

# Promoting health and preventing non-communicable diseases: evaluation of the adherence of the Italian population to the Mediterranean Diet by using the PREDIMED questionnaire

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## Abstract

A health promotion program was conducted in the Veneto Region in Italy. Participants were screened for non-communicable diseases and were referred to the nutrition clinic. The aim of this study was to assess the adherence to the Mediterranean diet in the Italian population by using the “PREvención con DIeta MEDiterránea” questionnaire.

The data showed that 63% of the participants were overweight, 57% presented hypercholesterolemia, 36% were hypertensive and 43% had high blood glucose levels. The results highlighted a low consumption of protective foods against non-communicable diseases such as fruit, vegetables, fresh fish, legumes and oily dried fruit. Overall, only 6% of the subjects who visited the nutritional clinic had the maximum adherence to the Mediterranean diet, 73% had an average adherence, followed by 21% with low adherence. Multivariable analysis between risk factors and socio-demographic characteristics and the adherence to Mediterranean diet revealed that male gender relates directly ( $p = 0.002$ , AOR = 2.95) to a low adherence.

There are three criteria in the questionnaire for a point in favour of Mediterranean diet which we believe to be inadequate, as they are not in accordance with the Italian guidelines for healthy eating. The “PREvención con DIeta MEDiterránea” questionnaire, if associated with a food frequency questionnaire or a food intake record, could become a useful tool for nutritional counseling in our Country.

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## Introduction

Non Communicable Diseases (NCD) such as cardiovascular diseases, type 2 diabetes mellitus, cancer and chronic respiratory diseases, represent an important global public health problem due to their high hospitalization rates, treatment costs and impaired quality of life (1).

In Italy NCDs are responsible for 91% of the mortality rate, significantly higher than the world mortality estimate for NCDs (71%) (2).

The Mediterranean Diet (MD), rich in olive oil, nuts, fruits and vegetables, whole grains and pulses, low-fat dairy, fish, moderate alcohol amounts and limited quantities of red meat and sweets represents the basis of the dietary pattern in a healthy population and was shown to be a natural supplemental resource for athletes (3).

MD has been amply recognized for its importance in the prevention, treatment and management of NCDs, along with the practice of regular physical activity (4). Many randomized controlled clinical trials have shown that together they are effective in the prevention of NCDs by countering risk factors such as low-grade of chronic inflammation, hypertension, overweight/obesity, hyperlipidemia and hyperglycemia (5, 6).

The Seven Countries Study was the first major study to investigate lifestyle along with other risk factors for cardiovascular diseases, across different countries for an extended period of time. It was found that there was a correlation between the Mediterranean diet and a lower incidence and mortality from these pathological conditions (7).

Years later, the Spanish “PREvención con Dieta MEDiterránea” (PREDIMED) study examined the effects of the MDs among Spanish patients at high risk for the development of cardiovascular diseases and confirmed MDs to be inversely related to the metabolic syndrome (8). Moreover, studies from the European Prospective Investigation

into Cancer and Nutrition (EPIC) cohort suggested that greater adherence to a Mediterranean dietary pattern could reduce overall cancer risk (9), especially gastric cancer (10), colorectal cancer (11) and bladder cancer (12). In addition, a case study in Italy showed that the MD brought benefits to nasopharyngeal cancer risk subjects (13).

Epidemiological studies confirmed the significant protection from major chronic degenerative diseases granted by an adherence to the MD as well as a reduced risk of NCDs incidence and mortality (14).

