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ARTICLE

Association between the consumption of omega-3-rich fish and depressive symptoms in older adults living in a middle-income country: EpiFloripa Aging cohort study

Associação entre o consumo de peixes ricos em ômega-3 e sintomas depressivos em idosos que vivem em um país de renda média: estudo de coorte EpiFloripa Idoso

Asociación entre el consumo de pescado rico en omega-3 y los síntomas depresivos en adultos mayores que viven en un país de ingresos medios: estudio de cohorte EpiFloripa Anciano

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Abstract

This study aimed to verify the association between the consumption of omega-3-rich (n-3) fish and depressive symptoms in older adults living in Southern Brazil. This is a cross-sectional analysis with data from the second wave of the EpiFloripa Aging cohort study (2013/2014) including 1,130 individuals aged 60 years or older. The presence of depressive symptoms was measured by the 15-items Geriatric Depression Scale *(GDS-15), and the consumption of n-3-rich fish by a question of weekly frequency. The minimum set of variables for adjustment was defined using directed acyclic graph (DAG). Poisson regression with robust error variance was applied (adjusted by Model 1: demographic and socioeconomic variables, Model 2: added behavioral variables, Model 3: added health variables). We identified the prevalence of depressive symptoms in 19% of older adults and 51.8% reported eating n-3-rich fish once a week. Models 1 and 3 showed an inverse association between n-3-rich fish and depressive symptoms. However, the association was reduced when behavioral factors (leisure-time physical activity) were included in Model 2. These findings suggest that n-3-rich fish intake tends to be associated with depressive symptoms in older adults. However, other factors, such as physical exercise, are as pivotal as n-3 fatty acids in preventing the development of depressive symptoms.*

Omega-3 Fatty Acid; Eating; Depression; Cross-Sectional Studies; Aging

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Introduction

Depressive disorders are among the most prevalent mood disorders affecting the older adult population [1]. Its prevalence has increased specially in lower-income countries, holding the second position worldwide in cause of disabilities in 2020; presenting a significant economic impact [2,3,4,5]. Depression in older adults living in low- and middle-income countries are associated with more frequent medical appointment and hospitalization, a significant family burden, and a higher risk of suicide and mortality [2,6,7]. Additionally, it is associated with significant consequences as poor quality of life, dependence in activities of daily living (ADLs), comorbidities, and cognitive impairment [6].

New research investigating the causes, course, and more effective forms of treatment and prevention of depression have been justified since the current approach mainly involves preventive health habits and high-cost rehabilitation programs [1,3,8,9,10]. The World Health Organization's (WHO) *Comprehensive Mental Health Action Plan 2013-2030* showed an imbalance among research performed in high vs. low/middle-income countries that needs to be addressed to ensure that they have culturally and economically appropriate strategies to respond to mental health needs and priorities [11].

Thus, the relationship between food intake and depression is a field of research that needs to be more elucidated. Epidemiological studies have observed a positive relationship between omega-3 (n-3) fatty acids intake and a lower prevalence of depressive symptoms in older adults [12,13,14,15]. Most of these studies were conducted in high-income countries. Recently, the International Society for Nutritional Psychiatry Research conducted a consensus-based practice guideline for clinical use of n-3 polyunsaturated fatty acids (PUFAs) in major depressive disorder (MDD), indicating the importance of consumption of these fatty acids for mental health [16].

Some mechanisms of action of n-3 in depression include plasticity and neurogenesis of neuronal cells, dysregulation of the neurotransmitter, and neuroinflammation [17,18,19,20]. Experimental studies have shown that diets deficient in n-3 lead to changes in the levels of neurotransmitter, such as dopamine and serotonin [21,22,23]. They are necessary for the structure and maintenance of brain cells and behavioral changes, such as anxious behavior and memory deficit [24,25,26]. Similarly, n-3 supplementation via fish oil produced an antidepressant effect in rodents [21,27].

The dietary n-3 eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are found in deep- and cold-water fatty fish (such as salmon, tuna, herring, sardines, and mackerels) and are also available as n-3 fish oil supplements [28]. The n-3 also is found in regional fish in Brazil, such as trout (*Salmus* sp.), South American silver croaker (*Plagioscion squamosissimus*), granulated catfish (*Pterodoras granulosus*), spotted sorubim (*Pseudoplatystoma corruscans*), and trahira (*Hoplias malabaricus*). Since these fish have an important source of n-3, their intake could be a strategy to increase n-3 in the diet and, perhaps, to prevent the development of depressive symptoms [29,30].

Considering the effects of n-3 in depression, as well as the scarce studies conducted in low- and middle-income countries, we aim to verify the cross-sectional association between the consumption of n-3-rich fish and depressive symptoms in older adults living in Southern Brazil.

Materials and methods

Study design and population

This cross-sectional analysis was carried out with data from the second interview (2013/2014) of the EpiFloripa survey, regarding the health conditions of older adults from Florianópolis, in the State of Santa Catarina, Brazil. The EpiFloripa Aging cohort study aims to investigate health determinants and aspects of older adults living in Southern Brazil. More details about the sample and methodology are in previous publications [31,32]; briefly, the baseline included 1,705 individuals of both sexes, aged 60 years and over, living in the urban area of Florianópolis (2009/2010). Older adults who were living in long-term care institutions, hospitals, or prisons were not eligible. All participants from baseline were invited to complete the second wave of interview (2013/2014), which enrolled 1,197 individuals. For this analysis those who presented complete data on depressive symptoms and n-3-rich fish intake were included, resulting in a final sample of 1,130 older adults. The power of the sample size (1-β

error probability) was calculated a posteriori (post hoc) using G*Power, version 3.1.9.7 (http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3), establishing as parameters the effect size (Exp β1) of 0.22, base rate (β0) of 0.19, and the small effect (R2) of other variables of 0.04 (power = 0.99).

Data were collected by trained interviewers at the participant's home, previously scheduled by phone. The interviewers were graduates in health science with experience in research. A previously designed survey questionnaire was used, and data was recorded in a laptop. The questionnaire contained socioeconomic, demographic, and health aspects related to aging, which included instruments validated to and translated into Brazilian Portuguese. The quality control of the data was carried out by telephone with 10% of the sample, using a short version of the questionnaire.

Exposure assessment

To evaluate the consumption of n-3-rich fish, we collected data on the weekly frequency of n-3-rich fish consumption (number of days per week). A list of n-3-rich fish was created based on a food composition table and on studies conducted at the national and regional level [29,30,33]. The list included salmon, tuna, sardines, anchovy, trout, South American silver croaker, and local n-3-rich fish (granulated catfish, spotted sorubim, and trahira). The frequency was categorized as "zero", "once a week", and "twice a week or more" for data analysis.

Outcome assessment

We analyzed the presence of depressive symptoms using the 15-items *Geriatric Depression Scale* (GDS-15) [34,35]. The scale gives a score of zero or one point for an answer of "no" or "yes" for each question, totaling 15 points. A score of ≥ 6 points was used as the cutoff for the presence of depressive symptoms, as suggested by Almeida & Almeida [34,36].

