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Adherence to Mediterranean diet and risk of depression later in life. A cross sectional study in East Attica, Greece

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Abstract

Objectives: The purpose of the present study was to estimate the prevalence of depression later in life in an urban area and to investigate the associations between possible risk and protective factors including adherence to a Mediterranean diet.

Methods: A cross-sectional study was conducted among the active members of the open day-care centres for older people, in East Attica, Greece. An anonymous questionnaire was developed to collect basic demographic and medical data, the Geriatric Depression Scale (GDS-15) was applied to screen the elderly for depressive symptoms, the Athens Insomnia Scale (AIS) was used to quantify sleep disturbances and adherence to the Mediterranean diet was evaluated using the Mediterranean Diet Score (MDS). Statistics was processed with SPSS 24.0.

Results: 154 older adults took part in the study. According to GDS-15, 24.7% (21.4% moderate and 3.2% severe type) screened positive for depressive symptoms. 29.9% of the participants reported inadequate sleep, based on AIS. Depression and insomnia in older participants were more frequent in women than in men, in lower educated, in participants with lower monthly income and in older people with comorbidity ($p < 0.05$).

MDS revealed that adherence to a Mediterranean diet was moderate for 64.3% of the participants, and it was high for 34.4%. Depression diagnosed by a physician, was strongly associated with MDS ($p = 0.035$) and AIS ($p = 0.001$). Logistic regression analysis results revealed a diet higher in vegetables and lower in poultry and alcohol was associated with decreased likelihood of developing symptoms of depression later in life.

Conclusions: Our results support that depression in older adults is common and strongly associated with several risk factors. Adherence to a Mediterranean diet may protect against the development of depressive symptoms in older age. Moreover, not only diet but also sleep-deficiency might contribute to the depression later in life.

Keywords

Depression, older age, Mediterranean diet, insomnia, Geriatric Depression Scale 15, Athens Insomnia Scale, Mediterranean Diet Score

INTRODUCTION

One in seven older adults above 65 years will suffer from depression according to World Health Organization (WHO 2009). Depression after the age of sixty is different from cases of depression that occur at a younger age in terms of clinical symptoms, aetiology, response to treatment and prognosis (Rapp et al., 2005).

Depression on late life is a complex condition with many and varied causes or influencing factors and it is often difficult to pin down an exact cause. The results of the studies performed indicates that depressive symptoms seen in older age are

related to the advancing of age, being a female, divorce and widowhood, living alone, low education and economical level, insomnia, the co-existence of a chronic illness and use of multiple drugs (Chang-Quan et al., 2010; Çınar & Kartal 2008; Weyerer et al., 2008).

Some studies suggest that eating a Mediterranean diet may help prevent depression. A main finding of the review was that there seemed to be a strong association between eating a Mediterranean-style diet and a reduced risk of developing symptoms of depression or being diagnosed with clinical depression (Pagliai et al., 2018; Sanchez-Villegas et al., 2006).

The Mediterranean diet is an eating pattern that emulates how people in the Mediterranean region have traditionally eaten, with a focus on foods like olive oil, fish and vegetables. A lifestyle rather than merely a diet, the eating plan is associated with getting regular exercise and eating meals with family and friends. The Mediterranean diet has become customary to be represented in the form of a pyramid, the base of which refers to foods which are suggested to be consumed most frequently and the top of the pyramid to those foods consumed rarely. A Mediterranean diet generally emphasizes eating fruits and vegetables, whole grains, legumes and nuts, using olive oil, eating dairy products, fish and poultry in moderation, limiting red meat, and sweets and wine to be consumed in low to moderate amounts (Willett et al., 1995).

Adherence to a Mediterranean diet has long been recognized as being good for health and has been associated with longer survival, reduced risk of cardiovascular or cancer mortality, and reduced risk of neurodegenerative disease (Trichopoulou et al., 2003; Sofi et al., 2008). A Mediterranean diet might also have protective effects against cognitive decline in older individuals, because it combines foods and nutrients potentially protective against cognitive dysfunction or dementia, such as monounsaturated fatty acids, fish, vitamins B12, folate and antioxidants (vitamin E, carotenoids, flavonoids) (Reynolds, 2006; Solfrizzi et al., 2006).