Although it has been demonstrated that MD offers a number of health benefits, engagement in such diet is decreasing for multifactorial influences such as lifestyles changes, food globalization, economic and sociocultural factors. This reduction has caused a shift towards a “Western diet”, which is richer in saturated fat, refined grains, simple carbohydrates and processed foods (15). This phenomenon is related to the high prevalence of overweight and obesity in Countries which are supposed to follow a traditional MD, like Italy (16, 17). Studies have been investigating the adherence of MD in the Italian population in all age groups, confirming an urgent need for public health strategies aimed at counteracting its reduction. In particular, a cross-sectional study among women from Southern Italy showed that adherence to the MD is relatively low and suggested that tailored nutritional programs should also take into account more engagement in physical activity since it is considered a major positive determinant of the adherence to MD (18). NCDs are often associated with older age groups, but evidence also shows a low adherence to the MD by children and adolescents. A cross-sectional study on paediatric obesity conducted in Northern Italy investigated MD adherence in children and adolescents and found that they are more likely to have dietary behaviours close to a Western dietary pattern (19). NCDs entail significant costs that are

not limited to healthcare expenditure, but also affects labour productivity, economic prosperity and social inequalities (20). It is therefore clear that counteracting NCDs represents a public health priority.

In order to fulfil this goal, it is important to identify an accurate and reliable instrument to assess MD adherence.

A study was conducted to assess the validity of a new short self-administered 15-item questionnaire “Questionnaire Mediterranean Diet” in measuring adherence to the Mediterranean diet in Italy. The study concluded that it could be a useful tool to assess adherence to the Mediterranean diet in the Italian population (21).

In this regard, in Italy a health promotion program was conducted in the Veneto Region to assess the adherence to the Mediterranean diet in the Italian population by using the validated 14-item PREDIMED questionnaire which was used previously in the PREDIMED study.

## Methods

The Train of Health<sup>1</sup> is a health promotion intervention aimed at assessing the prevalence of NCDs risk factors and promoting health by implementing targeted counselling. The duration of the study was one month, May 2019. The train stopped at the stations of the Veneto Region of Venice, Padua, Rovigo, Bassano del Grappa, Treviso, Belluno, Portogruaro, Verona and Vicenza. The train was structured in five carriages: the first two devoted to the promotion of health in a school setting, the third dedicated to College for Aspiring Missionary Doctors (CUAMM) activities, the fourth focused on

the screening NCDs risk factors via measurement of weight, height, Body Mass Index (BMI), blood pressure, cholesterolemia and glycaemia, and the fifth dedicated to the counseling clinics regarding nutrition, physical activity, cigarette smoking and cancer screening. In the fourth carriage, participants were asked to fill in a questionnaire which requested their demographic characteristics and lifestyle habits. On the basis of this form, the visitor was referred to the counseling clinic that best suited the risk factors screened.

A total of 1,401 subjects participated to the intervention, and 334 of them were referred to the nutritional clinic. Participation was voluntary and the study complies with the Declaration of Helsinki. Data were treated with full confidentiality, in accordance with the Italian legislation. Written informed consents were obtained and collected separately from information on participants' characteristics, in order to ensure the anonymity of the data.

Within the nutrition clinic, data were collected by compiling the PREDIMED questionnaire. This is a 14-item questionnaire concerning the consumption frequency of foods characteristic of the MD as well as foods typical of the Western diet. Each answer was assigned a score: 0 and 1 (table 1). The adherence to the MD of each participant was calculated by adding the score (0 or 1) given to each of the responses to the questionnaire. The total sum of the score assigned to each answer leads to the following result: low adherence = score from 0 to 5, average adherence = score from 6 to 9 and maximum adherence = score  $\geq 10$ . Percentages of participants for each item of the questionnaire were calculated. Moreover, the categories of each risk factor were compared with the three levels of adherence to the MD by evaluating the percentages. The chi-square test ( $\chi^2$ ) was used in order to analyze the frequency distribution of the variables investigated; the level of statistical significance is indicated by the value of  $p \leq 0.05$ .