The GDS-15 was translated into and validated to Brazilian Portuguese, according to the International Classification of Disease (ICD-10) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) to identify outpatients aged 60 or over who met the criteria for depressive disorder [34,37]. The sensitivity and specificity indexes of the cutoff point 5/6 (not case/case) produced respectively 85.4% and 73.9% according to ICD-10, and 90.9% and 64.5% according to the DSM-IV. The internal consistency using Cronbach's alpha coefficient presented a reliability index of 0.81 [34]. Moreover, in the test-retest reliability when the outpatient was evaluated twice in 48 to 72h, GDS-15 scores were reasonably stable, as assessed by paired Wilcoxon ($z = 1.60$, $p = 0.109$), by Spearman's correlation coefficient (rho = 0.86, $p < 0.001$), and by weighted kappa (0.64) [37]. Furthermore, the GDS-15 is recommended by the Brazilian Ministry of Health and is a useful alternative for the rapid assessment of the presence of depressive symptoms in older adults [38].

Covariates

The covariates were included following a hierarchical model, dividing them into three groups: demographic and socioeconomic; health; and behavioral covariates. Demographic and socioeconomic variables included gender, age range, schooling level, per capita family income in minimal wages according to the values in 2013 (BRL 678.00) and 2014 (BRL 724.00), retirement, family arrangements (live with someone/alone), and marital status (married/single/divorced/widowhood). Behavioral variables included attendance at social or religious events, alcohol consumption collected by *Alcohol Use Disorder Identification Test* (AUDIT) [39], smoking habit, and leisure-time physical activity (insufficiently active < 150 minutes or sufficiently active ≥ 150 minutes) collected by *International Physical Activity Questionnaire* (IPAQ) [40,41]. Information about antidepressant drug use was collected by consulting all boxes of medicines prescribed for and used by the participant. The *Anatomical Therapeutic Chemical Classification* codes from the WHO Collaborating Centre for Drug Statistic Methodology were applied for codification in the database [42].

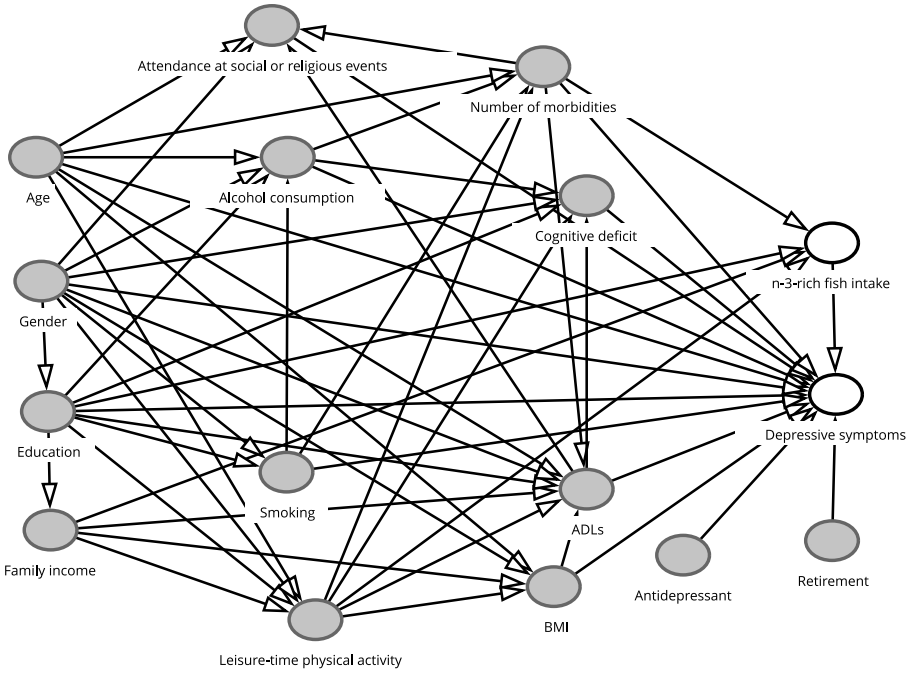
Health variables included dependence in ADLs (15 items scale, i.e., to lay down/get out of bed, feed oneself, look after your appearance, walk on flat surfaces, bathe, dress, go to toilet/continence, climb stairs, take own medications, walk close to home, go shopping, prepare meals, cut toenails, take

the bus or taxi, do housework), categorized into no disability, low disability (any level of disability in 1 to 3 activities), and moderate/severe disability (any level of disability in ≥ 4 activities) collected by the scale of daily personal and instrumental activities [43]; presence of cognitive deficit, investigated by the *Mini-Mental State Examination*, categorized as probable or absence of cognitive deficit (considering schooling level, with 19/20 cutoffs for illiterate and 23/24 for any level of education) [44,45]; number of morbidities (i.e., the sum of the following self-reported diseases: spine or back, arthritis, cancer, diabetes, bronchitis, cardiovascular, renal, tuberculosis, cirrhosis, stroke, osteoporosis, hypertension, and depression); and nutritional status according to body mass index (BMI) (underweight < 22kg/m^2, healthy weight 22-27kg/m^2, overweight > 27kg/m^2) [46,47]. A digital scale with a precision of 100g was used to measure weight (in kilograms) and a portable stadiometer with a precision of one millimeter was used to measure height (in meters).

A directed acyclic graph (DAG or causal Bayesian networks) was constructed to represent the theoretical-operational model and to elucidate the involvement of covariates in the relationship between n-3-rich fish consumption and depressive symptoms (Figure 1). The DAG was constructed using the DAGitty software, v. 3.0 (http://www.dagitty.net/dags.html) [48]. The graphic criteria for the selection of adjustment covariates were used to define the minimum set of potentially confounding covariates and to reduce the variable selection bias [49,50]. The minimum set of adjustment covariates indicated by the DAG to test the association was gender, age, schooling level, family income, leisure-time physical activity, BMI, number of morbidities, and dependence on activities of daily living.

Figure 1

Theoretical model of the minimum set of covariates adjustment indicated by the directed acyclic graph (DAG) of the association between omega-3-rich (n-3) fish consumption and depressive symptoms. EpiFloripa Aging cohort study.



ADLs: activities of daily living; BMI: body mass index.

Note: the DAG used to determine the minimum set of adjustments covariates was constructed based on literature associations between variables to test the directed effect of the exposure variable n-3-rich fish on the outcome variable depressive symptoms identified by the white circles. The other variables identified by the grey circles are the predecessor of exposure and outcome.

Statistics

In the descriptive analysis, absolute and relative frequency, prevalence, and their respective 95% confidence intervals (95%CI) were determined for depressive symptoms. The presence of depressive symptoms and consumption of n-3-rich fish according to characteristics were evaluated by the chi-square test. A p-value of 5% was considered statistically significant.

