

ORIGINAL ARTICLE

Dietary Variety Index and better health conditions in nonagenarians and centenarians: data from the project Multi-Professional Care for Oldest-Old

Índice de Variabilidade da Dieta relacionada à melhores condições de saúde em nonagenários e centenários: dados do projeto Atenção Multiprofissional ao Longevo

Índice de variabilidad de la dieta relacionada con las mejores condiciones de salud en nonagenarios y centenarios: datos del proyecto de atención multiprofesional Longevo

Luana De Souza Goulart¹ORCID0000-0001-8311-6727
Ângelo José Gonçalves Bós ¹ORCID0000-0003-4901-3155

¹Pontifical Catholic University of Rio Grande do Sul (PUCRS), Brazil.

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Email:angelo.bos@pucrs.br

Address: Avenida. Ipiranga, 6681 - Partenon, Porto Alegre, Brasil.

ABSTRACT

Background and Objectives: Healthy diets are characterized not only by the quantity, but also by the variety of foods consumed daily. The quality of the diet can then be classified through the Dietary Variety Index (DVI), which assesses the number of different foods consumed daily, classifying variety into three levels: low, medium, and high. The objective of the study was to associate socio-demographic and clinical factors with DVI in nonagenarians and centenarians. **Methods:** This cross-sectional study analyzed data from 242 participants of an in-home follow-up project linked to a Postgraduate Program. **Results:** Chewing ability and appetite were significantly related to DVI ($p=0.0033$ and 0.0368 , respectively). **Conclusion:** Participants with high and medium DVI seem to have a better health status. Varied diet can be a positive factor in quality of life and health among older adults.

Descriptors: Aging. Food consumption. Health status.

RESUMO

Justificativa e Objetivos: Dietas saudáveis apresentam como características não somente a quantidade, mas também variabilidade dos itens alimentares consumidos diariamente. A qualidade da dieta pode então ser classificada por meio do Índice de Variabilidade da Dieta (DVI), pontuado através número de diferentes itens alimentares consumidos diariamente, estratificado em três níveis: baixo, médio e alto. O objetivo do estudo foi relacionar fatores sociodemográficos e clínicos associados com o DVI em nonagenários e centenários. **Métodos:** O estudo transversal analisou dados de 242 participantes de um projeto de acompanhamento a domicílio vinculado a um Programa de Pós-graduação. **Resultados:** A capacidade mastigatória e o apetite foram significativamente relacionados com o DVI ($p=0,0033$ e $0,0368$, respectivamente). **Conclusão:** Participantes com DVI alto e médio, parecem apresentar melhores condições de saúde. Optar por uma dieta variada pode ser um fator positivo na qualidade de vida e saúde na longevidade.

Descriptores: Envelhecimento. Consumo alimentar. Condições de saúde.

RESUMEN

Justificación y objetivos: Las dietas saludables presentan como características no solo la cantidad, sino también la variabilidad de los alimentos que se consumen diariamente. La calidad de la dieta se puede clasificar a través del Índice de Variabilidad Dietética (DIV), puntuado por el número de diferentes alimentos que se consumen diariamente, estratificados entre niveles: bajo, medio y alto. El objetivo del estudio fue relacionar los factores asociados con la DVI en nonagenarios y centenarios. **Métodos:** El estudio fue descriptivo, cuantitativo y analítico. Se analizaron los datos de 242 participantes de un proyecto de seguimiento en el hogar vinculado a un programa de posgrado. **Resultados:** La capacidad masticatoria y el apetito se relacionaron significativamente con la DIV ($p=0,0033$ y $0,0368$, respectivamente). **Conclusión:** Los participantes con DVI alta y media, parecen presentar mejores condiciones de salud. Optar por una dieta variada puede ser un factor positivo en la calidad de vida y la salud en la longevidad.

Descriptores: Envejecimiento. consumo de alimentos. condiciones de salud.

