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Dietary patterns in people with mild cognitive impairment

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Abstract

Introduction and Objective. Dietary habits may be an essential modulator affecting diet-related cognitive decline. One hopes that their identification will allow opening the use of new approaches for the management of the prevention and treatment of patients with mild cognitive disorders and maintaining a good quality of life.
The aim of the research was to characterize dietary habits in people with mild cognitive impairment (MCI).
Materials and Method. The survey was conducted among 146 people. 101 patients in the MCI group and 45 people without cognitive impairment (n-MCI group) as control. The research tools were the Questionnaires Eating Behaviour (QEB) and the Montreal Cognitive Assessment (MoCA) screening test. Patients were qualified into MCI group based on the MoCA screening test (25 or fewer points in the MoCA test).
Results. Differences were found in the hierarchical list of foods typically consumed at breakfast and lunch between participants in the MCI and n-MCI groups. It was also shown that among patients with MCI, a significantly smaller percentage of respondents consumed low-fat dairy products; (p=0.001) and total vegetables (p=0.034), as well as cereal products (p=0.001) and fish (p=0.007). At the same time, this group was characterized by a higher consumption of high-fat and sugar products (p=0.010).
Conclusions. According to the findings, dietary behaviours based on diets low in saturated fats but rich in n-3 polyunsaturated fatty acids, as well as vitamins and bioactive substances, may be useful in preventing MCI. These health behaviors are known among people following the Nordic Diet from a northern cultural environment or the MD diet from Southern Europe.

Key words

Dietary behaviors, mild cognitive impairment, MoCA test, health prevention

INTRODUCTION

For many years, questions have been raised about the role of nutritional factors in the pathogenesis of cognitive disorders. The European Food Safety Agency (EFSA) defines the different cognitive functions as follows: (1) sustained attention – the ability to maintain attention on a stimulus or a task for a long period; (2) selective attention – the ability to focus the mind on a task or a specific stimulus; (3) immediate memory – the ability to maintain a small amount of information in a short time period; (4) working memory – the set of processes that allow the storage and management of information for the performance of complex cognitive tasks, such as language, reading, and mathematics [1, 2]. Cognitive impairment is undoubtedly not a solely deficient disease; however, it remains uncertain whether diet has a significant impact on its pathogenesis and progression. The occurrence of dementia conditions may also have an impact on the nutritional status of patients. Patients' dietary habits undergo alterations, including the inability to eat or excessive consumption, a loss of knowledge in cooking, menu planning and rationality, leading to a nutrient-poor diet. This process may therefore have a dual effect: nutritional deficiencies in themselves (complex deficiencies, rather than deficiencies of individual substances or vitamins) can impair cognitive functioning, and inadequate cognitive functioning can further exacerbate these deficiencies [3].

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Diagnosing food deficiencies at an early stage of the disease may help to slow down the development of symptoms. which would be of great social and economic importance. The chances of regaining pre-disease cognitive function are minimal; treatment is therefore aimed at slowing down the progression of the disease and maintaining the patient at the best possible level of functioning for as long as possible. Thus, in addition to pharmacological treatment that improves intellectual performance and influences behaviour, preventive treatment is possible by changing the patient's diet. To develop a comprehensive and balanced dietary intervention for individuals with cognitive impairment (and possibly other diseases in general), it is imperative to scrutinize and ascertain the dietary habits of these patients. Identifying these dietary habits may pave the way for novel prevention and management strategies for the mild cognitive impairment (MCI). A recognized test for the assessment of cognitive function in humans is the Montreal Cognitive Assessment (MoCA), originally developed to detect MCI, but now often used as a screening tool for dementia [4]. The Questionnaire of Eating Behaviour (QEB) was used to learn about eating habits.

OBJECTIVE

The aim of the research was to characterize dietary habits in people with cognitive impairment. as well as the mutual relationships (correlations) of selected dietary habits and the results of the MoCA test. The following questions were posed: does cognitive impairment depend on the diet profile? Is it related to the examined socio-demographic data? Do both healthy and unhealthy diet indices for both genders depend on BMI, basic socio-demographic data, and the MoCA test result?

MATERIALS AND METHOD

The study was conducted in 2022 at the Institute of Rural Health (IMW) in Lublin, Poland. The study groups were patients from the IMW Clinic.