To verify the association between n-3-rich fish consumption and depressive symptoms, Poisson regression with robust error variance was performed, estimating the crude and adjusted prevalence ratio (PR) and their respective 95%CI. Three models were used in the adjusted analyses, recommended by DAG, following hierarchical structure: Model 1 was adjusted for demographic and socioeconomic variables (age, schooling level, family income); Model 2 was adjusted for demographic, socioeconomic, and behavioral variables (leisure-time physical activity); and Model 3 was adjusted for demographic, socioeconomic, behavioral, and health variables (dependence on activities of daily living).

A p-value < 0.05 was considered statistically significant. Due to sample selection process, which was carried out by conglomerates in EpiFloripa Aging, sample weights were used in all analyses using the "svy" command in the software Stata 14.0 (https://www.stata.com).

Ethics approval

This study was conducted following the Declaration of Helsinki and all procedures involving research study participants were approved by the Ethics Research Committee for Research with Human Subjects of the Federal University of Santa Catarina (protocols n. 329,650 and n. 526,126). Written informed consent was obtained from all participants.

Results

Table 1 shows participant characteristics and the prevalence of depressive symptoms according to demographic, socioeconomic, behavioral, and health variables. Our sample presented a higher prevalence of women (62.9%) and the age range of 70-79 years (44.5%), and of those who did not eat fish (48.2%). We identified a prevalence of depressive symptoms in 19% (95%CI: 16.0; 22.5). The variables associated with depressive symptoms ($p < 0.05$) were gender, age, schooling level, income, attendance at social or religious events, alcohol consumption, leisure-time physical activity, antidepressant use, dependence in ADLs, cognitive deficit, and number of morbidities.

Table 2 shows the weekly consumption of n-3-rich fish according to participant characteristics. The variables associated with weekly consumption of n-3-rich fish ($p < 0.05$) were schooling level, income, attendance at social or religious events, smoking habit, and leisure-time physical activity.

Table 3 shows the association analysis using Poisson regression modeling with robust error variance. Consumption of n-3-rich fish once a week was not statistically significant in any model. However, a statistically significant association was found for the consumption of n-3-rich fish twice or more times per week in the crude and adjusted Model 1. The prevalence of depressive symptoms was lower in individuals who ate fish twice or more times per week in the crude and adjusted Model 1 when compared to those who never consumed n-3-rich fish. Nevertheless, when the behavioral variable (leisure-time physical activity) was included in Model 2, the association was not evident. The tendency was maintained in Model 3.

Discussion

Our results indicate a high prevalence of depressive symptoms in older adults interviewed by the EpiFloripa Aging study. Over half participants consumed n-3-rich fish at least once a week. There was an association between consumption of n-3-rich fish and depressive symptoms when the crude analysis was performed; demographics and socioeconomic variables were included in Model 1. This

Table 1

Participant characteristics and the prevalence of depressive symptoms according to demographic, socioeconomic, behavioral, and health variables. EpiFloripa Aging cohort study.

Characteristics	n	%	95%CI	Prevalence of depressive symptoms	
				%	p-value *
Gender [n = 1,130]					0.018
Men	398	37.1	34.0; 40.5	15.8	
Women	732	62.9	59.5; 66.1	20.9	
Age range (years) [n = 1,130]					0.005
60-69	400	35.0	31.0; 39.2	13.7	
70-79	497	44.5	40.6; 48.4	20.1	
≥ 80	233	20.5	18.0; 23.2	25.8	
Schooling level (years) [n = 1,129]					0.002
No formal education	78	6.4	4.7; 8.5	26.1	
1-4	398	34.2	28.2; 39.7	23.2	
5-8	181	15.9	13.4; 19.0	14.9	
9-11	167	17.6	15.3; 21.0	22.0	
≥ 12	262	25.9	21.1; 31.4	12.0	
Per capita family income (minimum wage) [n = 1,086]					< 0.001 **
≤ 1	87	6.9	5.1; 9.3	29.2	
> 1 and ≤ 3	307	28.2	24.6; 32.0	22.7	
> 3 and ≤ 5	216	19.2	15.9; 23.1	20.4	
> 5 and ≤ 10	261	23.9	20.5; 27.8	15.3	
> 10	215	21.8	17.0; 27.4	13.7	
Retirement [n = 1,028]					0.238
No	206	19.5	16.6; 22.8	24.4	
Yes	822	80.5	77.2; 83.4	17.9	
Family arrangements [n = 1,130]					0.887
Live with another/Others	903	78.8	75.3; 81.9	18.9	
Live alone	227	21.2	18.1; 24.7	19.1	
Marital status [n = 1,130]					0.433
Married	634	56.4	51.1; 59.3	16.0	
Single	69	5.7	4.3; 7.7	20.4	
Divorced	82	7.9	6.5; 9.9	27.0	
Widowed	345	30.0	27.5; 34.5	22.1	
Attendance at social or religious events [n = 1,130]					0.004
No	657	59.2	55.6; 62.8	22.0	
Yes	473	40.8	37.2; 44.4	14.7	
Alcohol consumption [n = 1,130]					< 0.001
No	692	60.5	56.0; 64.9	23.6	
Yes	438	39.5	35.1; 44.0	11.7	
Smoking [n = 1,130]					0.799
No	687	59.4	55.9; 62.9	18.5	
Yes	443	40.6	37.1; 44.1	19.7	
Leisure-time physical activity [n = 1,126]					< 0.001
Insufficiently active	817	71.7	67.2; 75.9	22.5	
Sufficiently active	309	28.3	24.1; 32.8	9.4	
Antidepressant use [n = 1,053]					0.001
No	875	82,9	80.5; 85.0	17.9	
Yes	178	17,1	15.0; 19.5	28.9	

(continues)

Table 1 (continued)

Characteristics	n	%	95%CI	Prevalence of depressive symptoms	
				%	p-value *
Dependence in ADLs [n = 1,126]					< 0.001
No disability	359	32.9	29.3; 36.7	5.3	
Low disability	450	40.2	37.0; 43.5	15.9	
Moderate/Severe disability	317	26.9	23.6; 30.5	41.1	
Cognitive deficit [n = 1,122]					< 0.001
Probable absence	863	78.3	73.9; 82.2	13.9	
Probable presence	259	21.7	17.8; 26.1	37.0	
Number of morbidities [n = 1,130]					< 0.001
None	69	6.5	5.1; 8.4	8.0	
1	180	17.5	15.3; 19.9	3.2	
≥ 2	881	76.0	73.1; 78.7	23.6	
Nutritional status [n = 1,114]					0.077
Underweight	97	8.8	7.2; 10.8	22.6	
Healthy weight	407	35.5	31.6; 38.6	16.4	
Overweight	610	55.7	52.4; 58.9	20.2	
N-3-rich fish consumption [n = 1,130]					0.123
None	528	48.2	43.9; 52.5	19.6	
Once a week	304	25.5	22.1; 29.2	18.3	
Twice a week or more	298	26.3	22.9; 30.0	18.4	
Presence of depressive symptoms [n = 1,130]					
Negative	907	81.0	77.5; 84.0	-	
Positive	223	19.0	16.0; 22.5	-	

95%CI: 95% confidence interval; ADLs: activities of daily living; BMI: body mass index.

