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Long-Term Fish Intake Is Associated With Less Severe Depressive Symptoms Among Elderly Men and Women

The MEDIS (MEDiterranean ISlands Elderly) Epidemiological Study

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Objective: This work aims at exploring the association between fish intake and depressive symptoms, in older adults. **Method:** During 2005-2007, 1,190 men and women (>65 years) free living in various Greek islands and in Cyprus participated in the study. Depressive symptoms were assessed using the validated Geriatric Depression Scale (GDS), and foods intake through a Food Frequency Questionnaire. **Results:** Almost 70% of the participants scored above the depressive cutoff (i.e., GDS score > 5), with

women having higher values. People classified under the 1st tertile of GDS score (i.e., GDS ≤ 5) were more educated, physically active, and report higher fish consumption. One portion increase of fish consumption per week was associated with 0.58 times (95% confidence interval: 0.45-0.73) lower likelihood of having GDS score above the clinical threshold, after various adjustments were made. **Discussion:** These findings may assist public health policy makers in better preventing emotional disorders among the elderly by promoting healthier eating habits.

Keywords: epidemiology; geriatrics; health behaviors

Depression is a highly prevalent disorder in the general population. This disorder constitutes a worldwide health problem because it is associated with functional impairment in normal life, poor compliance with medical therapy, and lifestyle interventions. Several studies demonstrated that 17%-20% of the general population suffers from mild to severe depression through life span, although it is also estimated that approximately 5% of adults have severe depression (Adamek & Slater, 2008). However, the range of prevalence of depression varies from country to country, although a high prevalence of depression was found among middle-aged and older individuals in various parts of the world, as well as in Greek population (Argyriadou et al., 2001; Panagiotakos et al., 2004, Papadopoulos et al., 2005, Psaltopoulou et al., 2008). A number of features of depression are changing through life course, so that those currently at highest risk are adolescents and older adults as well (Almeida et al., 2008). Thus, taking into account the increasing longevity throughout the world, the number of elderly who are depressed is expected to be at alarming rates during the next years (Klerman & Weissman, 1988, 1989).

Several prevention measures have been proposed through the past years, including social support, lifelong training, and diet interventions as well. Regarding diet, the contribution of omega-3 polyunsaturated fatty acids (PUFA) in the development and management of depression among middle-aged individuals has been reported in some but not all studies (Antypa, Van der Does, Smelt, & Rogers, 2008; Assisi et al., 2006; Gazi, Liberopoulos, Saougos, & Elisaf, 2006; Owen, Rees, & Parker, 2008; Sontrop & Campbell, 2006). Moreover, data in older adults are very limited. It is widely adopted that an important component of a healthy dietary pattern is fish. During the past two decades, several epidemiological studies and clinical trials have

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indicated the beneficial effects of fish intake in the prevention of a variety of noncommunicable diseases, like cardiovascular, neurological, and immunological disorders, diabetes, and cancer (Arvaniti, Panagiotakos, Pitsavos, Zampelas, & Stefanadis, 2006; Assisi et al., 2006; Balk, Lichtenstein, & Chung, 2006; Connor, 2000; Hu, Cho, Rexrode, Albert, & Manson, 2003; Panagiotakos et al., 2005, 2007; Panagiotakos, Pitsavos, et al., 2008; Schmidt, Skou, Christensen, & Dyerberg, 2000; Tavazzi et al., 2004; Zampelas et al., 2005). Specifically, reductions in cardiovascular disease (CVD) risk, depression, and rheumatoid arthritis symptoms have been correlated with omega-3 fatty acid intake. There is also an increased interest in the use of omega-3 fatty acid supplementation for other psychiatric illnesses and prevention of Alzheimer's disease (Martin, 2008). Although there is some evidence supporting that the deficiency in omega-3 may contribute to increased risks for depression and other diseases, according to Severus, Ahrens, and Stoll (1999) and Frasure-Smith, Lesperance, and Julien (2004), there is lack on studies concerning the effect of omega-3 fatty acids in the development of depression particularly in the elderly. Thus, in the context of the MEDIS (MEDiterranean ISlands) study, we aimed at evaluating the effect of fish intake in the presence of depressive symptoms, in a sample of elderly people living in Greek islands and Cyprus.