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Table 1 - Questionnaire PREDIMED and criteria for 1 point

1. Do you use olive oil as main culinary fat?	Yes	No		Yes
2. How much olive oil do you consume in a given day (including oil used for frying, salads, out-of-house meals, etc.)?	0-1	2-3	≥4	≥4 tbsps
3. How many vegetable servings do you consume per day? (1 serving: 200g; consider side dishes as half a serving)	0	1	≥2	≥2
4. How many fruits units (including natural fruit juices) do you consume per day?	0-1	2	≥3	≥3
5. How many serving of red meat, hamburger, or meat products (ham, sausage, etc.) do you consume per day? (1 serving: 100-150 g)	0	<1	≥1	<1
6. How many servings of butter, margarine, or cream do you consume per day?	0	<1	≥1	<1
7. How many sweet or carbonated beverages do you drink per day?	0	<1	≥1	<1
8. How much wine do you drink per week? (1 glass: 125 ml)	0-3	4-6	≥7	≥7
9. How many serving of legumes do you consume per week? (1 serving: 150 g)	0-1	2	≥3	≥3
10. How many servings of fish or shellfish do you consume per week? (1 serving 100-150 g of fish or 4-5 units or 200 g of shellfish)	0-1	2	≥3	≥3
11. How many times per week do you consume commercial sweets or pastries (not homemade) such as cakes, cookies, biscuits, or custard?	0-1	2	≥3	<3
12. How many servings of nuts (including peanuts) do you consume per week? (1 serving: 30 g)	0-1	2	≥3	≥3
13. Do you preferentially consume chicken, turkey, or rabbit meat instead of veal, pork, hamburger, or sausage?	Yes	No		Yes
14. How many times per week do you consume vegetables, pasta, rice, or other dishes seasoned with sofrito (sauce made with tomato and onion, leek, or garlic and simmered with olive oil)?	0	1	≥2	≥2

Afterwards, the risk factors whose frequency distribution showed to be statistically significant were entered into a logistic regression model together with socio-demographic characteristics. Adjusted Odds-Ratios (AORs) and relative 95% confidence intervals were calculated. The analyses were performed with the “IBM SPSS version 23” software.

## Results

### *Participants’ characteristics*

The missing percentage fractions indicate participants for whom there are no data available. Table 2 presents the percentages of participants classified according to their

demographic characteristics and related risk factors. 334 participants were analysed, 46% of whom were male and 51% were female. The majority of participants were people aged 51-65 years (38%), of Italian nationality (83%), employed (50%) and high school graduates (45%). 63% of the participants were overweight, 80% declared not to smoke. 57% presented hypercholesterolemia (22), 36% were hypertensive (23) and 43% had high blood glucose levels (24).

### *Results of PREDIMED questionnaire*

The results of the questionnaire showed that 90% of the participants used extra virgin olive oil as the main cooking fat and 84% habitually consumed it from 0 to 3 portions per day. 94% consumed less than one serving

Table 2 - Participants characteristics' and related risk factors

<b>Participants characteristics</b>	<b>%</b>	<b>Risk factors</b>	
<b>Gender</b>		<b>Weight</b>	
Males	46	Normal weight	37
Females	51	Overweight	40
Unknown data	3	Obesity	23
<b>Age group (years)</b>		<b>Smoke</b>	
18-35	17	Non Smoker	80
36-50	18	Smoker	7
51-65	38	Quit smoking	8
66-80	21	Unknown data	5
80+	2	<b>Cholesterolemia</b>	
Unknown data	4	Normal	28
<b>Nationality</b>		Moderately high	12
Italian	83	High	45
Foreigner	10	Unknown data	15
Unknown data	7	<b>Blood pressure</b>	
<b>Employment</b>		Normal	46
Retired	24	Hypertension	36
Employed	50	Isolated systolic hypertension	13
Unemployed	5	Unknown data	5
Student	6	<b>Fasting blood glucose</b>	
Housewife	6	Normal	43
Unknown data	9	Impaired fasting glucose	34
<b>Education</b>		Type 2 diabetes	9
Degree	18	Unknown data	14
High school diploma	45		
Middle school diploma	17		
Elementary school diploma	8		
Unknown data	12		