AIMS

The purpose of the present study was to estimate the prevalence of depression later in life, in an urban area in Athens and to investigate the associations between possible risk and protective factors including adherence to a Mediterranean diet, insomnia, socio-demographic characteristics and co-existence of medical illnesses.

MATERIAL AND METHODS

Design and sample:

We conducted a cross-sectional study of the registered and active members of the 5 open day-care centres for older people in the municipality of East Attica, Greece (two open day-care centres in Rafina-Pikermi and 3 in Pallini-Geraka-Athousa) from March to May 2018. Community-based open day-care centres are public in Greece and offer a professionally managed environment for older adults. All the open day-care centres for older people in East Attica were selected, and in each of them, the questionnaires were distributed either in the morning or

in the afternoon. During the study period, the same researcher visited one of the day-care centres daily, and distributed the questionnaires to the members. In the most cases, a face-to-face interview was performed, as requested by the great majority of respondents. In details, many participants expressed difficulty in completing the questionnaire for several reasons, such as inability to read, difficulty in understanding the questions, and deficient vision.

A convenience sample of the elderly in each open day-care centre was collected (10% of the active members). Based on the total number of active members of all the open day-care centres for older people in East-Attica (1.200 older adults), the minimum sample size was calculated at 120 subjects. The study period was 3 months; therefore, it was possible to collect more than calculated.

Inclusion and exclusion criteria:

All the participants were 65 years old and above. This is the minimum age someone must be to enrol in an open day-care centre for older people in Greece. Participants with any type of dementia, not active members and not visiting frequently (> 1 per month) one of the five open day-care centres were excluded from the studied population.

Instrument and assessment:

An anonymous questionnaire assessing various sociodemographic, clinical, lifestyle and dietary characteristics was applied; all the participants were given the validated Greek version of the 15-item Geriatric Depression Scale (GDS-15) to screen for depressive symptoms and to estimate the prevalence of depression in this particular population group. Patients with scores of 0–5 are considered normal; a score of 6–10 indicates moderate depression; and 11–15 indicates severe depression (Fountoulakis et al., 1999, Yesavage et al., 1982).

In order to quantify the presence of sleep disturbances, the Athens Insomnia Scale (AIS-8 items) was administered to all the participants. Each item of the scale is rated 0–3 (0: no problem and 3: serious problem). Scores ≥ 6 indicate diagnosis of insomnia (Soldatos et al., 2000).

Adherence to the Mediterranean diet was evaluated using the 11-components Mediterranean Diet Score (theoretical range 0–55). Scores > 36 indicate higher adherence to the Mediterranean diet (Panagiotakos et al., 2006). A systematic review of twenty-seven studies on Mediterranean diet and its

assessment scales, found that MDS is one of the most reliable scales for assessing adherence to the Mediterranean diet (Zaragoza-Martí et al., 2018).

For the consumption of items presumed to be close to Mediterranean diet (non-refined cereals, fruits, vegetables, legumes, olive oil, fish and potatoes) scores 0 to 5 for never, rare, frequent, very frequent, weekly and daily consumption during the last month were assigned, while for the consumption of foods presumed to be away from this pattern (red meat and products, poultry and full fat dairy products), scores on a reverse scale were assigned. Regarding alcohol consumption, score 5 was assigned for a consumption of < 300 mL a day, for consumption 600–700, 500–600, 400–500, 300–400 mL a day, scores 4 to 1 respectively and 0 for consumption > 700 mL a day or not (Arvaniti et al., 2008). Total scores of 0–20 indicates low adherence to Mediterranean diet, scores 21–35 moderate and > 36 high adherence to Mediterranean diet (Panagiotakos et al., 2006).

Data analyses:

Statistical analysis was performed with SPSS for Windows v.24.0 Statistical Package. A chi square test was used to test the difference between categorical variables. $P < 0.05$ was considered as statistically significant. Fitting to a normal distribution, was assessed for every variable, with the Kolmogorov-Smirnov test, and it was not rejected in any case, ensuring the adequacy of parametric tests. Variables showing, at univariate analysis, a statistical significant association with depression were introduced in a multivariate model in order to evaluate the association for a number of potential confounders and effect modifiers: age (in years); gender; education (years of school); financial level (individual income in Euro a month); marital status (married, unmarried, widower, divorced); having children (yes/no); a number of illnesses based on medical history (hypertension, musculoskeletal disorders, anxiety, depression diagnosed by a physician, hyperlipidaemia, respiratory problems and Parkinson's disease) (yes/no), insomnia based on AIS and adherence to Mediterranean diet according to MDS questionnaire.