The criteria for inclusion in the study were: good general health; an education level of at least completed elementary level. The criteria for exclusion from the study were: active cancerous disease and mental diseases, including depressions within the period of five years after recruitment; and addiction to drugs and alcohol.

The study was conducted on 146 people: 101 patients from the study group and 45 healthy people as controls. Patients were qualified into the study group (MCI-patient) based on the MoCA screening test and based on the criterion of MoCA score level (25 or fewer points in the MoCA test). The control group consisted of 45 people with similar characteristics (age, gender, place of residence, and education), and an MoCA test result of ≥ 26 points.

Qualified participants were asked to complete the QEB (Questionnaire of Eating Behaviour) which includes examining respondents' basic eating habits, frequency of consumption of selected products, frequency of meals and composition. The method was developed together with the procedure for interpreting the results by the Group of Behavioural Determinants of Nutrition at the Committee for the Science of Human Nutrition, Polish Academy of Sciences in Warsaw. It was also used to collect basic socio-demographic data on the those surveyed [5].

In addition to the MoCA test and the QEB questionnaire, the following measurements were taken: height and body weight to determine the BMI index.

Two indicators of diet quality were proposed: the 'Prohealthy Diet Index' (pHDI-8) and the 'Non-healthy Diet Index' (nHDI-8). The latter index was calculated by adding up the frequency of consumption (times/day) of the indicated eight food groups with a potential beneficial impact on health: 1) whole-wheat bread; 2) milk, including flavoured milk; 3) fermented milk drinks, e.g. yogurt and kefir; 4) cottage cheese, including homogenized cheese; 5) fish products and dishes; 6) dishes made from legume seeds, e.g. beans and peas; 7) fruits; 8) vegetables.

The nHDI-8 index was calculated by summing-up the frequency of consumption (times/day) of the indicated eight food groups with a possible adverse impact on health: 1) fast food, e.g. fries, hamburgers, pizza, hot dogs and casseroles; 2) fried foods (meat, flour); 3) yellow cheeses (including processed cheese); 4) sweets and confectionery; 5) tinned meat. fish, vegetables and meat; 6) sweetened carbonated drinks, such as Coca-Cola, Pepsi, Sprite, Fanta, and Orangeade; 7) energy drinks; 8) alcoholic beverages. To simplify the interpretation of both indices, the total frequency of consumption was calculated and expressed on a scale of 0 – 100 points, according to pattern.

Diet index (pHDI-8 and nHDI-8, in points) = (100/16) × the sum of the frequency of consumption of the eight food groups (times/day). Daily frequency rates are expressed as times per day. as proposed: never = 0; 1 – 3 times a month = 0.06; once a week = 0.14; several times a week = 0.5; once a day = 1; several times a day = 2.

The intensity of features favourable or unfavourable for health was expressed, considering: 0 – 33 points = weak; 34 – 66 pts = moderate; 67 – 100pts = large [5].

Statistical analysis. Statistical and graphical analyses were performed using GraphPad Prism 5. Results were presented as mean value (x) ± standard deviation (SD), or as % of a given data population. The significance of differences between MCI and n-MCI total groups, as well as between the genders in MCI group regarding parameters expressed as percentages, were assessed using the chi-square test. The differences in MoCA test depending on the gender of the subjects were analyzed with Student's test. Because the data failed to meet normality assumptions (Shapiro-Wilk test used), the non-parametric Spearman correlation was used to determine the relationship between the diet indicators and the examined socio-demographic data. In all analyses, a significance level of $p<0.05$ was considered statistically significant.

RESULTS

The collected and calculated socio-demographic data of the surveyed patients are presented in Table 1.

MCI-patients (MCI) and people with a normal MoCA (n-MCI) test result (not showing any cognitive disorders – control group) were characterized by similar values of socio-demographic data in terms of: education (p=0.934), living environment (p=0.619), financial situation (p=0.294) and BMI (p=0.813). However, differences were found in BMI (p=0.001), living environment (p=0.024) and financial status (p=0.017) in the MCI group between men and women.

Small differences concerned: the age of the respondents (lower – 56.36 years in MCI to 62 years in n-MCI); no differences were in gender structure (p=0.229).