INTRODUCTION

The assessment of food consumption in any age group is important because it is related to nutritional status and health conditions. Eating habits can be associated with the development of diseases, especially chronic non-communicable diseases (CNCDs), which tend to be more prevalent in older adults.¹

Food consumption can be influenced by age, environment, religion, socioeconomic status, lifestyle and nutritional status.^{1,2} One way to evaluate food consumption is to assess the dietary pattern, which consists of identifying the food groups most consumed by an individual or a population.¹

Dietary assessment instruments are a tool to assess and verify adherence to healthy diets. The Healthy Eating Index (HEI), created by Kennedy in 1995, assesses the consumption of ten components of the American food pyramid. The overall quality of the diet is based on the number of servings of each food item. The HEI was adapted for Brazil by Fisberg², also according to the servings of the components of the food pyramid. This version of the instrument was called *Índice da Qualidade da Dieta* (IQD).³ We can see that there is no universal instrument for assessing dietary quality. The need for portioning food items makes the instrument more difficult to be applied by professionals with no training in nutrition. In this sense, Yokoyama and collaborators describe a different approach to assess the quality of the diet, called the Dietary Variety Index (DVI).⁴ Here, the quality of the diet is assessed according to the daily consumption of different food items, and the participants are classified into three

groups: low, medium and high dietary variety. The authors observed that older adults with higher dietary variety had better physical function and greater lean mass.⁴

Epidemiological research addressing eating habits have been carried out in Brazil. In 2006, the Ministry of Health created the Telephone Survey System for Risk Factors for CNCDS (VIGITEL).⁵ Among the variables used in the VIGITEL survey is a list of food items and their weekly or daily frequency is computed.⁵ As this instrument is easy to apply, even by professionals who are not nutritionists, it was used in an in-home assessment of the health status of nonagenarians and centenarians of the project Multi-Professional Care for Oldest-Old (AMPAL) of the Graduate Program on Biomedical Gerontology of the Pontifical Catholic University of Rio Grande do Sul (PUCRS), Porto Alegre. Thus, the food items contained in the instrument can be assessed by the DVI, proposed by Yokoyama.⁴ In addition to the assessment of eating habits, the AMPAL instrument also assesses the physical function of lower and upper limbs, which allows identifying if the use of the instrument proposed by Yokoyama et al. is also valid for the population of nonagenarian and centenarians in Brazil.

Therefore, the present study aims to observe the possible relationship between the DVI and the socio-demographic and clinical characteristics of nonagenarians and centenarians in the city of Porto Alegre/RS.

METHOD

This is a cross-sectional study. Data from the 242 evaluations of the AMPAL project, collected from April to November 2016, were analyzed. Evaluations of participants on enteral or parenteral nutritional therapy and evaluations that, for some reason, did not contain all items in the questionnaire were excluded.

The study variable (dependent variable) was the DVI, which was classified according to the VIGITEL food assessment instrument⁵, which assesses the weekly consumption of different food groups. To calculate the DVI, 8 food items were scored: beans, vegetables, greens, meat (beef or chicken), natural fruit juice, fruit, milk, and fish. Items considered unhealthy, such as sweets, soft drinks, artificial juices, snacks replacing meals, were not considered. Each food item with a minimum weekly frequency of 5 times received 1 point; items consumed less than 5 times a week scored zero. Thus, the maximum number of points that the participant could have was 8 and the minimum was 0 (participant who did not consume any of the items considered healthy at least 5 times a week). Participants were classified as low (0 – 3 points), medium (4 – 6 points) and high variety (≥ 7 points).

The participants were assessed by a structured questionnaire containing socio-demographic and clinical variables. Chronological age and gender were checked using the identity card. Skin color, education and income were self-reported by the older adult or their companion/caregiver.

Alcohol consumption and engagement in physical exercise were assessed and the frequency was recorded according to number of days per week. Symptoms such as weight loss, xerostomia, loss of appetite, constipation and diarrhea were dichotomously classified as yes or no. Body weight (kg) was measured with a digital scale. Height (m) was measured with an inextensible measuring tape attached to the wall of the participant's home. These data were obtained with the individual barefoot on the scale, wearing light clothes, with the feet together, in an upright position with arms extended along the body.