Method

The MEDIS study is a health and nutrition survey, which aimed to evaluate bio-clinical, lifestyle, behavioral, and dietary characteristics of elderly people living in Mediterranean islands (Panagiotakos et al., 2007).

Participants

A random, population-based, multistage sampling method (i.e., age group, 3 levels [65-75, 75-85, 85+], and 2 sex levels) was used to select men (76 ± 7 years) and women (74 ± 7 years), from Cyprus Republic and Mitilini, Samothraki, Cephalonia, Crete, Corfu, Limnos, and Zakynthos islands, in Greece. Individuals residing in assisted living centers as well as those with a clinical history of CVD or cancer were not included in the survey. The target sample size was as follows: 300 people from Cyprus and 150 from each one of the other islands. Of the initially selected people, 553 men and 637 women (n = 1,190) agreed to participate (Cyprus, n = 300; Mitilini, n = 142; Samothraki, n = 100; Cephalonia, n = 115; Crete, n = 131; Corfu, n = 149; Limnos, n = 150; Zakynthos, n = 103). Of them, 460 (39%)

were living in rural areas of the islands. The participation rate varied between 75% and 89% from island to island. A group of health scientists (i.e., physicians, dietitians, and nurses) with experience in field investigation collected all the required information, using a quantitative questionnaire and standard procedures.

The retrieved data were confidential, and the study followed the ethical considerations provided by the World Medical Association (WMA; 52nd WMA General Assembly, Edinburgh, Scotland, October 2000). Moreover, the Institutional Review Board approved the design, procedures, and aims of the study. Before the interviews, participants were informed about the aims and procedures of the study and provided their consent.

Assessment of Depressive Symptoms

Symptoms of depression during the past month were measured using a shortened version of the self-report, Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986; Yesavage et al., 1983). This version of the GDS has been found both reliable and valid in older populations (Sheikh & Yesavage, 1986). Moreover, this tool has been validated in the Greek population in 168 control subjects and 103 patients suffering from clinically diagnosed depression (Fountoulakis et al., 1999). The range of the depression variable that refers to possible scores is from 0 to 15 and had been divided into three groups for clinical purposes (0-5: no signs of depression; 6-10: mild depression; 11-15, severe depression; Fountoulakis et al., 1999). To increase the precision of the retrieved psychological information from the participants, we asked a close friend, companion, or sibling of them to answer the same questions regarding the participant's psychological status. Both data sets (i.e., from participants and their friends, companion, or siblings) were compared using Kendall's τ coefficient. Participants with significant discordance (i.e., >3%) from their counterparts were excluded from the psychological analyses (four participants were excluded).

Other Measurements

The retrieved information included basic demographic characteristics, such as age, gender, annual income, and lifestyle factors, as well as various bio-clinical characteristics. Current smokers were defined as those who smoked at least one cigarette per day or have stopped cigarette smoking during the past 12 months. Former smokers were defined as those who previously smoked but have not done so in a year or more. The remaining participants were defined as rare or noncurrent smokers. Passive smokers