* p-value of chi-square test;

** p-value of chi-square test for trend.

association, however, was not maintained when leisure-time physical activity was added to the analysis, indicating that other pivotal factors are related to the development of depressive symptoms in this population.

Previous studies with similar methodology reported that the prevalence of depressive symptoms varied regionally within Brazil from 13% to 39%. These results could be explained by the sociodemographic and cultural differences of each Brazilian regions [51,52,53,54]. Some of the factors that we found significantly associated with the prevalence of depressive symptoms were similar to those in previous studies, such as higher prevalence in older women, lower schooling level, not attending social or religious events, insufficient physical activity, dependence in ADLs, and self-report of two or more morbidities [52,53,54]. We chose to keep the variable of self-reported depression diagnosis with the number of morbidities, since we used the GDS to measure depressive symptoms and not depression diagnose.

About 51.8% of the participants reported n-3-rich fish intake at least once a week. This proportion is lower than the national estimate for overall fish consumption (58.4%) [55]. There was also a higher proportion of individuals with lower education and income among those who never consumed n-3-rich fish, which is in line with what was described by the *Brazilian National Health Survey* (PNS) in 2013 [55], and by other studies with older adults [56,57,58]. Lower consumption of fish was reported by lower-income individuals, suggesting that socioeconomic characteristics may influence this kind of food. It is believed that schooling level and income may influence access to n-3-rich fish, which tend to be more expensive than other types of fish in Brazil. Lower schooling level could affect an individual's understanding and knowledge on the health-related benefits of n-3-rich fish.

Table 2

Omega-3-rich (n-3) fish consumption according to participant characteristics. EpiFloripa Aging cohort study.

Characteristics	Total	Weekly consumption						p-value *
		None		Once		Twice or more		
		n	%	n	%	n	%	
Gender [n = 1,130]								0.078
Men	398	182	47.8	122	30.1	94	22.1	
Women	732	346	48.4	182	22.8	204	28.8	
Age range (years) [n = 1,130]								0.659
60-69	400	194	48.6	106	27.4	100	24.0	
70-79	497	231	49.3	138	25.1	128	25.6	
≥ 80	233	103	45.3	60	23.2	70	31.5	
Schooling level (years) [n =1,129]								0.012
No formal education	78	47	61.6	17	19.2	17	19.2	
1-4	398	199	51.1	93	21.1	113	27.8	
5-8	181	96	50.8	51	23.2	43	26.0	
9-11	167	81	47.1	54	28.5	42	24.4	
≥ 12	262	104	40.0	89	32.1	83	27.9	
Per capita family income (minimun wave) [n = 1,086]								0.002
≤ 1	87	47	57.2	18	16.9	22	25.9	
> 1 and ≤ 3	307	160	51.7	69	21.8	78	26.5	
> 3 and ≤ 5	216	100	50.6	60	24.5	56	24.9	
> 5 and ≤ 10	261	128	49.6	63	22.5	70	27.9	
> 10	215	75	37.8	83	37.9	57	24.3	
Retirement [n = 1,028]								0.103
No	206	104	50.7	43	19.8	59	29.5	
Yes	822	374	47.4	232	26.6	216	26.0	
Family arrangements [n = 1,130]								0.300
Live with another/others	903	421	48.5	251	26.2	231	25.3	
Live alone	227	107	47.2	53	23.0	67	29.8	
Marital Status [n = 1,130]								0.270
Married	634	282	45.9	185	27.8	167	26.3	
Single	69	39	55.5	12	20.5	18	24.0	
Divorced	82	44	55.3	18	21.5	20	23.2	
Widowed	345	163	49.1	89	23.4	93	27.5	
Attendance at social or religious events [n = 1,130]								0.022
No	657	324	51.7	157	23.1	176	25.2	
Yes	473	204	43.1	147	29.0	122	27.9	
Alcohol consumption [n = 1,130]								0.058
No	692	332	50.2	169	23.0	191	26.8	
Yes	438	196	45.2	135	29.3	107	25.5	
Smoking [n = 1,130]								0.011
No	687	302	45.3	183	24.9	202	29.8	
Yes	443	226	52.4	121	26.5	96	21.1	
Leisure-time physical activities [n = 1,126]								0.022
Insufficiently active	817	403	50.1	209	24.2	205	24.9	
Sufficiently active	309	124	42.0	92	28.0	93	30.0	
Antidepressant use [n = 1,053]								0.724
No	875	414	49.2	230	24.4	231	26.4	
Yes	178	81	46.4	52	29.0	45	24.7	

(continues)

Table 2 (continued)

Characteristics	Total	Weekly consumption						p-value *
		None		Once		Twice or more		
		n	%	n	%	n	%	
Dependence in ADLs [n = 1,126]								0.087
No disability	359	147	43.0	109	31.6	103	25.4	
Low disability	450	229	51.8	112	22.4	109	25.8	
Moderate/Severe disability	317	149	48.6	83	23.1	85	28.3	
Cognitive deficit [n = 1,122]								0.126
Probable absence	863	390	47.1	244	27.0	229	25.9	
Probable presence	259	134	51.9	59	20.8	66	27.3	
Number of morbidities [n = 1,130]								0.430
None	69	25	30.2	23	44.7	21	25.1	
1	180	85	48.9	51	28.4	44	22.7	
≥ 2	881	418	49.6	230	23.2	233	27.2	
Nutritional status according to BMI [n = 1,114]								0.248
Underweight	97	53	55.2	24	23.7	20	21.2	
Healthy weight	517	175	45.6	117	27.3	115	27.1	
Overweight	500	292	48.8	157	24.1	161	27.1	
Presence of depressive symptoms [n = 1,130]								0.123
Negative	907	413	47.7	249	25.8	245	26.5	
Positive	223	115	50.4	55	24.1	53	25.5	

ADLs: activities of daily living; BMI: body mass index.

* p-value of chi-square test.

Table 3

Association between omega-3-rich (n-3) fish consumption and depressive symptoms in older adults. EpiFloripa Aging cohort study.

Frequency *	Crude analysis			Model 1			Model 2			Model 3 (final)		
	PR	95%CI	p-value	PR	95%CI	p-value	PR	95%CI	p-value	PR	95%CI	p-valeu
None	1.00						1.00			1.00		
Once	0.90	0.78; 1.03	0.142	0.96	0.83; 1.10	0.525	0.96	0.83; 1.10	0.536	0.99	0.87; 1.12	0.885
Twice or more	0.87	0.78; 0.98	0.024	0.89	0.79; 0.99	0.035	0.91	0.82; 1.02	0.104	0.90	0.81; 1.01	0.075

95%CI: 95% confidence interval; PR: prevalence ratio.

Note: poisson regression was used to verify the association.

Model 1: adjusted for demographic and socioeconomic variables (gender, age, education); Model 2: adjusted for demographic, socioeconomic, and behavioral variables (leisure-time physical activity); Model 3 (final): adjusted for demographic, socioeconomic, behavioral, and health variables (body mass index, dependence on activities of daily living and number of morbidities).