per day of seasonings such as butter, margarine and cream. As for soffrito (a mixture of minced onions, carrots and celery fried in virgin oil), 44% used it more than 2 times a week to season dishes. 55% of the participants consumed more than 2 portions of vegetables per day and 19% consumed more than 3 portions of fresh fruit. As for oily dried fruit, only 23% consumed more than 3 servings per week. Regarding meat, 75% of participants did not consume it daily and 74% of those who consumed it daily preferred white over red meat. 17% of the participants consumed more than 3 portions per week of legumes, while for fish and seafood the percentage was 15%. The sweet and/or

carbonated beverages were not consumed daily by 87% of the participants, whereas for the ready-made desserts, 43% consumed more than 3 portions per week. 87% of the participants consumed from 0 to 6 glasses of wine. Overall, only 6% of the subjects who visited the nutritional clinic showed maximum adherence to the Mediterranean Diet, 73% had an average adherence, followed by 21% with a low or nul adherence. Table 3 shows the percentage distribution of adherence to MD by risk factor category and their related p-values. Table 4 reports the multivariable analysis which associates risk factors and socio-demographic characteristics with the adherence to MD. Among the risk

Table 3 - Percentage distribution of adherence to MD by risk factor category and related p-values

Risk factors	Low adherence %	Average adherence %	Maximum adherence %	P-value
Weight				0.03
Normal weight	22	69	9	
Overweight	25	70	5	
Obesity	13	86	1	
Smoke				0.95
Non Smoker	20	74	6	
Smoker	36	64	-	
Quit smoking	15	77	8	
Cholesterolemia				0.44
Normal	24	70	6	
Moderately high	25	75	-	
High	19	74	7	
Blood pressure				0.03
Normal	21	77	2	
Hypertension	22	70	8	
Isolated systolic hypertension	16	70	14	
Fasting blood glucose				0.57
Normal	23	69	8	
Impaired fasting glucose	20	76	4	
Type 2 diabetes	16	81	3	

factors analysed, only “weight” and “blood pressure” have been considered, since they are characterized by a p-value < 0.05. Lower adherence to the MD was observed among males ( $p = 0.002$ , AOR = 2.95), however the two risk factors investigated do not maintain their significance as shown in the bivariate analysis.

## Discussion

Individually, the results of the analysis demonstrated a low consumption of protective foods against NCDs, such as fresh fruit, vegetables, fish, pulses and oily dried fruit.

Multivariable analysis between socio-demographic characteristics and risk factors

with adherence to MD revealed that lower adherence to the MD was observed among males, nevertheless no other significant associations were found with other variables.

“Weight” and “blood pressure” present p-values statistically significant in the bivariate analysis, however logistic regression model found no associations with the adherence to the MD.

It is possible that some participants, considering their history of risk factors, had already improved their eating habits previously, therefore influencing the results of the questionnaire. It is not possible to conclude that there is an association without investigating beforehand whether the participants have recently changed their eating habits. A solution could be adding a question to investigate this aspect.

Table 4 - Multivariable analysis between risk factors and socio-demographic characteristics with adherence to MD

	ref.	AOR	95% CI		P value
			Lower	Upper	
<b>Participants characteristics</b>					
Gender male		<b>2.95</b>	<b>1.51</b>	<b>5.76</b>	<b>0.002</b>
Age		0.98	0.96	1.01	0.144
Foreigner		0.48	0.15	1.61	0.237
<i>Education</i>	Degree				
High school diploma		2.44	0.96	6.23	0.062
Middle school diploma		2.54	0.84	7.65	0.097
<i>Occupation</i>	Employed				0.801
Unemployed/Student/Housewife		0.97	0.40	2.38	0.951
Retired		0.72	0.27	1.92	0.506
<b>Risk factors</b>					
<i>Weight</i>	Normal				
Overweight		1.05	0.51	2.16	0.894
Obese		0.44	0.17	1.14	0.091
<i>Blood pressure</i>	Normal				0.725
Hypertension		1.17	0.58	2.36	0.672
Isolated systolic hypertension		0.77	0.26	2.23	0.624