were those exposed to environmental tobacco smoke (at workplace, home or restaurants, etc.) for more than 30 min per day. According to the Ministry of Economics, the basic income (i.e., lowest level to meet basic needs) is 8,000 Euros per person. Dietary habits were assessed through a semiquantitative, validated, and repeatable food-frequency questionnaire. Frequency of consumption of various food groups and beverages (i.e., meat and products, fish and seafood, milk and other dairy products, fruits, vegetables, greens and salads, legumes, cereals, coffee, tea, and soft drinks) on daily, weekly, or monthly basis was assessed. Particularly, participants were asked to report all common types of fish (1 serving = 120 g) and seafood consumed in Greece and Cyprus (i.e., Sand, Smelt, Anchovy, Swordfish, Mackerel, Sardine, Hake, Gilthead sea, Bream, Scad, Striped Mullet); however, no data on fatty acids concentrations in adipose tissue or plasma were available to confirm the accuracy of the reported intake. Nevertheless, the Food Frequency Questionnaire used has been found repeatable; thus, the previous limitation may not alter the results of the study. Furthermore, intake of various alcoholic beverages (i.e., wine, beer, etc.) was measured in terms of wineglasses adjusted for ethanol intake (e.g., one 100 ml glass of wine was considered to have 12% ethanol). The participants reported a consistency of their dietary habits throughout the past 10 years. To evaluate overall dietary habits the MedDietScore (possible range 0-55) was used (Panagiotakos, Chrysohoou, Pitsavos, & Stefanadis, 2006). Higher values of this diet score indicates greater adherence to the Mediterranean diet. Physical activity was evaluated using the shortened version of the self-reported, International Physical Activity Questionnaire (IPAQ; Craig et al., 2003). Frequency (times per week), duration (minutes per time), and intensity of physical activity during sports, occupation, and/or free-time activities were assessed. Participants were classified as inactive, minimally active, and HEPA active (health-enhancing physical activity; a high active category). Diabetes mellitus (type 2) was determined by fasting plasma glucose tests and was analyzed in accordance with the American Diabetes Association diagnostic criteria (i.e., fasting blood glucose levels greater than 125 mg/dl or use of special medication indicated the presence of diabetes). Participants who had blood pressure levels ≥140/90 mmHg or used antihypertensive medications were classified as hypertensive. Fasting blood lipids levels were also recorded, and hypercholesterolemia was defined as total serum cholesterol levels >200 mg/dl or the use of lipid-lowering agents. High-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides were also recorded. Weight and height were measured to attain body mass index (BMI) scores (kg/m^2). Obesity was defined as BMI > 29.9 Kg/m^2.

Statistical Analysis

Continuous variables are presented as $M \pm SD$. Categorical variables (i.e., financial status, smoking habits, physical activity, and prevalence of clinical disorders) are presented as absolute and relative frequencies (%). After controlling for equality of variances (homoscedacity) using the Levene's test, associations between continuous variables and group of participants (e.g., low, moderate, and high depression score) were evaluated with ANOVA. Associations between categorical variables and depression groups were tested by the use of the chi-square test, without the correction of continuity. Ordinal logistic regression analysis evaluated the association between fish intake and GDS groups (i.e., 0-5 as reference category, 6-10, and >10), whereas regression analysis evaluated the association between fish intake and the score of GDS, after various adjustments were made. A p value <.05 was considered as statistically significant. SPSS version 14 software was used for all calculations (SPSS Inc., Chicago, IL).

Results

Table 1 presents several characteristics of the study's sample by gender. The mean GDS score differed between genders, with women having higher values (7.4 ± 4.4 vs. 8.9 ± 4.1, $p < .001$). Forty percent of the participants were in the highest GDS category (i.e., GDS score > 10), indicating intense depressive symptoms, whereas another approximately 30% of the participants scored above the depression cutoff (i.e., GDS score > 5), indicating mild depressive symptoms. In addition, the mean consumption of fish (times/week) is slightly higher among men than women, whereas alcohol consumption is more prevalent among men (Table 1).

Table 2 illustrates various characteristics of the participants by depression status. Among other findings, fish intake was higher in people with no or low depressive symptoms, as compared to those with moderate or high depression (Table 2). Moreover, individuals in the lowest GDS category had less CVD risk factors than those with signs of mild or intense depressive symptoms (i.e., in the middle or highest tertiles) appear to be more educated and more physically active than those in the middle and higher tertiles, although smoking and alcohol consumption is more prevalent among this group. Furthermore, people who reported physically active were more likely to eat increased quantities of fish ($p < .001$).