Simple and multiple binary regression analyses were performed to assess which factors are associated independently with depression. Baseline characteristics and nutrition habits were selected as independent variables, and depression as the dependent variable. In the initial binary regression analysis, a threshold of $P < 0.1$ was used to identify candidate variables for inclusion in the final model. The multiple regression analyses were performed using the backward elimination strategy.

RESULTS

A total of 154 individuals took part in the study, 33.1% visiting the open day-care centres of Rafina-Pikermi, 63.6% were women, mean age of all respondents was 71 years. **Table 1** presents the demographic data of the studied population.

Mediterranean Diet Score revealed that vegetables, fruits and non-refined cereals were consumed 4 to 5 times a week by 48%, 59.7% and 44.2% of the participants, respectively. Once a month, participants ate fish, potatoes and legumes (43.5%, 43.5% and 37.7% respectively). 2–3 times a week, red meat (56.5%) and poultry (48.1%) were consumed by almost half of the elderly. Full fat dairy products were never consumed by 44 individuals (28.6%). Olive oil, 4 to 5 times a week was being used by the great majority of older responders 90.3% ($n = 139$). Alcohol was never consumed by 53 persons, whereas 40.3% consumed 4 to 5 times a week.

Older participants, based on their medical history, reported to suffer in 44.2% respondents from hypertension, in 46.8% from musculoskeletal disorders, in 37.7% from anxiety and in 17.5% from depression diagnosed by a physician. 50%, 14.3% and 2.6% of the respondents suffered from hyperlipidaemia, respiratory problems and Parkinson's disease, respectively.

According to GDS-15, 24.7% of the participants screened positive for depressive symptoms, 21.4% of moderate and 3.2% of severe type of depression. Depression was more frequent in women than in men (14.3% vs 3.2%, $p = 0.034$), in lower-educated ($p = 0.012$), in participants with lower monthly income ($p = 0.003$), and in older people with co-existence of illnesses such as musculoskeletal disorders, anxiety, depression and respiratory problems (**Table 2**).

29.9% ($n = 46$) of the older individuals reported inadequate sleep, based on AIS. Insomnia was significantly associated with female gender ($p = 0.009$), lower educational level ($p = 0.008$) and was more often among older adults who are suffering from headache, anxiety and depression diagnosed by a physician (**Table 2**).

Mediterranean Diet Score revealed that 64.3% ($n = 99$) of the group had moderate adherence to the Mediterranean diet, while a third of the older adults (34.4%, $n = 53$) had high adherence and only 1.3% ($n = 2$) low adherence to the Mediterranean diet (MDS mean score: 33 ± 5).

Depression diagnosed by a physician was significantly associated with adherence to the Mediterranean diet ($p =$

Table 1. Sociodemographic characteristics of the sample (N = 154)

Characteristics	N or %
Total recorded participants	154
Male (%) / female (%)	36.4/63.6
Mean age in years ± SD	71 ± 8.1
Nationality	
Hellenic/other (in %)	98.8/1.2
Member of open day-care centre (in %)	
Gerakas/ Rafina-Pikermi /Anthousa/Pallini	25.3/33.1/27.3/14.3
Educational level (in %)	
Low (1–6 years)/Medium (7–12 years)/High (> 12 years)	26.6/43.5/29.8
Financial level (individual a month) (in%)	
< 500 E/500–1000 E/1000–2000 E/> 2000	18.8/51.3/27.3/2.6
Marital status	
Married/Not married/Divorced/Widowed (in %)	68.2/3.9/5.2/22.7
Children	
Yes/No (in %)	94.8/5.2
Frequency of visiting open day-care centres (in %)	
> 1 monthly/> 1 weekly/almost daily	13.6/60.4/26.0
Co-morbidity	
Yes/ No (in %)	66.4/33.6

Table 2. Associations between co-morbidities and Geriatric Depression Scale-15 (GDS-15), Mediterranean Diet Score (MDS) and Athens Insomnia Scale (AIS)

