



Dietary Habits and Depression among Greek Multiple Sclerosis Patients

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Abstract

Multiple Sclerosis (MS) is a neurodegenerative disease with no complete cure. Although dietary factors have been implicated in both the onset and the progression of the disease, there are still no official dietary guidelines. The present pilot study aimed to investigate dietary habits and depression in MS patients and to explore possible associations. Thirty multiple sclerosis patients were recruited via the Greek Multiple Sclerosis Society. Dietary habits were assessed with a semi-quantitative Food Frequency Questionnaire (FFQ) and depression was evaluated by using the Beck Depression Inventory questionnaire. The study showed that fish consumption was high (≥ 2 servings/week) for 70% of the patients. More than half of the patients consumed dairy products on a weekly basis. The majority of patients reported daily consumption of olive oil. Sixty percent of the patients consumed at least 2 servings of red meat per week. Fruit and vegetable intake was less than 2 servings/day (for each food group separately), for most patients. Forty percent of the patients consumed snacks (mostly cake, biscuits and chocolate) on a weekly basis. Furthermore, the prevalence of depression was 33.3% mild, 10% moderate and 10% severe depression. The level of depression was inversely associated with chocolate consumption ($r = -0.526$, $p = 0.003$). In conclusion, the dietary habits of the majority of patients were characterized by high consumption of red meat and low consumption of fruits and vegetables. Depression was highly prevalent among the patients, which exhibited an inverse association with chocolate consumption. The study underlined the need for dietary management in MS patients.

Keywords: Multiple sclerosis; Dietary habits; Food frequency questionnaire; Nutrition; Depression

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Introduction

Multiple Sclerosis (MS) is an autoimmune inflammatory demyelinating disease of the central nervous system with varied clinical presentations [1]. It affects mainly people of young age, mostly women, and is the most common cause of non-traumatic disability in young adults. According to the Atlas of MS, Europe has the highest rate of MS of all World Health Organization (WHO) regions, with approximately 133 per 100,000 people affected [2]. At present, there is no complete cure for MS [3].

Several studies have reported high rates of depression in MS, with a prevalence between 4.3% and 59.6% [4]. Depression is considered a part of MS symptomatology and is associated with increased disease severity and disability progression [5,6]. It is also the main determinant of patients' quality of life, regardless of disability status [7].

Furthermore, although the etiology and pathogenesis of MS have not been fully elucidated, dietary factors have been implicated in both the onset and the progression of the disease [8,9]. Given the paucity of data on Greek MS patients, a pilot study was conducted at Heraklion, Crete, to investigate dietary habits and depression in MS patients and to explore possible associations.

Materials and Methods

Thirty neurologist-confirmed MS patients (16 men and 14 women) from Heraklion Crete were recruited via the Greek Multiple Sclerosis Society at the local office in Heraklion. All patients were of the relapsing-remitting type. After obtaining written informed consent, the participants were asked to complete a semi-quantitative Food Frequency Questionnaire (FFQ) in order to estimate dietary habits over the past year. The FFQ required participants to indicate the number of servings (on average) of specific food groups consumed, in times per day, per week, per month, or seldom/never. Depression was assessed using the Beck Depression Inventory questionnaire [10], which has

Table 1: Dietary characteristics of multiple sclerosis patients based on the food frequency questionnaire.

Food group	Average consumption over the past year							
	4-6/day	2-3/day	1/day	5-6/week	2-4/week	1/week	1-3/month	seldom or never
Red meat	0% (n=0)	3.3% (n=1)	10% (n=3)	6.7% (n=2)	40.0% (n=12)	26.7% (n=8)	3.3% (n=1)	10.0% (n=3)
Poultry	6.7% (n=2)	16.7% (n=5)	26.7% (n=8)	23.3% (n=7)	10% (n=3)	3.3% (n=1)	10% (n=3)	3.3% (n=1)
Fish	0% (n=0)	0% (n=0)	0% (n=0)	13.3% (n=4)	56.7% (n=17)	16.7% (n=5)	10% (n=3)	3.3% (n=1)
Eggs	0% (n=0)	6.7% (n=2)	3.3% (n=1)	0% (n=0)	23.3% (n=7)	40% (n=12)	26.7% (n=8)	0% (n=0)
Dairy	0% (n=0)	3.3% (n=1)	16.7% (n=5)	6.7% (n=2)	23.3% (n=7)	6.7% (n=2)	13.3% (n=4)	30% (n=9)
Olive oil	83.3% (n=25)	10% (n=3)	3.3% (n=1)	3.3% (n=1)	0% (n=0)	0% (n=0)	0% (n=0)	0% (n=0)
Legumes	16.7% (n=5)	16.7% (n=5)	3.3% (n=1)	10% (n=3)	30% (n=9)	20% (n=6)	3.3% (n=1)	0% (n=0)
Cereals	3.3% (n=1)	10% (n=3)	20% (n=6)	6.7% (n=2)	30.0% (n=9)	20% (n=6)	6.7% (n=2)	3.3% (n=1)
Fruits	6.7% (n=2)	10% (n=3)	10% (n=3)	10% (n=3)	6.7% (n=2)	20% (n=6)	6.7% (n=2)	30% (n=9)
Vegetables	3.3% (n=1)	10% (n=3)	13.3% (n=4)	3.3% (n=1)	20% (n=6)	20% (n=6)	10% (n=3)	20% (n=6)
Snacks	0% (n=0)	3.3% (n=1)	16.7% (n=5)	3.3% (n=1)	16.7% (n=5)	20% (n=6)	26.7% (n=8)	13.3% (n=4)

been translated and adapted to the Greek population [11].

Statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS), version 22.0. Nominal and ordinal data were summarized as absolute frequencies and percentages. Continuous variables were summarized as mean and standard deviation. Categorical variables were compared with the chi square test. P-values below 0.05 were considered statistically significant. Quantitative variables were compared with the student t-test in case of a normal distribution or otherwise with the Mann-Whitney U and Kruskal–Wallis nonparametric tests. Also, Pearson and Spearman tests were used to examine correlations between continuous variables with normal and abnormal distribution.

Results and Discussion

The mean age of the participants was 40.6 ± 10.3 years for males and 42.1 ± 11.6 years for females. Mean age at diagnosis was 30.9 ± 6.8 and 30.5 ± 8.2 years for men and women, respectively. The majority of patients, 73.3% (n=22) were married. Mean annual household income was 19863.14 ± 11171.45 Euro. All patients had at least secondary school education and most of them (56.7%, n=17) had a bachelor's degree.

The main characteristics of the patients, in terms of dietary habits, are summarized in Table 1. For the majority of patients red meat intake was at least 2 servings/week. Half of the patients consumed poultry on a daily basis. Almost all patients consumed at least 1 tablespoon of olive oil per day. Consumption of fish was at least 2 servings/week for most patients. Most patients consumed cereals and legumes at least twice a week. Fruit and vegetable intake was less than 2 servings/day (for each food group separately), for the majority of patients. One-fifth of patients consumed snacks (mostly cake, biscuits, chocolate, nuts, and chips) on a daily basis. With regard to milk intake (Figure 1), 43.3% of the patients (n=13) reported never or seldom, whereas 16.7% (n=5) reported daily consumption, of which 80% (n=4) preferred non-fat or reduced-fat milk.

The distribution of depression among patients is demonstrated in Table 2. The prevalence of depression was 33.3% (n=10) mild, 10% (n=3) moderate and 10% (n=3) severe depression. There was no statistically significant difference in depression between men and women. The level of depression correlated inversely with chocolate consumption (r= -0.526, p=0.003).

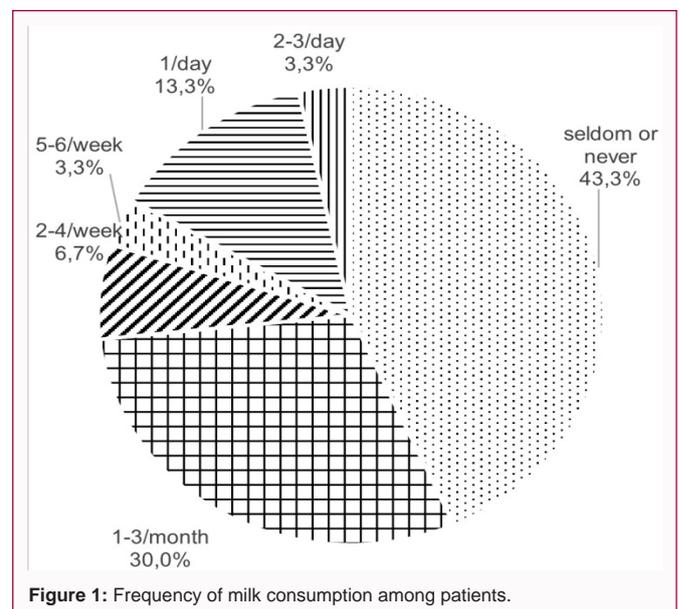


Figure 1: Frequency of milk consumption among patients.

The present study revealed that the dietary habits for the majority of Greek MS patients were not healthy. Fruit and vegetable intake for the majority of patients was lower than the recommendations of the National Nutrition guide for Greek adults [12]. Our findings are in line with a study by Balto et al. which demonstrated that most people with MS do not meet nutritional guidelines for fruits and vegetables [13]. Fruits and vegetables are rich in vitamins, minerals, dietary fiber and a variety of phytochemicals which work synergistically to support a wide range of health benefits [14]. High fruit and vegetable intake is associated with reduced levels of patient-reported disease activity and disability in MS [15].

Most patients avoided milk consumption. Studies on milk and dairy consumption and MS have yielded controversial results, so far. Some studies have indicated a protective effect, mostly attributed to calcium and vitamin D, while others support a negative role on etiology and progression of MS, due to the high saturated fat content and the presence of butyrophilin. Saturated fats can increase the translocation of endotoxins into the blood stream and activate the innate immune system and inflammatory cytokines that can affect MS-related symptoms [16]. Butyrophilin is a protein of the milk

Table 2: Distribution of depression among patients.