* Weekly consumption frequency.

The proportion of individuals with depressive symptoms decreased slightly with the consumption of n-3-rich fish twice or more times per week compared to once a week or less. In Models 1 and 2, higher consumption seemed to be a protective factor against depressive symptoms. However, the inclusion of leisure-time physical activity reduced the association. Some studies have found an association between physical activity and depressive symptoms/depression [59,60,61], such as a previous study with the same sample of EpiFloripa Aging [62] that support the idea that physical activity could protect against the emergence of depression [63]. A possible explanation is that exercise may alleviate depression by increasing availability of serotonin and norepinephrine [64], reducing systemic inflammatory signaling [59,65], and influencing neurotrophins synthesis such as brain-derived neurotrophic factor (BNDF) [65]. Furthermore, some evidence has raised discussion on the collaborative effect of n-3 and physical activity acting in the increase of hippocampal neurogenesis and neurotrophic factors, promoting mental health and reducing the risk of neurological disorders [65,66,67,68].

In Brazil, studies have not yet been conducted to investigate the relationship between depressive symptoms and consumption of n-3-rich fish in older adults. However, previous studies using different ways to evaluate both depression and fish consumption in other countries have shown contradictory results. Similarly, one research carried in Cuba, Dominican Republic, Venezuela, Mexico, Peru, India, and China found, in an unadjusted analysis, that fish intake on most days of the week resulted in a low prevalence of depression (PR = 0.73; 95%CI: 0.59; 0.91) when compared to fewer days, however, after adjustments the association was attenuated [12].

Other observational studies worldwide have shown a statistically significant association between fish consumption and depressive symptoms/depression even after adjustments including physical activity [14,15,69,70,71,72]. In Finland, the consumption of fish less than once a week showed a 31% higher probability of having mild to severe depression (OR = 1.31, 95%CI: 1.10; 1.56) [14]. In Singapore, the consumption of n-3-rich fish three times per week showed a lower chance of having depressive symptoms (OR = 0.60, 95%CI: 0.40; 0.90) [15]. In two studies on the Greek Islands, the consumption of 300g of fish per week reduced the probability for depressive symptoms by 66% (OR = 0.34, 95%CI: 0.19; 0.61) [69], and once a week showed a lower probability of 36% (OR = 0.64, 95%CI: 0.48; 0.84) [70]. In Japan, the consumption of 111.1g/day of fish showed a reduction of 66% in the risk of depressive disorder (OR = 0.44, 95%CI: 0.23; 0.84) [71]. In Italy, the highest quartile of fish and shellfish consumption was associated with a subsequent decrease in depressive symptoms (B = -0.97, 95%CI: -1.74; -0.21) [72].

Results from a meta-analysis of clinical trials of supplementation in individuals diagnosed with depression concluded that the n-3 fatty acids are effective in the treatment of depressed older adult patients, and the benefits of supplementation were significant only in those with mild to moderate depression [73]. Another study, however, suggested that the n-3 PUFA treatment can reduce depressive symptoms among adults aged 60 or older [74]. Nonetheless, a recent guideline from the subcommittee of the international society for nutritional psychiatry research indicated the use of n-3 PUFAs in the treatment and prevention of MDD in high-risk populations including older adults [16].

An interesting finding of our study is that 17.9% of older adults classified with depressive symptoms have not used antidepressants, and 28.9% (p = 0.001) of older adults who used antidepressants were also classified with depressive symptoms. Often subclinical forms of depression are frequent in older adults, associated with the fact that there is a gap in the availability of psychological treatment for them in low/middle-income countries [75,76,77]. Diagnosing older adult people at risk of depression is very important, since it is a strategy that can help prevent serious disabilities and other complications [78]. Moreover, some studies discussed that around 10-30% of individuals with depression presented resistance to drug therapy, not responding to treatment with at least two antidepressants [79,80,81,82]. Other limiting factors of pharmacological treatment are the unpleasant side effects that the available antidepressants often have. Additionally, unintentional non-adherence, such as forgetfulness and the inability to follow treatment instructions due to lack of understanding or physical problems can also be responsible for any eventual interruption of the treatment [83,84].

Some of the strengths of our study includes being in line with the WHO's *Comprehensive Mental Health Action Plan 2013-2030,* increasing the data from low- and middle-income countries. It is the first study conducted in Brazil that investigates this relationship in the older adult population using a representative sample, with methodological strictness (e.g., trained interviewers, a pilot study, face-to-face interviews, and quality control of the interview) and specific methods for cross-sectional data

analysis. Furthermore, the GDS-15 scale is one of the most widely used tools in such studies and has been validated for application in the Brazilian population.

The main limiting factor of this study is that we could not measure the levels of n-3 fatty acids incorporated in red blood cells, which would provide a more accurate reflection of any previous consumption of n-3 fatty acids. Determining these levels requires a high investment for epidemiological studies with large samples, which made it difficult to perform in a middle-income country like Brazil. Also, we did not have information on oral supplementation with n-3 fatty acids. However, the study aimed to evaluate the relationship of depressive symptoms with food intake, which we were able to do. Although the consumption of n-3-rich fish may be biased by interpretation and responses from the individuals interviewed in this study, other international studies also use questions to estimate weekly food intake, including national surveys such as the *Risk and Protective Factors Surveillance System for Chronic Noncomunicable Diseases Through Telephone Interview* (Vigitel) [12,14,15,85].

In conclusion, n-3-rich fish intake reduced the likelihood of depressive symptoms when adjusted for socioeconomic and health variables, but the association was not so evident when leisure-time physical activity was included in the analysis. We were able to observe factors related to the consumption of this type of food among the older adults, showing that perhaps the propagation of information about consuming these fish could be one strategy, not only for its health benefits but also for possibly reducing the prevalence of developing depressive disorders.

The consumption of n-3-rich fish could be encouraged in Florianopolis since it is a seaside town with a local fish supply. It is necessary, however, to improve access to and information on the benefits of consuming n-3-rich fish, as well as to improve public policies that promote access to and consumption of these kind of fish. Studies with more advanced methodologies and that include serum levels of n-3 fatty acids are needed to help understand the relationship between consumption of n-3-rich fish and the development of mood disorders among older adults.

Contributors

G. Ceolin contributed to the data analysis and interpretation and writing. G. Rockenbach contributed to the critical review of intellectual content. S. C. Confortin, E. d'Orsi, and J. D. Moreira contributed to the study conception and design and critical review of intellectual content. All the authors approved the final version to be published and are responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work.