Regarding the main research hypothesis, a strong, inverse association was observed between fish intake and GDS score. Particularly, age and sex

Table 1
Sociodemographic, Clinical, and Lifestyle Characteristics of the Participants of the MEDIS Epidemiological Study

	Men (n = 553)	Women (n = 637)	p
Age (years)	75.0 ± 7.3	73.1 ± 6.7	<.001
Education level (years of school)	6.5 ± 3.4	5.3 ± 3.0	<.001
Geriatric Depression Score	7.4 ± 4.4	8.9 ± 4.1	<.001
Financial status (%)			<.001
Low	48.9	63.3	
Middle	31.3	23.9	
High	19.7	12.8	
Current or former smoker (%)	25.5	3.8	<.001
Physical activity (%)	56.7	43.3	<.001
Body mass index (kg/m^2)	27.9 ± 4.2	29.4 ± 5.3	<.001
Prevalence of obesity (%)	27.3	41.1	<.001
Prevalence of hypertension (%)	62.5	72.1	<.001
Prevalence of diabetes (%)	21.0	22.9	<.001
Prevalence of hypercholesterolemia (%)	46.3	62.4	<.001
MedDietScore (range 0-55)	33.3 ± 4.3	33.7 ± 3.8	.099
Fish intake (times/week)	2.3 ± 1.2	2.0 ± 1.1	<.001
Ethanol consumption (>6 g/day, %)	73.0	27.0	<.001

Note: MEDIS = MEDiterranean ISlands.

only adjusted linear regression analysis revealed that 1 portion increase of fish consumed per week was associated with –0.807 ± 0.23 (p = .001) lower GDS score. Similarly, logistic regression analysis showed that 1 portion increase of fish per week was associated with 0.58-times lower likelihood (95% confidence interval [CI]: 0.45-0.73) of having GDS score >5. The benefits from fish intake remained similar even when adjusted for age, sex, education status, BMI, physical activity status, and the presence and management of hypertension, hypercholesterolemia, and diabetes (multi-adjusted odds ratio of having GDS >5 per 1 fish intake/week = 0.64, 95% CI: 0.48-0.84). Furthermore, ordinal logistic regression analysis (having two outcome categories, i.e., mild and intense depressive symptoms vs. no symptoms) confirmed the aforementioned findings that fish consumption was associated with a decrease in the likelihood of having significant depressive symptoms, after adjusting for age, sex, educational status, living conditions, physical activity, and MedDietScore (Table 3).

Finally, we reported in our unadjusted analyses that increased physical activity and higher levels of education is found in those who had lower score in the depression scale (Table 1). We have already adjusted for the effect of physical activity and education status on the relationship between

Table 2
Sociodemographic, Clinical, and Lifestyle Characteristics of Participants by Depression Status, in Men and Women From the MEDIS Epidemiological Study

	Geriatric Depression Score (0-15)			
	≤5 (n = 188, 31.6%)	5-10 (n = 161, 27.1%)	>10 (n = 246, 41.3%)	p
Age (years)	73.9 ± 6.7	75.6 ± 7.1	75.8 ± 7.6	.011
Sex (%, male)	39.2	28.6	32.2	<.001
Body mass index (kg/m^2)	27.8 ± 4.3	29.3 ± 5.1	29.6 ± 5.5	.001
Education level (years of school)	6.4 ± 3.3	5.7 ± 3.4	5.0 ± 2.9	<.001
Physical activity (%)	40.5	26.0	33.5	<.001
Current or former smoker (%)	53.1	23.5	23.5	<.001
MedDietScore (0-55)	34.2 ± 4.2	34.2 ± 3.8	34.2 ± 3.3	.996
Fish intake (times/week)	2.6 ± 1.2	1.9 ± 1.1	2.0 ± 1.2	<.001
Alcohol (>6 g ethanol/day, %)	45.5	22.2	32.3	<.001
Hypertension (%)	26.6	27.3	46.1	<.001
Diabetes (%)	23.7	31.4	44.9	<.001
Hypercholesterolemia (%)	28.6	26.3	45.1	<.001

Note: MEDIS = MEDiterranean ISlands. $p < .05$ for the differences between GDS 5-10, >10 versus <5, after correcting the inflation of type-I error using the Bonferroni rule.