Depression Level	Male (n=16)	Female (n=14)	Total (n=30)
Minimal	56.3% (n=9)	35.7% (n=5)	46.7% (n=14)
Mild	25% (n=4)	42.9% (n=6)	33.3% (n=10)
Moderate	6.3% (n=1)	14.3% (n=2)	10% (n=3)
Severe	12.5% (n=2)	7.1% (n=1)	10% (n=3)

fat globule membrane which shares 50% sequence homology with myelin oligodendrocyte glycoprotein. It has been postulated that it may trigger an autoimmune response against central nervous system myelin [17-19]. On these grounds, MS patients should prefer non-fat dairy products and especially yogurt, which is an excellent source of probiotics, according to Mirashrafi et al. [20], probiotic administration may suppress depression and improve disease progression and general health in relapse-remitting MS patients.

The majority of the patients reported a daily intake of olive oil. Olive oil contains monounsaturated fatty acids and phenolic compounds, which are responsible for its antioxidant, anti-inflammatory, and immunomodulatory properties and may have a protective effect in MS [21,22]. Also, the dietary habits of most patients were characterized by high consumption of fish, which is associated with reduced risk of MS [23]. Fish, especially fatty fish, are a rich source of vitamin D and anti-inflammatory omega-3 fatty acids, which have been linked to reduced relapse rate and progression to disability [24].

Almost all patients consumed legumes on a weekly basis. Legumes comprise a rich source of proteins, dietary fiber, micronutrients, and bioactive phytochemicals and their consumption has been associated with lower risk of MS [25]. Isoflavones are a major class of phytoestrogens in legumes with anti-inflammatory properties and according to a recent study, a diet rich in isoflavone may offer protection against MS, *via* modulation of gut microbiome, since isoflavone-metabolizing bacteria are depleted in patients with MS compared to healthy individuals [26].

Most patients consumed cereals on a weekly basis. Whole grain cereals are a good source of dietary fiber, vitamins E and B, minerals and phenolic compounds, which exert anti-oxidant and anti-inflammatory properties [27]. A study by Ghadirian et al. showed that cereal consumption had a protective effect in MS patients [28]. However, MS patients should be tested for gluten-related disorders, which sometimes co-occur with MS, and in this case gluten-containing grains namely wheat, rye, and barley, and their products, should be avoided [29].

Intake of red meat was high for the majority of patients. Although non-processed red meat is an important dietary source of protein, iron, zinc, vitamin B12, other minerals and vitamins, it should be consumed in moderation due to the high saturated fat content and the presence of N-glycolylneuraminic acid [30,31]. It has been postulated that long-term ingestion of N-glycolylneuraminic acid from red meat consumption may promote inflammation and may be a risk factor for MS [32,33].

Although there are currently no official dietary guidelines for MS, this doesn't mean that patients should abstain from a healthy diet. A nutritious, well-balanced diet emphasizing vegetables, fruits, whole grains, legumes, fish, prebiotics, and probiotics, will help maintain optimum energy and nutrient levels, may reduce systemic

inflammation and improve gut microbiota, as well as physical and mental health [34,35]. Several recent studies demonstrate that high-fiber diets exert a positive impact on the gut microbiome, which regulates immune homeostasis [36]. Emerging data support the idea that alterations in the gut microbiome and increased intestinal permeability play an important role in the pathogenesis of MS and dietary habits are key modulators of gut microbiome composition and function [37,38]. Therefore, the combination of pre- and probiotics, which may restore intestinal dysbiosis, is highly recommended, and the anti-inflammatory Mediterranean diet, which beneficially impacts on gut microbiota, has a strong rationale for use [34,39,40].

As for depression, 20% of the patients had moderate or severe depression, which is within the range of general prevalence of depression in MS patients (4.27% to 59.6%), according to the literature [4]. Interestingly, the degree of depression was inversely associated with chocolate consumption. A recent cross-sectional survey demonstrated that consumption of chocolate was associated with reduced odds of clinically relevant depressive symptoms in the general population [41]. Chocolate, especially the dark variety, is rich in flavonoids, which possess antioxidant, anti-inflammatory and neuroprotective properties [42]. Dark chocolate may exert a prebiotic effect on the gut microbiome and may also improve fatigue in relapsing-remitting MS patients [43,44]. Therefore, dark chocolate represents a healthy snack option for MS patients.

Given the pilot nature of this study, there are several limitations that should be acknowledged. A main limitation of this study was the small sample size. Also, the study did not include a detailed FFQ with specific food items, e.g., types of cereal or type of chocolate. Clearly further studies with larger patient samples are required to verify the findings of the present study. Nevertheless, this study underlines the need for dietary management in MS patients. Hence, future research should focus on the relationship between dietary patterns, and MS activity and progression, which will enable the development of appropriate dietary interventions for management of the disease.

Conclusion

The study revealed that the majority of patients did not follow a healthy eating pattern. The dietary habits of most patients were characterized by high consumption of red meat and low consumption of fruits and vegetables. Depression was highly prevalent among the patients, which exhibited a novel inverse association with chocolate consumption. The study highlights the need for dietary management in MS patients.

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