Additional informations

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References

1. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-5). 5th Ed. Washington DC: American Psychiatric Association; 2014.
2. Chisholm D, Sweeny K, Sheehan P, Rasmussen B, Smit F, Cuijpers P, et al. Scaling-up treatment of depression and anxiety: a global return on investment analysis. Lancet Psychiatry 2016; 3:415-24.
3. DiLuca M, Olesen J. The cost of brain diseases: a burden or a challenge? Neuron 2014; 82:1205-8.
4. Institute for Health Metrics and Evaluation. Depressive disorders – level 3 cause. http://www.healthdata.org/results/gbd_summaries/2019/depressive-disorders-level-3-cause (accessed on 06/Jan/2021).
5. Knapp M, Wong G. Economics and mental health: the current scenario. World Psychiatry 2020; 19:3-14.
6. Avasthi A, Grover S. Clinical practice guidelines for management of depression in elderly. Indian J Psychiatry 2018; 60 Suppl 3:S341-62.
7. Brandão DJ, Fontenelle LF, da Silva SA, Menezes PR, Pastor-Valero M. Depression and excess mortality in the elderly living in low- and middle-income countries: systematic review and meta-analysis. Int J Geriatr Psychiatry 2019; 34:22-30.
8. James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018; 392:1789-858.
9. Olesen J, Gustavsson A, Svensson M, Wittchen H-U, Jonsson B. The economic cost of brain disorders in Europe. Eur J Neurol 2012; 19:155-62.
10. Whiteford HA, Ferrari AJ, Degenhardt L, Feigin V, Vos T. The global burden of mental, neurological and substance use disorders: an analysis from the Global Burden of Disease Study 2010. PLoS One 2015; 10:e0116820.
11. World Health Organization. Comprehensive mental health action plan 2013-2030. https://www.who.int/publications/i/item/9789240031029 (accessed on 01/Sep/2022).
12. Albanese E, Lombardo FL, Dangour AD, Guerra M, Acosta D, Huang Y, et al. No Association between fish intake and depression in over 15,000 older adults from seven low and middle income countries – the 10/66 study. PLoS One 2012; 7:e38879.
13. Appleton KM, Peters TJ, Hayward RC, Heatherley SV, McNaughton SA, Rogers PJ, et al. Depressed mood and n-3 polyunsaturated fatty acid intake from fish: non-linear or confounded association? Soc Psychiatry Psychiatr Epidemiol 2007; 42:100-4.
14. Tanskanen A, Hibbeln JR, Tuomilehto J, Uutela A, Haukkala A, Viinamäki H, et al. Fish consumption and depressive symptoms in the general population in Finland. Psychiatr Serv 2001; 52:529-31.
15. Wu D, Feng L, Gao Q, Li JL, Rajendran KS, Wong JCM, et al. Association between fish intake and depressive symptoms among community-living older Chinese adults in Singapore: a cross-sectional study. J Nutr Health Aging 2016; 20:404-7.
16. Guu T-W, Mischoulon D, Sarris J, Hibbeln J, McNamara RK, Hamazaki K, et al. International Society for Nutritional Psychiatry Research practice guidelines for omega-3 fatty acids in the treatment of major depressive disorder. Psychother Psychosom 2019; 88:263-73.
17. McNamara RK. Role of omega-3 fatty acids in the etiology, treatment, and prevention of depression: current status and future directions. J Nutr Intermed Metab 2016; 5:96-106.
18. Song C, Shieh C-H, Wu Y-S, Kalueff A, Gaikwad S, Su K-P. The role of omega-3 polyunsaturated fatty acids eicosapentaenoic and docosahexaenoic acids in the treatment of major depression and Alzheimer's disease: acting separately or synergistically? Prog Lipid Res 2016; 62:41-54.
19. Su K-P. Biological mechanism of antidepressant effect of omega-3 fatty acids: how does fish oil act as a "mind-body interface"? Neurosignals 2009; 17:144-52.
20. Su K-P. Nutrition, psychoneuroimmunology and depression: the therapeutic implications of omega-3 fatty acids in interferon-α-induced depression. BioMedicine 2015; 5:21.
21. Levant B. N-3 (Omega-3) polyunsaturated fatty acids in the pathophysiology and treatment of depression: pre-clinical evidence. CNS Neurol Disord Drug Targets 2013; 12:450-9.
22. Massart R, Mongeau R, Lanfumey L. Beyond the monoaminergic hypothesis: neuroplasticity and epigenetic changes in a transgenic mouse model of depression. Philos Trans R Soc B Biol Sci 2012; 367:2485-94.
23. Song C, Manku MS, Horrobin DF. Long-chain polyunsaturated fatty acids modulate Interleukin-1β-Induced changes in behavior, monoaminergic neurotransmitters, and brain inflammation in rats. J Nutr 2008; 138:954-63.
24. Harauma A, Moriguchi T. Dietary n-3 fatty acid deficiency in mice enhances anxiety induced by chronic mild stress. Lipids 2011; 46:409-16.
25. Labrousse VF, Leyrolle Q, Amadieu C, Aubert A, Sere A, Coutureau E, et al. Dietary omega-3 deficiency exacerbates inflammation and reveals spatial memory deficits in mice exposed to lipopolysaccharide during gestation. Brain Behav Immun 2018; 73:427-40.