Anthropometric measurements were analyzed as numerical variables and described by mean and standard deviation. Circumferences were measured using an inelastic and inextensible anthropometric tape. Mid-upper arm circumference (MUAC) was measured around the brachial perimeter, at the midpoint between the acromion and the olecranon, with the arms extended along the body; the measure was taken in the nearest centimeter, with the arm at a 90° angle to the torso. Abdominal circumference (AC) was measured around the abdominal region, at the level of the belly button, with the patient standing, at the end of a normal expiration. Calf circumference (CC) was measured in the space between the ankle and the knee, with the individual standing upright. Anthropometric measurements were taken according to the protocol of the World Health Organization (WHO)⁶. The Body Mass Index (BMI) was calculated by dividing body weight (kg) by height (m) squared. The Geriatric Depression Scale (GDS), which is an instrument for multi-professional use, was used to detect the presence or absence of depressive symptoms. A score of up to 2 points indicates that the older adults has no symptom of depression, while scores above 2 indicate depressive symptoms. The score was collected and classified as presented in the database.

The physical function of the participants was also assessed. The function of the lower limbs was assessed by a 3-meter walk test, known as Timed-Up-and Go Test (TUG), measured in seconds.⁷

The distribution of socio-demographic and clinical characteristics, and food-related symptoms were calculated according to DVI levels and tested by Chi-square analysis. BMI, AC, MUAC, CC, MMSE score, number of CNCDS and TUG test score were calculated for each

DVI level and tested by the Analysis of Variance test (ANOVA). The level of significance was set at 5% ($p < 0.05$); p -values between 0.05 and 0.1 were considered indicative of significance. The tests were carried out using the EPI Info program version 7.2.3.1, a freeware developed by the Centers for Disease Control and Prevention of the US Government.

The research is part of the AMPAL project, approved by the Research Ethics Committee (REC) of the PUCRS (CAEE 55906216.0.0000.5336) under opinion No. 1,639.96. The study "Eating habits related to survival in nonagenarians and centenarians of the AMPAL" was also approved by the REC of the same University (PUCRS), under opinion number 2,939,062.

RESULTS

The socio-demographic and clinical characteristics are shown in Table 1. The sample was composed of 242 participants, of which 73% were female. The frequency of low dietary variety was homogeneous between genders ($p=0.4202$).

The age group of 90-94 years was predominant in the research (79%). Participants aged 95 to 99 years had a higher frequency of high (39%) and low (25%) DVI. Younger nonagenarians (<95 years) had a frequency of medium DVI higher than expected (46%). Centenarians, on the other hand, had a frequency of high DVI higher than expected (36%, $p=0.8516$).

Single participants had the highest frequency of high DVI (45%); married participants had the highest frequency of medium dietary variety (53%); divorced participants had the highest frequency of low DVI (50%). Widowed participants had frequencies of dietary variety that were closer to the expected number, which may explain why the association between marital status and dietary variety was not significant ($p=0.1277$).

Those who could read and write presented a higher frequency of high DVI (35%) compared to those who could not. Individuals who could not read and write had lower DVI (28%), but this was not significant ($p=0.1599$).

General self-perceived health was associated with the quality of the diet, with a p -value indicative of statistical significance. The frequency of nonagenarians with low and medium dietary variety was higher among those with poor or very poor self-reported health ($p=0.0942$). In contrast, those with regular self-perceived health had a DVI higher than expected (39%). Among participants with excellent self-perceived health, medium dietary variety was the most frequent (45%).

Engagement in physical exercise had a positive association with the DVI. Older adults who engaged in physical exercise had greater dietary variety (43.64%) than sedentary older adults, who had a higher frequency of low variety (23.89%, $p=0.1944$).

Among the participants, 70% did not have the habit of consuming alcohol during the week. Older adults who did not consume alcohol had a higher DVI (33.73%; $p=0.3894$).