The MCI were mostly men, about 10 years younger, living mainly in the countryside (42.6%; women only 27.6%), with a better financial situation (16.7% of respondents above average; women 6.7%).

The MoCA screening test for the assessment and detection of cognitive disorders in n-MCI was 27.02 points and 23.25 points at MCI. There were no differences in MoCA depending on the gender of the subjects in both n-MCI (p=0.420) and MCI (p=0.117).

Diet health index – pHDI-8. an indicator of diet quality in terms of its health-promoting properties, did not show any major differences in MCI and n-MCI. In both groups, however, it was much greater in women – over 23 points than in men – over 19 points.

Unhealthy diet index – nHDI-8, an indicator of diet quality in terms of its adverse impact on health, was similar in MCI and n-MCI (both above 8 points). A higher value of the nHDI-8 index was found in men in both groups, but in MCI this difference was much higher. In the MCI group, the nHDI-8 index was 9.83 points in men and 6.96 points in women.

A hierarchical list of foods during breakfast (Tab. 2). lunch (Tab. 3) and dinner (Tab. 4) usually consumed in descending order based on the answers provided by respondents with MCI, compared with n-MCI persons are presented in the Tables.

Table 1. Characteristics of MCI-patients (MCI, test group) and individuals with normal MoCA test results (n-MCI, control group)

Subjects	Control group (n-MCI) n=45	Study group (MCI) n=101
Age. years; mean (SD)	62.0 (7.28)	56.36 (16.18)
women	64.33 (7.27)	62.17 (11.20)
men	59.47 (6.43)	52.91 (15.18)
		p=0.156
Gender; % women	53	47
men	47	54
		p=0.229
Education; %	total	total women men
Basic	4.5	4.9 9.5 7.4
Primary	25.5	22.8 20.3 24.1
Medium	43.3	44.6 40.4 44.5
Higher	26.7	27.7 29.8 24.0
	p=0.934	p=0.395
BMI. kg/m^2; mean (SD);	31.16 (5.56)	30.58 (5.35)
BMI %	total	total women men
below: 18.5 (underweight)	0	0 0 0
18.5 – 25 (normal)	10.9	12.9 12.5 5.3
25 – 30 (overweight)	33.5	31.7 37.5 31.3
over 30 (obesity)	55.6	55.4 50.0 63.2
	p=0.813	**p=0.001**
Living environment; %;	total	total women men
village	37.8	33.6 27.6 42.6
town under 20 thousand	11.2	15.9 14.9 13.0
town 20 – 100 thousand	22.1	22.8 23.4 18.5
town over 100 thousand	28.9	27.7 34.0 25.9
	p=0.619	**p=0.024**
Financial status; %	total	total women men
below average	14.4	20.8 23.4 18.5
average	72.1	67.3 70.2 64.8
above average	13.5	14.9 6.4 16.7
	p=0.294	**p=0.017**
MoCA; pkt; mean (SD)	27.02 (1.15)	23.25 (2.78)
women	27.04 (1.20)	22.89 (3.04)
men	26.95 (1.13)	23.56 (2.52)
	p=0.420	p=0.117
Prohealthy diet index [1];		
pHDI- 8; pts mean (SD)	21.20 (9.845)	21.20 (9.845)
women	23.19 (9.61)	23.16 (10.06)
men	19.52 (1.50)	19.48 (9.412)
Non-healthy diet index [2];		
nHDI- 8 pts; mean (SD)	8.37 (4.19)	8.496 (7.463)
women	7.87 (3.93)	6.963 (4.319)
men	8.75 (4.62)	9.831 (9.219)

The basic groups of products consumed during breakfast in both groups were: tea, coffee, meat, cold cuts, bread and eggs. These foods shows similar percentage of respondents (p=0.614). In the MCI group, a smaller percentage was found of respondents consuming potentially health-beneficial foods, such as: milk, yogurt, kefir, cottage and homogenised cheese (p=0.001), in contrast to n-MCI control.

The patients included in the study ate mainly soups, meat and meat dishes for dinner. However, important percentage differences between groups were found in the consumption of vegetable salads, potatoes, cereal products, rice, groats, pasta and fish, which were more often consumed by healthy people (p=0.005). Characteristically, fried pancakes, croquettes, fritters, and sweet desserts were often eaten by patients with MCI (p=0.01).