Table 3
Results From Ordinal Linear Regression Analysis Examining the Effect of Various Lifestyle Factors (Independent Factors) on the Presence of Depression as Measured by the Geriatric Depression Score (Dependent Outcome; <5 (Reference Category) vs. 5-10 vs. >10)

	Beta Coefficient	p
Fish intake (times/week)	–0.529	.001
Age (years)	0.060	.03
Sex (male vs. female)	0.934	.03
Education level (years of school)	0.026	.67
Living alone (yes vs. no)	0.736	.10
Financial status (good vs. moderate/low)	–1.490	.04
Physical activity (yes vs. no)	0.289	.47
MedDietScore, without fish consumption (0-50)	–0.019	.71

fish intake and depression status (Table 3), without any significant alterations in the main research finding. To strengthen our analysis, we have also

tested about the interaction effect of physical activity, education status, and fish intake on depression status. No significant interactions were observed between physical activity and fish intake as well as education status and fish intake on depression ($p = .41$, and $p = .90$, respectively).

Discussion

The majority of the elderly men and women participants reported moderate to severe levels of depressive symptoms (i.e., approximately 70%), with women scoring higher values in the depression scale used as compared to men. Various dietary habits were evaluated, and one of the major findings is that the highest intake of fish was reported by people with no or low depressive symptoms. Multiadjusted analysis revealed that an increase in the fish intake was correlated with a decrease in the GDS score of the participants and, consequently, with lower likelihood of having GDS score above the depression cutoff (i.e., GDS score > 5) after controlling for various behavioral and sociodemographic characteristics (i.e., educational level, financial status, physical activity, dietary habits, age, and gender). Thus, a hypothesis may be stated that depressive symptomatolgy is independently associated with fish and seafood intake among elderly people. However, the cross-sectional design of the study cannot allow causal interpretations. Regarding fish intake, both genders consumed adequate quantities, with men consuming fish and other seafood more often than women; the latter may also partially explain the lower depressive symptomatolgy observed among men.

Results from previous studies on data examining the association of dietary intake of fish or omega-3 fatty acids with the development of depression among middle aged and elderly individuals are conflicting. Some studies indicate that increased depressive symptoms were reported by infrequent fish consumers (Silvers & Scott, 2002; Sontrop, Avison, Evers, Speechley, & Campbell, 2008; Tanskanen, Hibbeln, & Tuomilehto, 2001; Timonen et al., 2004), whereas other studies reported no relationship between fish consumption and depression (Jacka et al., 2004; Sanchez-Villegas, Henriquez, Bes-Rastrollo, & Doreste, 2006; Suzuki et al., 2004). Furthermore, recent studies revealed that the deficit of omega-3 PUFAs is also associated with depression (Fitten, 2008; Kyrozis et al., 2008; Martin, 2008; Su, 2008). For example, Su (2008) and Martin (2008) have recently reported that populations who consume a small amount of omega-3 PUFAs appear to have a higher prevalence of major depressive disorders. A meta-analysis by Lin and Su (2007) concluded that there is a moderate effect of

omega-3 PUFA supplementation on depressed mood in patients with mood disorders. From an ecological point of view it could be suggested that since the consumption of omega-3 fatty acids from fish and other sources has declined in most populations (Balanza et al., 2007), and the incidence of major depression has increased (Hibbeln, 1998), a relationship could exist between these ecological observations. It is, however, still hard to conclude whether the changes in fish consumption are causally related to the etiology of major depression, based on ecological findings.