The mean BMI of the participants was similar between the DVI groups. However, those with high DVI had a lower BMI (24.62 kg/m²) compared to the others. The lower the DVI, the higher the mean BMI ($p=0.48668$). Participants with high DVI had a higher mean MMSE score than the other groups ($p=0.0893$).

Greater scores in the TUG test were more common among those with medium DVI (19.4±14.73 seconds), who were less than 2 seconds faster than the group with high DVI, which had the worst scores ($p=0.7762$).

Table 1. Distribution of socio-demographic and clinical characteristics according to levels of dietary variety.

	Dietary variety			Total no. (%)	p
	High no. (%)	Medium no. (%)	Low no. (%)		
Gender					0.4202
Female	62(34.83)	75(42.13)	41(23.03)	178(73.55)	
Male	18(28.13)	33(51.56)	13(20.31)	64(26.45)	
Age group					0.8516
90-94	61(31.77)	89(46.35)	42(21.88)	192(79.34)	
95-99	14(38.89)	13(36.11)	9(25.00)	36(14.88)	
100+	5(35.71)	6(42.86)	3(21.43)	14(5.79)	
Civil status					0.1277
Married	15(29.41)	27(52.94)	9(17.65)	51(21.07)	
Divorced	0(0.00)	3(50.00)	3(50.00)	6(2.48)	
Single	10(45.45)	5(22.73)	7(31.82)	22(9.09)	
Widowed	55(33.74)	73(44.79)	35(21.47)	163(67.36)	
Skin color					0.5868

White	63(31.98)	91(46.19)	43(21.83)	197(81.40)	
Non-white	17(37.78)	17(37.78)	11(24.44)	45(18.60)	
Can read and write					0.1599
No	4(16.00)	14(56.00)	7(28.00)	25(10.33)	
Yes	76(35.02)	94(43.32)	47(21.66)	217(89.67)	
General health					0.0942
Great or good	47(32.64)	65(45.14)	32(22.22)	144(59.50)	
Regular	26(38.81)	30(44.78)	11(16.42)	67(27.69)	
Poor or very poor	5(23.81)	11(52.38)	5(23.81)	21(8.68)	
Does not know	2(20.00)	2(20.00)	6(60.00)	10(4.13)	
Physical exercise					0.1944
Yes	24(43.64)	21(38.18)	10(18.18)	55(23.40)	
No	55(30.56)	82(45.56)	43(23.89)	180(76.60)	
Alcohol consumption					0.3894
Yes	23(31.51)	37(50.68)	13(17.81)	73(30.17)	
No	57(33.73)	71(42.01)	41(24.26)	169(69.83)	
BMI (mean±SD)	24.7±3.70	25.2±3.49	25.4±5.13	25.1±3.94	0.4867
AC (mean±SD)	92.3±13.05	95.3±12.42	92.5±13.95	93.6±13.03	0.2448
MUAC (mean±SD)	27.5±3.64	27.5±3.15	28.1±4.67	27.7±3.69	0.6754
CC (mean±SD)	32.4±3.79	32.9±3.64	32.1±5.21	32.6±4.10	0.5014
MMSE (mean±SD)	21.2±6.35	19.7±7.60	17.9±8.33	19.8±7.45	0.0893
GDS					0.2455
≤2	63(33.33)	88(46.81)	37(19.68)	188(77.69)	
>2	15(32.61)	18(39.13)	13(28.26)	46(19.01)	
Does not know	2(25.00)	2(25.00)	4(50.00)	8(3.31)	
CNCD (mean±SD)	4.57±1.960	4.51±2.265	4.04±2.418	4.43±2.206	0.3348
TUG	21.2±15.37	19.4±14.73	20.3±12.57	20.3±14.49	0.7762
Total	80(32.92%)	109(44.86%)	54(22.22%)	242(100%)	

SD=Standard Deviation, BMI=Body mass index (Kg/m²), MUAC=Mid-upper arm circumference (MUAC), AC=Abdominal circumference (cm), CC=Calf circumference (cm), MMSE=Mini-Mental State Examination, GDS=Geriatric depression scale, CNCD=Chronic Non-Communicable Disease, TUG= Timed-Up-and Go Test

Table 2 shows the distribution of food-related symptoms according to the groups of dietary variety.