Bread, meat and cold cuts were usually eaten at dinner by people with MCI (more than 71%), while only about 5% indicated fish consumed during dinner, compared to about 57% and 13% in the healthy people (p=0.015). However, a

Table 2. Hierarchical list of foods usually consumed during breakfast

Foods consumed during breakfast (at least 3 times a week)	% person	
	MCI group	n-MCI group
tea. coffee	77.42	77.80
meat. cold cuts	80.00	73.12
bread	80.00	70.97
eggs	46.67	46.24
cottage and homogenised cheese	22.20	37.63
yellow cheese	30.11	20.00
milk. yogurt. kefir	24.73	37.80
fruits or vegetables	15.60	20.43
cereal products. flakes. groats. pasta	15.05	22.20
jam. marmalade. honey	15.05	11.10
fish	2.22	5.38
fruit or vegetable juices	2.15	2.12

Table 3. Hierarchical list of foods usually consumed during lunch (p=0.020)

Foods consumed during lunch (at least 3 times a week)	% person	
	MCI group	n-MCI group
soups	79.57	82.20
meat dishes	78.49	86.67
vegetable salads	55.91	68.90
potatoes	52.26	66.70
cereal products. rice. groats. pasta	20.00	31.18
fish	19.35	28.89
compotes. fruit or vegetable juices	18.28	15.60
pancakes. croquettes. fritters	16.13	8.90
boiled vegetables	13.98	13.30
eggs (in various forms)	11.83	8.90
bread	10.75	8.90
fruits	8.60	13.30
milk. yogurt. kefir	4.30	2.20
desserts	3.23	2.20

Table 4. Hierarchical list of foods usually consumed during dinner (p=0.288)

Foods consumed during dinner (at least 3 times a week)	% person	
	MCI group	n-MCI group
bread	74.19	71.10
meat, cold cuts	71.10	56.99
tea, coffee	56.99	71.10
cottage and homogenised cheese	27.96	26.70
milk, yogurt, kefir	24.73	23.40
fruits or vegetables	23.66	24.44
eggs (in various forms)	22.58	24.44
yellow cheese	21.51	24.44
hot dishes	20.43	22.20
jam, marmalade, honey	13.98	11.11
fish	5.38	13.40
fruit or vegetable juices	3.23	4.40

similar percentage of respondents in both groups usually consumed other foods during dinner (p=0.941).

Overall. it was shown that among participants with MCI, a significantly smaller percentage of respondents consumed the low-fat dairy products (milk, yogurt, kefir, cottage cheese and homogenized cheese (p=0.001) and total vegetables (p=0.034), as well as cereal products (p=0.001) and fish (p=0.007). At the same time, this group was characterized by a higher consumption of high-fat and sugar products (p=0.010). The consumption of fruits and fruit or vegetable juices was similar in both groups (p=0.608).

Quantitative differences were found between study groups in the foods typically consumed for breakfast (p=0.010) and lunch (p=0.02) (results not shown).

Next, the potential relationships between dietary quality indicators (pHDI and nHDI) and socio-demographic data were examined. Tables show the relationship between the health-promoting diet index (pHDI) (Tab. 5) and non-healthy diet index (nHDI-8) (Tab. 6) and age, education, place of residence, financial status, and body mass index, or number of meals consumed.

Table 5. Relationship between the health-promoting diet index (pHDI-8) and socio-demographic data for persons with MCI

	Prohealthy diet index pHDI-8	
	Men; n=54	Women; n=47
Age	p = 0.187; r = – 0.133	p = 0.401; r = – 0.149
Education	p = 0.191; r = – 0.131	**p = 0.024; r = – 0.282**
Place of residence	p = 0.486; r = 0.005	**p = 0.008; r = – 0.318**
Financial status	**p = 0.031; r = 0.274**	p = 0.335; r = 0.081
BMI	p = 0.084; r = 0.205	p = 0.296; r = 0.110
No. of meals	**p = 0.048; r = 0.245**	p = 0.231; r = 0.028

Table 6. Relationship between the non-healthy diet index (nHDI-8) and socio-demographic data for persons with MCI.