Regarding the potential pathophysiological explanations, phospholipids PUFAs levels in human tissues have shown an antidepressant effect in some but not all studies among middle-aged and older adults. Briefly, the deficit of omega-3 PUFAs has been associated with neurological, cardiovascular, cerebrovascular, autoimmune, metabolic diseases, and some types of cancer. In addition, interventional trials have suggested that omega-3 fatty acids found in fish tend to attenuate atherosclerotic process. During the past few years, several authors have gone beyond the epidemiological findings and underlined the benefit from omega-3 fatty acids intake in the treatment of depression (Adams, Lawson, Sanigorski, & Sinclair, 1996; Appleton et al., 2006; Freeman et al., 2006; Grubb, 1990; Parker et al., 2006). Research has established that docosahexaenoic acid, a long-chain omega-3 PUFA, found in fish oils plays a fundamental role in brain structure and function. In addition, docosahexaenoic acid along with eicosapentaenoic and docosapentaenoic acid seems to play a role in the etiology of depression (Stahl, Begg, Weisinger, & Sinclair, 2008). Low-chain PUFAs are essential nutrients for growth and normal cell function; docosahexaenoic acid is necessary for the development and maintenance of normal central nervous system structure and function. Docosahexaenoic acid accumulates in the brain during growth and is continually turned over by uptake from plasma (Innis, 2005). Furthermore, these nutrients are critical to ensure neurite outgrowth, proper brain development, and membrane function in the central nervous system (Martin & Bazan, 1992). In their previous works, Maes et al. (1996, 1999) observed that depressive patients had very low fatty acids levels in their blood samples. Specifically, major depressed patients had a significantly higher arachidonic : eicosapentaenoic acid ratio in both serum cholesteryl esters and phospholipids and a significantly higher omega-6:omega-3 ratio in the cholesteryl ester fraction than healthy volunteers and minor depressed participants. Furthermore, an abnormal metabolism of omega-3 long chain-PUFAs in depression was confirmed, and fish intake and fatty acids alterations were found to be related to the inflammatory response. Particularly, in the ATTICA study the investigators

reported that fish intake of >150 g/week was associated with decreased levels of proinflammatory markers, such as C-reactive protein, interleukin-6, tumor necrosis-α, amyloid A, and white blood cell counts (Zampelas et al., 2005). In addition, in a previous analysis from the same study, it has been showed that depressive symptomatology was positively correlated with various proinflammatory markers (Panagiotakos et al., 2004). Thus, a hypothesis could be stated that eating more fish could lead to lower depression status through the modification of inflammation process. Furthermore, fish is rich in other lipids, such as cholesterol, which may also play a role in the depression status. However, in a recent report from the EPIC-Greece project among 610 healthy men and women, the investigators observed that intake of calories, total or saturated lipids, did not exhibit significant association with the depression scale used (Kyrozis et al., 2008). Fish is also rich in protein (Hussein et al., 1991). However, valid data on humans are very sparse in the literature regarding the effect of dietary protein intake on depressive symptomatology. Thus, it is hard to suggest that fish protein may also play a role in reducing depression status of elderly individuals. Finally, it should be noted that there might be some other microconstituents in fish oil, apart from omega-3 PUFAs that may have beneficial effect against CVDs, like polar lipids (Nasopoulou, Nomikos, Demopoulos, & Zabetakis, 2007), but these considerations deserves further investigation in larger human studies.