26. Moreira JD, Knorr L, Ganzella M, Thomazi AP, Souza CG, Souza DG, et al. Omega-3 fatty acids deprivation affects ontogeny of glutamatergic synapses in rats: relevance for behavior alterations. Neurochem Int 2010; 56:753-9.
27. Park Y, Moon H-J, Kim S-H. N-3 polyunsaturated fatty acid consumption produces neurobiological effects associated with prevention of depression in rats after the forced swimming test. J Nutr Biochem 2012; 23:924-8.
28. Calder PC, Yaqoob P. Understanding omega-3 polyunsaturated fatty acids. Postgrad Med 2009; 121:148-57.
29. Andrade AD, Rubira AF, Matsushita M, Souza NE. ω3 fatty acids in freshwater fish from south Brazil. J Am Oil Chem Soc USA 1995; 72:1207-10.
30. Scherr C, Gagliardi ACM, Miname MH, Santos RD, Scherr C, Gagliardi ACM, et al. Fatty acid and cholesterol concentrations in usually consumed fish in Brazil. Arq Bras Cardiol 2015; 104:152-8.
31. Schneider IJC, Confortin SC, Bernardo CO, Bolsoni CC, Antes DL, Pereira KG, et al. EpiFloripa Aging cohort study: methods, operational aspects, and follow-up strategies. Rev Saúde Pública 2017; 51:104.
32. Confortin SC, Schneider IJC, Antes DL, Cembranel F, Ono LM, Marques LP, et al. Life and health conditions among elderly: results of the EpiFloripa Idoso cohort study. Epidemiol Serv Saúde 2017; 26:305-17.
33. Núcleo de Estudos e Pesquisas em Alimentação, Universidade Estadual de Campinas. Tabela brasileira de composição de alimentos. http://www.nepa.unicamp.br/taco/index.php (accessed on 19/Aug/2018).
34. Almeida OP, Almeida SA. Short versions of the geriatric depression scale: a study of their validity for the diagnosis of a major depressive episode according to ICD-10 and DSM-IV. Int J Geriatr Psychiatry 1999; 14:858-65.
35. Almeida OP, Almeida SA. Reliability of the Brazilian version of the Geriatric Depression Scale (GDS) short form. Arq Neuropsiquiatr 1999; 57(2B):421-6.
36. Paradela EMP, Lourenço RA, Veras RP. Validation of geriatric depression scale in a general outpatient clinic. Rev Saúde Pública 2005; 39:918-23.
37. Almeida OP, Almeida SA. Confiabilidade da versão brasileira da Escala de Depressão em Geriatria (GDS) versão reduzida. Arq Neuropsiquiatr 1999; 57(2B):421-6.
38. Departamento de Atenção Básica, Secretaria de Atenção à Saúde, Ministério da Saúde. Envelhecimento e saúde da pessoa idosa. Brasília; Ministério da Saúde; 2006. (Série A. Normas e Manuais Técnicos). (Cadernos de Atenção Básica, 19).
39. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. The alcohol use disorders identification test: guidelines for use in primary care. 2nd Ed. Geneva: World Health Organization; 2001.
40. Benedetti TB, Mazo GZ, Barros MVG. Application of the International Physical Activity Questionnaire (IPAQ) for evaluation of elderly women: concurrent validity and test-retest reprodutibility. Rev Bras Ciênc Mov 2004; 12:25-34.
41. Benedetti TRB, Antunes PC, Rodriguez-Añez CR, Mazo GZ, Petroski ÉL. Reproducibility and validity of the International Physical Activity Questionnaire (IPAQ) in elderly men. Rev Bras Med Esporte 2007; 13:11-6.
42. World Health Organization Collaborating Centre for Drug Statistics Methodology; Norwegian Institute of Public Health. ATC/DDD index. https://www.whocc.no/atc_ddd_index/ (accessed on 20/Dec/2019).
43. Rosa TEC, Benício MHD, Latorre MRDO, Ramos LR. Determinant factors of functional status among the elderly. Rev Saúde Pública 2003; 37:40-8.
44. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12:189-98.
45. Almeida OP. The Mini-Mental State Examination and the diagnosis of dementia in Brazil. Arq Neuropsiquiatr 1998; 56(3B):605-12.
46. American Academy of Family Physicians; American Dietetic Association; National Council on the Aging. Nutrition screening and intervention resources for healthcare professionals working with older adults. Nutrition Screening Initiative. Washington DC: American Dietetic Association; 2002.
47. Lohmann TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign: Human Kinetics Books; 1988.
48. Textor J, van der Zander B, Gilthorpe MS, Liśkiewicz M, Ellison GTH. Robust causal inference using directed acyclic graphs: the R package 'dagitty'. Int J Epidemiol 2016; 45:1887-94.
49. Shrier I, Platt RW. Reducing bias through directed acyclic graphs. BMC Med Res Methodol 2008; 8:70.
50. Hernán MA, Robins JM. Causal inference: what if. Boca Raton: Chapman & Hall/CRC; 2020.
51. Barcelos-Ferreira R, Izbicki R, Steffens DC, Bottino CMC. Depressive morbidity and gender in community-dwelling Brazilian elderly: systematic review and meta-analysis. Int Psychogeriatr 2010; 22:712-26.
52. Hellwig N, Munhoz TN, Tomasi E, Hellwig N, Munhoz TN, Tomasi E. Sintomas depressivos em idosos: estudo transversal de base populacional. Ciên Saúde Colet 2016; 21:3575-84.
53. Maciel ACC, Guerra RO. Prevalence and associated factors of depressive simptomatology in elderly residents in the Northeast of Brazil. J Bras Psiquiatr 2006; 55:26-33.

54. Ramos GCF, Carneiro JA, Barbosa ATF, Mendonça JMG, Caldeira AP. Prevalence of depressive symptoms and associated factors among elderly in northern Minas Gerais: a population-based study. J Bras Psiquiatr 2015; 64:122-31.
55. Jaime PC, Stopa SR, Oliveira TP, Vieira ML, Szwarcwald CL, Malta DC, et al. Prevalence and sociodemographic distribution of healthy eating markers, National Health Survey, Brazil 2013. Epidemiol Serv Saúde 2015; 24:267-76.
56. Dijkstra SC, Neter JE, Brouwer IA, Huisman M, Visser M. Misperception of self-reported adherence to the fruit, vegetable and fish guidelines in older Dutch adults. Appetite 2014; 82:166-72.
57. Touvier M, Kesse-Guyot E, Méjean C, Estaquio C, Péneau S, Hercberg S, et al. Variations in compliance with recommendations and types of meat/seafood/eggs according to sociodemographic and socioeconomic categories. Ann Nutr Metab 2010; 56:65-73.
58. Bakre AT, Chen R, Khutan R, Wei L, Smith T, Qin G, et al. Association between fish consumption and risk of dementia: a new study from China and a systematic literature review and meta-analysis. Public Health Nutr 2018; 21:1921-32.
59. Frank P, Kaushal A, Poole L, Lawes S, Chalder T, Cadar D. Systemic low-grade inflammation and subsequent depressive symptoms: Is there a mediating role of physical activity? Brain Behav Immun 2019; 80:688-96.
60. Aktürk Ü, Aktürk S, Erci B. The effects of depression, personal characteristics, and some habits on physical activity in the elderly. Perspect Psychiatr Care 2019; 55:112-8.
61. Andrade-Gómez E, Martínez-Gómez D, Rodríguez-Artalejo F, García-Esquinas E. Sedentary behaviors, physical activity, and changes in depression and psychological distress symptoms in older adults. Depress Anxiety 2018; 35:884-97.
62. Borges LJ, Benedetti TRB, Xavier AJ, d'Orsi E. Fatores associados aos sintomas depressivos em idosos: estudo EpiFloripa. Rev Saúde Pública 2013; 47:701-10.
63. Schuch FB, Vancampfort D, Firth J, Rosenbaum S, Ward PB, Silva ES, et al. Physical activity and incident depression: a meta-analysis of prospective cohort studies. Am J Psychiatry 2018; 175:631-48.
64. Lin T-W, Kuo Y-M. Exercise benefits brain function: the monoamine connection. Brain Sci 2013; 3:39-53.
65. Farioli-Vecchioli S, Sacchetti S, di Robilant NV, Cutuli D. The role of physical exercise and omega-3 fatty acids in depressive illness in the elderly. Curr Neuropharmacol 2018; 16:308-26.
66. Chytrova G, Ying Z, Gomez-Pinilla F. Exercise contributes to the effects of DHA dietary supplementation by acting on membrane-related synaptic systems. Brain Res 2010; 1341C:32-40.
67. Wu A, Ying Z, Gomez-Pinilla F. Docosahexaenoic acid dietary supplementation enhances the effects of exercise on synaptic plasticity and cognition. Neuroscience 2008; 155:751-9.
68. Leckie RL, Weinstein AM, Hodzic JC, Erickson KI. Potential moderators of physical activity on brain health. J Aging Res 2012; 2012:948981.
69. Chrysohoou C, Tsitsinakis G, Siassos G, Psaltopoulou T, Galiatsatos N, Metaxa V, et al. Fish consumption moderates depressive symptomatology in elderly men and women from the IKARIA Study. Cardiol Res Pract 2011; 2011:219578.
70. Bountziouka V, Polychronopoulos E, Zeimbekis A, Papavenetiou E, Ladoukaki E, Papairakleous N, et al. Long-term fish intake is associated with less severe depressive symptoms among elderly men and women: the MEDIS (MEDiterranean ISlands Elderly) epidemiological study. J Aging Health 2009; 21:864-80.
71. Matsuoka YJ, Sawada N, Mimura M, Shikimoto R, Nozaki S, Hamazaki K, et al. Dietary fish, n-3 polyunsaturated fatty acid consumption, and depression risk in Japan: a population-based prospective cohort study. Transl Psychiatry 2017; 7:e1242.
72. Elstgeest LEM, Visser M, Penninx BWJH, Colpo M, Bandinelli S, Brouwer IA. Bidirectional associations between food groups and depressive symptoms: longitudinal findings from the Invecchiare in Chianti (InCHIANTI) study. Br J Nutr 2019; 121:439-50.
73. Bae J-H, Kim G. Systematic review and meta-analysis of omega-3-fatty acids in elderly patients with depression. Nutr Res 2018; 50:1-9.
74. Bai Z-G, Bo A, Wu S-J, Gai Q-Y, Chi I. Omega-3 polyunsaturated fatty acids and reduction of depressive symptoms in older adults: a systematic review and meta-analysis. J Affect Disord 2018; 241:241-8.
75. Lopes CS, Hellwig N, Silva GA, Menezes PR. Inequities in access to depression treatment: results of the Brazilian National Health Survey – PNS. Int J Equity Health 2016; 15:154.
76. Wang PS, Aguilar-Gaxiola S, Alonso J, Angermeyer MC, Borges G, Bromet EJ, et al. Worldwide use of mental health services for anxiety, mood, and substance disorders: results from 17 countries in the WHO World Mental Health (WMH) Surveys. Lancet 2007; 370:841-50.
77. World Health Organization. Depression. https://www.who.int/news-room/fact-sheets/detail/depression (accessed on 13/Feb/2020).
78. Krishnamoorthy Y, Rajaa S, Rehman T. Diagnostic accuracy of various forms of geriatric depression scale for screening of depression among older adults: systematic review and meta-analysis. Arch Gerontol Geriatr 2020; 87:104002.