	Non-healthy diet index nHDI-8	
	Men; n=54	Women; n=47
Age	p = 0.476; r = 0.009	p = 0.292; r = – 0.076
Education	p = 0.396; r = 0.039	p = 0.139; r = 0.150
Place of residence	p = 0.307; r = 0.076	p = 0.083; r = 0.192
Financial status	p = 0.079; r = 0.209	p = 0.065; r = 0.209
BMI	p = 0.210; r = 0.120	p = 0.246; r = 0.096
Number of meals	p = 0.336; r = – 0.063	p = 0.437; r = 0.022

A relationship was shown between the healthy diet index (pHDI) and the place of residence (r=-0.318; p=0.008) and education (r=-0.282; p=0.024) of women with MCI, and between pHDI and financial status (r=0.274; p=0.031), and number of meals consumed (r=0.245; p=0.048) in men (Tab. 5).

No relationship was found between the unhealthy diet index (nHDI-8) and the examined socio-demographic data for people with MCI (Tab. 6).

DISCUSSION

The presented study assessed basic dietary habits, dietary patterns and diet, and their relative associations in patients with cognitive impairment and possible dementia (MCI group) diagnosed by the MoCA screening test. These data were collated and compared with people who showed no signs of cognitive decline (n-MCI group). As shown in Table 2, there were no differences in the basic socio-demographic data between the two groups. Socio-demographic characteristics are a combination of social and demographic factors determining primarily the socio-economic status of participants (SESP), as well as gender and age. SESP, among others, consists of an individual's educational level, living environment and financial status. The results of the population study indicated that SESP was related to health outcomes [6]. Individuals with low SESP have been reported to have poorer general health status, a lower life expectancy, and an increase in chronic conditions, including mental disorders and cognitive deficits [7, 8]. The lack of differences between the study groups is important because it may indicate that the cause of cognitive disorders in the NCI group was not of a socio-economic nature.

Recently, there has been increasing interest in the critical role that dietary patterns, rather than any single nutrient, play in cognitive function and dementia. Dietary patterns are the quantities. proportions, varieties and combinations of different foods and beverages in the diet, as well as frequency of habitual consumption [9]. Therefore. the study presents a hierarchical list of the most frequently consumed foods during main meals by patients with cognitive impairment and possible dementia (MCI group). These eating behaviours as a dietary patterns were compared with the dietary patterns of cognitively healthy people. This was to demonstrate whether there were any dietary patterns and dietary components that significantly distinguish the two study groups.

To date, little is known from the literature about the association between dairy consumption and cognition. In general, higher consumption of milk or dairy products is associated with better overall cognitive function, and a reduced likelihood of vascular dementia and cognitive impairment, although the results are inconsistent [10]. The reason for the inconsistent results was that it focused on the association of overall dairy consumption with the risk of cognitive decline, without distinction between types of dairy products or fat content, and quantity of intake. Therefore. measuring dairy intake must be specific in terms of type, fat content and quantity consumed. Moreover, the influence may differ depending on the cognitive function subscale. For example, the B-PROOF Study indicated that higher intake levels of fermented dairy, skimmed dairy, buttermilk and cheese were associated with better executive functioning scores and better information processing speed scores. No associations were observed, however, between dairy consumption and attention, working memory or episodic memory [11]. There is also data from the PREDIMED-Plus Cohort study in which no associations were observed on the association between low-fat milk, yogurt, cheese, and fermented dairy intake, and changes in cognitive performance [12].

In the MCI group in the presented study, a significantly smaller percentage of respondents were found who consumed low-fat dairy products, such as milk, yogurt, kefir, cottage cheese, and homogenised cheese. At the same time, this group was characterized by a higher consumption of high-fat and sugar products. These results partially confirm the conclusions of the study from the B-PROOF Study.

Nevertheless. the existing evidence is not sufficient to conclude that low-fat milk and dairy product intake and avoiding high-fat products contribute to a reduced risk of cognitive decline [12].

A hierarchical list of foods usually consumed mainly during lunch shows that the important percentage differences between groups were found in the consumption of total vegetables, cereal products and fish, which were more often consumed by n-MCI people. Another characteristic of people from the MCI group was a very low percentage of respondents consuming fish dishes which are very beneficial for health due to their nutritional value. In the current study, the proportion of MCI to n-MCI people consuming fish was 19.35% to 28.89% for lunch, and 5.38% to 13.4% for dinner. In addition, the consumption of fruit, and fruit or vegetable juices, was similar in both groups.