Co-morbidities	GDS-15	MDS	AIS
Headache			
Pearson Correlation	-0.088	0.074	-0.203
Sig (2-tailed)	0.280	0.359	0.012
N	154	154	154
Musculoskeletal disorders			
Pearson Correlation	-0.180	0.048	-0.146
Sig (2-tailed)	0.026	0.552	0.071
N	154	154	154
Anxiety			
Pearson Correlation	-0.285	0.140	-0.176
Sig (2-tailed)	0.000	0.083	0.029
N	154	154	154
Respiratory problems			
Pearson Correlation	0.267	0.048	0.140
Sig (2-tailed)	0.001	0.555	0.084
N	154	154	154
Depression (diagnosed by physician)			
Pearson Correlation	-0.478	0.170	-0.271
Sig (2-tailed)	0.000	0.035	0.001
N	154	154	154

Table 3. Logistic Regression analysis results of Mediterranean Diet Score components (MDS) and Depression as a dependent variable diagnosed by a physician

	B	S.E.	Wald	df	Sig.	Exp(B)
vegetables	-0.223	0.135	2.752	1	0.097	0.800
poultry	-0.448	0.179	6.305	1	0.012	0.639
alcohol	-0.328	0.090	13.196	1	0.000	0.720
Constant	1.993	0.857	5.406	1	0.020	7.337

0.035) and insomnia ($p = 0.001$). On the other hand, MDS is not significantly associated with GDS-15 ($p = 0.051$), AIS ($p = 0.099$) or the other demographic parameters.

In order to analyse the possible association between adherence to Mediterranean diet and depression diagnosed by a physician, subjects were categorized into depressed and non-depressed, with depression as dependent variable and food categories as independent variables. The multiple regression analyses were performed using the backward elimination, and the most important foods and with beneficial effect on depression later in life were higher consumption in vegetables and lower in poultry and alcohol.

One unit increase in the Mediterranean Diet Score (i.e., greater adherence to the Mediterranean diet) was associated with lower likelihood of having depression.

In details, each unit increase in vegetable intake was tied to a 20-percent lower risk of depression. In addition, each unit decrease in poultry intake and alcohol consumption was linked to a 36.1% and 28% reduction in depression likelihood, respectively (**Table 4**).

DISCUSSION

According to our results, one in four participants estimated to suffer from both moderate and severe depressive symptoms. Depression is common among the elderly with a significant impact on quality of life. In the study of Argyriadou et al., prevalence of depression estimated 16% among the participants – members of the open day-care centres for older people in Kavala, Greece (Argyriadou et al., 2001), lower than the prevalence of this study. On the other hand, based on 3 studies conducted in Greece, the prevalence of depressive symptoms was higher, 45% in the municipality of Patras, West Greece (Argyropoulos et al., 2015), 35% in North Greece (Argyropoulos et al., 2018) and 46% in the rural population of elderly people in Crete (Aleftinou et al., 2016). Moreover, in a recent study, at the same setting of older adults, 84.3% of the

sample shows depressive symptoms with the elderly living in Athens presented to suffer more from depression compared to those living in semi-urban areas (Babatsikou et al., 2018).

The difference in prevalence of depression may be attributed to several reasons such as the place of living, that is, urban or rural, the specific characteristics of each population, the male and female ratio, the educational and economic level of the participants, the size of the sample as well as the diagnostic tool used to assess depression.

The prevalence of depression depends on many factors, demographic or health related. Female gender is associated with depression and several studies support the same finding (Argyropoulos et al., 2018; Stylianopoulou et al., 2010; Kessler, 2003). The results of Yaka et al., in Turkey, revealed women to be at higher risk of developing depression too (Yaka et al., 2014). Several studies support that the co-existence of other diseases or pain affects the likelihood of developing depressive symptoms in older age (Argyropoulos et al., 2015; Papadopoulos et al., 2005; Chong et al., 2001).

Depression among respondents depends strongly on the educational level and the economic situation, which is in line with the results from studies conducted in Greece and Turkey (Yaka et al., 2014; Aleftininos et al., 2016, Argyropoulos et al., 2018). Depression is negatively associated to these two factors, and this in our case means that the higher the level of education and income, the better the emotional health, and so, the lower the likelihood of depression.

In the present study, approximately 1 out of 3 elderly suffer from insomnia. The prevalence of sleep problems is higher in older adults and it is often associated with other age-related conditions and has a negative effect on cognition and mortality (Ancoli-Israel, 2009). Based on 2 studies, the prevalence of insomnia was similar to our study (Paparrigopoulos et al., 2010; Argyropoulos et al., 2014). Sleep difficulties have been significantly associated in the present study with female gender, low educational level and co-morbidity, parameters that have

been found to be detrimental to sleep quality and in the other studies (Paparrigopoulos et al., 2010; Argyropoulos et al., 2014).