79. Al-Harbi KS. Treatment-resistant depression: therapeutic trends, challenges, and future directions. Patient Prefer Adherence 2012; 6:369-88.
80. Jaffe DH, Rive B, Denee TR. The humanistic and economic burden of treatment-resistant depression in Europe: a cross-sectional study. BMC Psychiatry 2019; 19:247.
81. Johnston KM, Powell LC, Anderson IM, Szabo S, Cline S. The burden of treatment-resistant depression: A systematic review of the economic and quality of life literature. J Affect Disord 2019; 242:195-210.
82. Otte C, Gold SM, Penninx BW, Pariante CM, Etkin A, Fava M, et al. Major depressive disorder. Nat Rev Dis Primer 2016; 2:16065.
83. Wong SK, Ima-Nirwana K-YC and S. Vitamin D and depression: the evidence from an indirect clue to treatment strategy. Curr Drug Targets 2018; 19:888-97.
84. Horne R. Representations of medication and treatment: advances in theory and measurement. In: Petrie KJ, Weinman JA, editors. Perceptions of health and illness: current research and applications. Amsterdam: Harwood Academic Publishers; 1997. p. 155-88.
85. Monteiro CA, Moura EC, Jaime PC, Claro RM. Validity of food and beverage intake data obtained by telephone survey. Rev Saúde Pública 2008; 42:582-9.

Resumo

Este estudo buscou verificar a associação entre o consumo de peixes ricos em ômega-3 (n-3) e sintomas depressivos em idosos residindo no Sul do Brasil. Esta é uma análise transversal com dados da segunda onda do estudo de coorte EpiFloripa Idoso (2013/2014) e incluiu 1.130 indivíduos com 60 anos ou mais. A presença de sintomas depressivos foi medida pela Escala de Depressão Geriátrica *de 15 itens (GDS-15) e pela frequência semanal de consumo de peixes ricos em n-3. O conjunto mínimo de variáveis para ajuste foi definido utilizando-se um gráfico acíclico dirigido (GAD). Foi aplicada a regressão de Poisson com variância robusta de erros (ajustada pelo Modelo 1: variáveis demográficas e socioeconômicas, Modelo 2: variáveis comportamentais adicionadas e Modelo 3: variáveis de saúde). Identificamos a prevalência de sintomas depressivos em 19% dos idosos e 51,8% relataram comer peixes ricos em n-3 uma vez por semana. Os Modelos 1 e 3 apresentaram uma associação inversa entre peixes ricos em n-3 e sintomas depressivos. No entanto, a associação foi reduzida quando fatores comportamentais (atividade física de lazer) foram incluídos no Modelo 2. Esses achados sugerem que a ingestão de peixes ricos em n-3 tende a estar associada a sintomas depressivos em idosos. No entanto, outros fatores como o exercício físico são tão cruciais quanto os ácidos graxos n-3 em prevenir o desenvolvimento de sintomas depressivos.*

Ácidos Graxos Ômega-3; Ingestão de Alimentos; Depressão; Estudos Transversais; Envelhecimento

Resumen

El objetivo de este estudio fue verificar la asociación entre el consumo de pescado rico en omega-3 (n-3) y los síntomas depresivos en adultos mayores que viven en el Sur de Brasil. Análisis transversal con datos de la segunda oleada del estudio de cohortes EpiFloripa Anciano (2013/2014) que incluyó a 1.130 individuos de 60 años o más. La presencia de síntomas depresivos se midió mediante la Escala de Depresión Geriátrica *de 15 ítems (GDS-15), y el consumo de pescado rico en n-3 mediante una pregunta sobre la frecuencia semanal. El conjunto mínimo de variables para el ajuste se definió mediante un gráfico acíclico dirigido (GAD). Se aplicó la regresión de Poisson con varianza de error robusta (ajustada por el Modelo 1: variables demográficas y socioeconómicas, Modelo 2: variables de comportamiento añadidas, Modelo 3: variables de salud añadidas). Se identificó la prevalencia de síntomas depresivos en el 19% de los adultos mayores y el 51,8% informó de que comía pescado rico en n-3 una vez a la semana. Los Modelos 1 y 3 mostraron una asociación inversa entre el pescado rico en n-3 y los síntomas depresivos. Sin embargo, la asociación se redujo cuando se incluyeron los factores conductuales (actividad física en tiempo libre) en el Modelo 2. Estos resultados sugieren que la ingesta de pescado rico en n-3 tiende a asociarse con los síntomas depresivos en los adultos mayores. Sin embargo, otros factores como el ejercicio físico son tan fundamentales como los ácidos grasos n-3 para prevenir el desarrollo de síntomas depresivos.*

Ácidos Grasos Omega-3; Ingestión de Alimentos; Depresión; Estudios Transversales; Envejecimiento

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