Older adults who reported regular, poor or very poor chewing ability presented a frequency of high DVI higher than expected (respectively 51% and 39%). On the other hand, those who reported great or good chewing presented a higher frequency of medium DVI (52%). This association was significant (p=0.003), indicating that chewing is related to dietary variety.

Regarding appetite, those who reported regular appetite had a greater dietary variety (44%). Those who reported good or great appetite presented medium DVI (49%). Older adults with poor or very poor appetite had low DVI (33%). This result was significant (p=0.037).

Regarding xerostomia, those who did not have the symptom demonstrated a high DVI (67%), while those who reported xerostomia had mean and low DVI (53% and 40%). The result was indicative of significance (p=0.0645).

Table 2. Distribution of the frequency of food-related symptoms according to the groups of dietary variety.

	Dietary variety			Total n (%)	P
	High n (%)	Medium n (%)	Low n (%)		
Chewing					0.0033
Great or good	45(27.78)	85(52.47)	32(19.75)	162(66.94)	
Regular	22(51.16)	13(30.23)	8(18.60)	43(17.77)	
Poor or very poor	11(39.29)	8(28.57)	9(32.14)	28(11.57)	
Does not know	2(22.22)	2(22.22)	5(55.56)	9(3.70)	
Appetite					0.0368
Great or good	49(29.88)	81(49.39)	34(20.73)	164(67.77)	
Regular	23(44.23)	19(36.54)	10(19.23)	52(21.40)	
Poor or very poor	8(33.33)	8(33.33)	8(33.33)	24(9.92)	

Weightloss					0.9168
Yes	63(33.69)	83(44.39)	41(21.93)	187(77.27)	
No	13(34.21)	17(44.74)	8(21.05)	38(15.70)	
Does notknow	4(23.53)	8(47.06)	5(29.41)	17(7.02)	
Decreased food intake					0.8858
None	54(32.73)	75(45.45)	36(21.82)	165(68.18)	
Mild	11(31.43)	14(40.00)	10(28.57)	35(14.46)	
Moderate/severe	15(35.71)	19(45.24)	8(19.05)	42(17.36)	
Xerostomia					0.0645
Yes	75(33.94)	99(44.80)	47(21.27)	221(91.32)	
Sometimes	1(6.67)	8(53.33)	6(40.00)	15(6.20)	
No	4(66.67)	1(16.67)	1(16.67)	6(2.48)	
Oral injury					0.7559
Yes	6(28.57)	9(42.86)	6(28.57)	21(8.68)	
No	74(33.48)	99(44.80)	48(21.72)	221(91.32)	
Constipation					0.6552
Yes	17(38.64)	20(45.45)	7(15.91)	44(18.18)	
Sometimes	19(27.54)	32(46.38)	18(26.09)	69(28.51)	
No	44(34.11)	56(43.41)	29(22.48)	129(53.31)	
Diarrhea					0.3954
Sometimes	8(22.22)	17(47.22)	11(30.56)	36(14.88)	
No	72(34.95)	92(44.66)	42(20.39)	206(85.12)	
Total	80(32.92%)	109(44.86%)	54(22.22%)	242(100%)	

DISCUSSION

The proportion of women in the sample was similar to that observed in the projection of the Brazilian Institute of Geography and Statistics for residents of Rio Grande do Sul aged 90 years or over (73%), demonstrating that the sample is representative of this characteristic.⁸Females had a higher frequency of high DVI compared to males. Most men had

a medium DVI. According to Gomes et al., in a population of older adults in a city in Rio Grande do Sul, females had a better diet quality.⁹