In addition, according to our results, depression diagnosed by a physician is significantly associated with insomnia, meaning that the better the quality of sleep, the less likely it is for the respondent to experience depression. The association of sleep disorders with depression and vice versa is a common finding of many studies (Baglioni et al., 2011; Argyropoulos et al., 2014., 2010; Neikrug et al., 2010; Ancoli-Israel et al., 2008).

Our results revealed that approximately half of the elderly present moderate to high adherence to a Mediterranean diet and participants with depression diagnosed by a physician presented lower adherence to the Mediterranean diet. Consumption of particular food groups revealed to have a protective role against depression in the elderly. Older participants with higher consumption in vegetables and lower in alcohol and poultry suffer less from depression.

Numerous studies have demonstrated the protective character of the Mediterranean diet in mental health problems, with the strongest link to a protective effect against depressive symptoms, regardless of age (Milaneschi et al., 2010). In a meta-analysis study conducted by Psatopoulou et al., in 2013, high or moderate adherence to Mediterranean diet was consistently associated with reduced risk of depression (RR = 0.68, 95% CI = 0.54–0.86), and cognitive impairment (RR = 0.60, 95% CI = 0.43–0.83). In a multicentre, randomized, primary clinical trial that aimed to assess the effects of a Mediterranean-type diet on CVD, the results suggest that a Mediterranean diet supplemented with nuts could exert a beneficial effect on the risk of depression in patients with DM2 (Sánchez-Villegas et al., 2013). Moreover, in line with our results, a study supports that consuming a greater amount of olive oil and fruit is associated with a lower risk of depression (Pagliai et al., 2018).

The anti-inflammatory effect of antioxidant ingredients, vitamins and flavonoids contained in vegetables and other foods may explain their protective role against depression (Opie et al., 2017). In a study, folate and B12 vitamin intake was inversely associated with depression prevalence among the participants (Sanchez-Villegas et al., 2006). Moreover, the benefit of the Mediterranean Diet for depression in older age may be due to its effects on vascular health and is proven to maintain a high level of vascular health and prevents many of the usual problems of aging (Aizenstein et al., 2016).

CONCLUSIONS

Depression and insomnia are common in older age and strongly associated with several risk factors. Adherence to a Mediterranean diet may protect against developing depressive symptoms in older age. Sleep-deficiency might contribute to depression later in life too.

Although we should be cautious about the study findings, they represent another potential reason to adopt a Mediterranean diet. Following a healthy lifestyle, which includes not only a Mediterranean diet, but also plenty of physical activity and drinking alcohol only in moderation, is linked to a reduction in depression. But that doesn't mean people get depressed because they have a less healthy lifestyle. It has been noticed that patients struggling with symptoms of depression is hard to stick to a healthy diet and it's possible to feel less motivated to socialize and take exercise.

LIMITATIONS

While any insight into diet or lifestyle factors that might improve mental wellbeing and help reduce the numbers of people affected by the condition is welcome, it's important to recognize the limitations of this research.

This is a cross-sectional study that cannot show the direction of cause and effect and no inference can be made, the questionnaires were given to subjects only once, the prevalence of depression depends on the cut-off scores used to distinguish between no depression and depression, this is a convenience sampling of the active members of the open day-care centres and the study was conducted in a specific population; so, our findings cannot be generalized for the whole older population.

Moreover, people may be less likely to prepare and eat healthy meals when they are feeling depressed, so the study could just show that people prone to depression have less healthy diets. Also, people who eat healthy diets tend to have generally healthier lifestyles, including taking more exercise, which is thought to protect against depression.

ETHICAL APPROVAL AND INFORMED CONSENT

Ethical approval for conducting this study was obtained from the Advisory Board of the open day-care centres for older people in East-Attica and every effort has been made to adhere to the recommended best practice to protect the interests and welfare of the participants. Verbal informed consent explaining the objectives and procedures was obtained from

all the participants before the study, and they were ensured of anonymity and confidentiality.

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DISCLOSURE OF INTEREST

The authors declare that they have no competing interest.

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