatty acid (21%). Myristic fatty acid which, as does palmitic acid, also increases the serum concentration of LDL-C[10], represented 4% of the ingested fatty acids. These results support the current guidelines that recommend reduction, but not elimination, of saturated fatty acids in the diet.

The most effective replacement for saturated fatty acids in terms of coronary heart disease (CHD) risk seems to be polyunsaturated fatty acids (PUFA). Despite evidence of CHD risk reduction by PUFA, there are no large population studies with large consumption of high quantities of polyunsaturated fatty acids for long periods. Thus, as there is no information on the safety impact of high intakes of PUFA in large populations; this introduces a note of caution for recommending high intakes only of PUFA. Postulated mechanisms for the effects of marine n-3 fatty acids on CHD risk include favorable effects on cardiac rhythm, platelet aggregation, inflammatory responses, and serum triglyceride levels. High intakes of marine n-3 fatty acids also reduce triglyceride levels[9,11]. The results in this study have shown that the consumption of polyunsaturated fatty acids was less than 10% TEV, suggesting that moderate consumption of these substances may have a role in increased longevity.

The only nutritionally important monounsaturated fatty acid is oleic acid, which is abundant in olive and canola oils and also in nuts. Monounsaturated fatty acids as part of a diet that is low in saturated fatty acids and cholesterol and rich in vegetables, fruits, and grain products have received increased attention as being potentially beneficial to risk reduction because of their association with low rates of CHD in olive-oil consuming populations of the Mediterranean basin[11-14]. In the present study, a monounsaturated fatty acid, oleic acid, was the most prevalent fatty acid in the lipid fraction, representing 30% of the total ingested fatty acids. Since monounsaturated fatty acids are associated with a possible reduction in the risk of cardiovascular diseases, this result reinforces the benefits of their consumption.

The sodium reduction shown to lower blood pressure and prevent hypertension also seems to prevent cardiovascular disease[15]. Our results showed that the participants of this study have a mean daily consumption of 3.2 g sodium. In Brazil as a whole, the mean daily ingestion of salt is 10 to 12g/day[16] which is equivalent to 4.0 to 4.8 g sodium. These results support previous studies showing that a reduction in the consumption of salt results in decreased risk of cardiovascular diseases and increased longevity[16]. The analysis of micronutrients in the meal samples showed that the intake recommended by the Dietary Reference Intakes (DRI) were not reached in the case of potassium (4,700 mg/day), calcium (1,200 mg/day) and magnesium (420 mg/day for men and 320 mg/day for women)[17]. Although the importance of potassium for reducing blood pressure levels and the risk of stroke is well established[9] and calcium is kwon to prevent osteoporosis, there is no reliable information that the levels of micronutrients in the diet is less important for longevity than the levels of macronutrients. Studies with persons over 75 years of age have already shown that few elderly ingest the recommended concentrations of micronutrients recommended by DRI[18].

The *Baltimore Study of Aging*[19] showed that thinness is not associated with longevity. Our results seem to support this conclusion, since most of the long-lived individuals in our sample were eutrophic (43.9%) or overweight (35.7%). Altough in this study some of the long-living elderly were overweight, it is important to note that the previous nutritional status of these overweight elderly.

Unhealthy dietary practices that include high consumption of saturated fats, salt and refined carbohydrates, as

well as low consumption of fruits and vegetables, are associated with high cardiovascular risk[9]. Taken as a whole, the results of the present study reinforce the great importance of an adequate and balanced diet, without excessive fat and salt, in the promotion of longevity.

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