The older age groups had a higher frequency of high DVI, a result similar to a study that demonstrated that older participants had a better diet quality than younger ones.¹⁰ In our research, single and widowed older adults had a higher frequency of high dietary variety. This higher frequency may have been a result of the greater number of women in these two groups.¹¹

Older adults who could not read and write had a lower frequency of high DVI. Although not significant, this observation is relevant, as it demonstrates an important relationship from the point of view of public health. Difficulties in reading may affect the older adult's ability to select their food. A study observed that older adults with 8 years of education or more had worse diet quality than those with 0 to 3 years of education.¹²

In our results, older adults who reported good or great health status had a high DVI, and this observation was significant. The influence of self-perceived health status on diet quality is highlighted by a few authors. Good perceived physical health was positively associated with overall diet quality in Shatenstein's study. However, some authors did not assess self-perception and health in their studies.¹²⁻¹⁵

Older adults who engage in physical exercise have high DVI. Several studies relate physical exercises to a healthier lifestyle, including diet quality. One study mentions the benefits of regular physical exercise and a healthier diet for older adults.¹⁶ Regular physical exercise is associated with improved strength, flexibility and functional capacity, protection against injuries and falls, and higher quality of life among older adults.¹⁶

Older adults who did not consume alcohol had a higher dietary variety. This observation is like that found by Assumpção et al, who stated that there is a relationship between good diet quality and non-consumption of alcohol.¹²

Older adults with high DVI had a lower mean BMI than the other groups, but higher abdominal and calf circumference than those with low DVI. Our finding agrees with other studies in the scientific literature, which mention that older adults with adequate nutritional status have a better diet quality.⁹

Older adults with high DVI had better scores in the cognitive assessment (MMSE); this association was indicative of statistical significance. An international study associated better diet quality with good cognitive function¹⁵.

The older adults with the lowest scores in the TUG test were those with a medium DVI. These were also probably those who exercise and consume more food. A good functional capacity in older adults is associated with diets with healthy food that, consequently, meet

nutritional needs.¹⁶When this does not occur, the lack of important nutrients, associated with poor eating habits, leads to loss of mobility and physical strength.¹⁶

Older adults with poor or very poor chewing had low DVI. Xerostomia and impaired chewing influence the selection of food for consumption among older adults. Harder foods such as meat, raw vegetables, fruits and grains are not common in the diet of individuals who have these problems.¹⁴The reduced consumption of these foods is related to an increased consumption of carbohydrates and refined sugar, which have a softer texture. This can lead to nutritional problems in the medium and long term. This data was confirmed in the study by Emami et al., which demonstrated that the oral condition (dentition and humidity) affects the selection and consumption of softer and less varied foods.¹⁷

A study by Abreu found a 40% prevalence of xerostomia among older adults. This condition is very prevalent in this population.²⁰This result is in line with our findings, which confirmed a high prevalence of xerostomia (dry mouth) in the population studied. In our sample, 91.32% of the older adults interviewed had xerostomia; however, the reasons are not clear. Constant or occasional xerostomia was indicative of significance for low DVI, demonstrating that this condition influence food choices. Our finding agrees with a study by Gomes that found a low diet quality among older adults with oral problems.⁹

The present study is the first to use the DVI to assess diet quality in nonagenarians and centenarians in a sample representative of this age group. This is one of the strongest points of this analysis. The instrument proved to be very practical for use in the context of epidemiological research, but it still needs validation.

A quality diet is directly related to dietary variety, since diets with higher number of nutrients have a greater chance of meeting the nutritional needs of nonagenarians and centenarians, which are different from the needs of other age groups.

Investigating eating habits considering the variety of food groups allows knowing the eating patterns of older adults, and thus, it is possible to provide dietary guidelines for that specific group.

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Authors' contributions:

Luana de Souza Goulart and Ângelo José Gonçalves Bós contributed to the conception, study design, analysis and drafting the article.

Luana de Souza Goulart and Ângelo José Gonçalves Bós contributed to the planning and design of the article, review and final approval of the article;

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.