In addition to the aforementioned main findings, the prevalence of the classical CVD risk factors (i.e., hypertension, diabetes, dyslipidemias) seem to be lower among the participants who had been classified in the lowest GDS score category. This observation has also been reported in a report from the Cypriot cohort of the MEDIS Study (Panagiotakos, Kimlaw, et al., 2008) as well as other previous studies performed in elderly populations (Black, Markides, & Ray, 2003; Kiecolt-Glaser & Glaser, 2002; Zimmerman et al., 2008). Among several findings reported in previous works regarding the profile of depressive people, elderly with no or less severe depressive symptoms seem to be better educated. This was also a finding from the current study (Table 2). Thus, it could also be suggested that more educated have better adherence to the guidelines for healthier eating and therefore consume more often fish and seafood than people who had been classified with more severe depression. Moreover, several studies have showed that increased physical activity lowers the incidence of depression, and those who continue to be physically active are less likely to present depressive symptomatology (Carbonare, 2009; Martin, Church, Thompson, Earnest, & Blair, 2009). This has been attributed to an increase in the levels of

brain-derived neurotrophic factor (Russo-Neustadt, Beard, Huang, & Cotman, 2000). We have also observed that physical activity was associated with lower scores in the depression scale (Table 1) and higher fish consumption. However, the latter relationships did not alter the investigated association of fish intake on depressive symptomatology, in our elderly sample. Furthermore, we observed that education status was inversely associated with depressive symptomatology (Table 1). It has been suggested that those with higher education level are more likely to be mentally active, a fact that decreases the incidence of depression in them (Mackin & Areán, 2009). Thus, we have tested for the potential interaction effect of education and fish intake on depressive symptomatology of the participants; the results were insignificant, indicating that the observed effect of fish consumption on depression status was independent of education level of the participants.

At this point it should be noted that there are concerns that high oily fish consumption could impact on intakes of environmental contaminants like methylmercury (MeHg), polychlorinated biphenyls, dioxins, and others (International Programme on Chemical Safety [IPCS], 2008). However, observational studies that have evaluated the effect of MeHg on human health reported conflicting findings. Although more studies are needed to resolve this issue, it is important to take also into account that both the benefits and risks of eating fish vary depending on a person's stage of life; that is, children and pregnant women should avoid potentially contaminated fish, whereas middle-aged and older people, for whom the benefits of eating fish far outweigh the risks, should consume fish according to the guidelines. In any case, eating a variety of fish will help minimize any potentially adverse effects due to environmental pollutants (IPCS, 2008).

Strengths of the present work are the use of validated instruments and the examination of, and control for, several potentially confounding variables. However, the study is a cross-sectional, based on volunteers of the general population, and as such has the potential of recall bias. Although detailed and accurate sociodemographic and clinical data were recorded, this bias may still exists. Thus, due to the nonexperimental design of this study, direct cause and effect relationships could not be established. In addition, somatic symptoms may be more reliable indicators of depression than an emotional state. Scores from depression screening tools are used to indicate the need for further evaluation and not as a basis for diagnosis. Although our study is lacking of a psychiatric interview of the participants that would increase the certainty of the diagnosis, self-administrative depression screening tools are useful for detecting depression (Kerr & Kerr, 2001)

and demonstrate good accuracy for detecting late-life major depression in the primary care (Watson & Pignpone, 2003).

Considering the growing population of elderly people in industrialized world, the investigation of associations between lifestyle and psychological factors among elderly surely is of interest. As this grossly is influenced by national and cultural factors, different regional studies are necessary to elucidate this topic. The present study investigated the association between fish intake and the prevalence of depression in an elderly population. Despite the limitations of this study, a strong, independent association between depression and the infrequent fish consumption was revealed, taking into consideration a variety of lifestyle behaviors (e.g., smoking, dietary intake, and physical activity), sociodemographic characteristics (e.g., financial status, living conditions, and educational status), and controlling for anthropometric factors. These findings are of major importance from a public health perspective because they are observed in an elderly population-based sample of free-living individuals. Hence, the increase in fish consumption and thus the higher intake of omega-3 fatty acids may act in treating depression, especially when patients do not respond to their antidepressive meditation (Zigelstein et al., 2000).

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