The diet of the n-MCI group largely corresponded to the Mediterranean diet (MD). where unrefined carbohydrates, starches, fruit, vegetables and fish are consumed a few times in a week. However, in contrast to MD, both groups had a high consumption of meat dishes. Many studies have shown that greater adherence to this diet is linked to a low risk of cognitive decline and a lower prevalence of dementia [13]. Also, these data are consistent with studies by other authors. A review of the long-term prospective cohort studies found both a decreased risk of dementia or cognitive decline in people with high consumption of vegetables and their significant associations with specific vegetables. Interestingly, these studies did not find an association between fruit intake and the risk of cognitive decline or dementia [14].

Specific dietary patterns and a healthy diet may protect against mild cognitive impairment. There is evidence that a higher intake of healthy foods as well as a balanced diet (for example MD) is a powerful potential method for reducing the cognitive Impairment [13].

Mechanisms such as oxidative stress and free radical damage, neuro-inflammation and vascular dysfunction contribute to the development of neurological diseases and cognitive decline. On the other hand, there is evidence that nutrition may be an important modulator of these processes, reducing the burden of cognitive decline. In addition, due to various genetic or environmental factors, these mechanisms may aggravate pathological conditions [13]. Therefore. specific dietary patterns and foods are included in the MD diet [15], Nordic Diet [16], and the Dietary Approaches to Stop Hypertension (DASH) Diet [16], which may help maintain cognitive function due to the high amounts of Eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and omega-3 fatty acids present in fish, as well as antioxidants, mineral salts (phosphorus, calcium, magnesium, potassium, iron, zinc and copper), vitamins (thiamine, riboflavin, niacin, pyridoxine, biotin, folic acid, and vitamins A and E), as well as other bioactive compounds present in fruit, vegetables and cereal products. This was also confirmed in research by the authors of the current study [13].

The most novel asspect of this study was the calculation of the health-promoting diet index (pHDI) and non-healthy diet index (nHDI-8) scores for MCI patients, based on the Questionnaire of Eating Behaviour which examined the respondents' basic eating habits. The interpretation of both indices is intuitive – the higher the diet index value, the greater the intensity of features favourable or unfavourable for health.

It was found that the values of both pHDI-8 and nHDI-8 as indicators of the quality of the diets in MCI as in the n-MCI patients were at a similar low levels. This indicates that the intensity of features beneficial or unfavourable for health used in the diet shown in the QEB survey for both MCI and n-MCI was weak.

When examining the potential relationships between dietary quality indicators (pHDI and nHDI-8) and the examined socio-demographic data, positive correlations were found between the healthy diet index (pHDI-8) and the place of residence and education in women with MCI, and between pHDI-8 and the financial status and number of meals consumed in men.

Generally, much research has suggested an association between lower socio-economic status (SES) and the quality of nutrition. However, the influence of different SES indicators, including education and subjective financial status or placement, on dietary behaviours remains unclear. It is well known that the association between education and dietary behaviours may be modulated by another aspect of SES – the financial status or place of residence associated with lifestyle-related factors. Education may not always affect dietary habits; for example, it was found that an unhealthy diet associated with lifestyle-related factors was observed in people across both low and high educational levels [13].

CONCLUSIONS

Dietary habits may be an essential modulator affecting diet-related cognitive decline. One hopes that their identification will allow opening the use of new approaches for the management of the prevention and treatment of patients with mild cognitive disorders and maintaining a good quality of life.

The study compared dietary patterns and nutrient intake between healthy and MCI patients and showed that among participants with MCI, a significantly smaller percentage of respondents consumed the low-fat dairy products (milk, yogurt, kefir, cottage cheese and homogenized cheese), and total vegetables, as well as cereal products and fish. At the same time, this group was characterized by a higher consumption of high-fat and sugar products.

According to the findings of the study, dietary behaviours based on diets low in saturated fats but rich in n-3 polyunsaturated fatty acids, as well as vitamins and bioactive substances, may be useful in preventing MCI. These are health behaviours known among people following the Nordic Diet from a northern cultural environment, or the MD diet from Southern Europe.

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