Only significant data are bold

No associations were observed between degrees of adherence to the MD and the remaining risk factors. This is in contrast to the PREDIMED Spanish study, which found that the score derived from the questionnaire was inversely associated with all adiposity index. This could be due to three criteria for MD which are believed to be inadequate as they are not in alignment with what is reported in the Italian Guidelines for healthy eating (25). The question regarding the consumption of olive oil increases the adherence score for a quantity of 40 grams of oil per day, without considering the specific needs of the subject. Also the question about wine consumption which scores one point for MD adherence if you consume more than seven glasses per week, does not consider the direct association between harmful use of alcohol and the increased risk of

developing cancer (26). A point in favour of the MD is also assigned to the last question if the consumption of soffritto is higher than twice a week. It would be correct to modify the question assigning a positive score for how many times a week the dishes are simply seasoned with raw oil. Moreover, a further integration to the questionnaire should be the addition of a question that includes the category of fresh and aged cheeses, given their widespread consumption in the Italian population.

The main strength of this study is that it was quick and inexpensive to conduct. Nonetheless, these results must be interpreted with caution as there are major limitations in this study.

First, it was a cross-sectional study design. Therefore, it can not be used to analyze behaviour over a period of time and does

not help determine cause and effect. As a consequence, conclusions are indications for further prospective and experimental investigations. Second, in this project only the PREDIMED questionnaire was used to collect data, as opposed to the Spanish PREDIMED study that instead used it in combination with a full-length Food Frequency Questionnaire (FFQ) in order to obtain information about total energy intake and alcohol intake. Third, there is a great variability among individuals of the sample in terms of age, who can be subjected to biases that may have influenced the results. The fourth limitation regards the missing data that could be due to a lack of transcription in the database. Finally, another limit concerns the lack of a question which ensures that the participants had not recently changed their eating habits before taking part at the Train of Health.

## Conclusions

Although the majority of the participants have an average adherence to the MD, an improvement is needed in the consumption of several Mediterranean diet components in order to increase adherence in the population. The questionnaire's items provide important data and they are in line with the scientific literature regarding poor eating habits. While adherence is lower among obese individuals, adherence is higher among people with hypertension, possibly due to a change in a voluptuary habits following the diagnosis. In this direction, further investigations are desirable.

When interpreting the data it is important to consider that we only used the PREDIMED score without integrating it with a FFQ. Epidemiological studies which have investigated the Mediterranean diet adherence have mainly used the PREDIMED score with a FFQ or 24-hour recalls or 7 or 14-day record diaries to assess dietary habits

more comprehensively. Therefore, despite the PREDIMED score has been validated and used in epidemiological surveys, its reliability in assessing the adherence to the Mediterranean dietary pattern without FFQ or a food intake record should be more thoroughly investigated.

Moreover, there are criteria for a point in favour of MD which are in contrast with the Italian Guidelines for healthy eating. We believe they should be taken into further consideration since they influence the sum of the score, thus modifying the results.

Despite the study limitations, we conclude that the PREDIMED questionnaire, if associated with a FFQ or a food intake record, could be a useful tool for nutritional counselling due to its rapid estimation of adherence to the Mediterranean diet.

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## Riassunto

*Promuovere la salute e prevenire le malattie croniche degenerative: valutazione dell'aderenza alla Dieta Mediterranea in un campione di popolazione italiana tramite il questionario PREDIMED*

Viene presentato un intervento in ambito di promozione alla salute all'interno di un treno nella Regione del Veneto in Italia. I partecipanti sono stati selezionati in base ai fattori di rischio per le malattie croniche degenerative e sono stati indirizzati all'ambulatorio nutrizionale. Lo scopo di questo studio è stato di valutare l'aderenza alla dieta Mediterranea da parte di un campione di popolazione italiana tramite l'utilizzo del questionario "PREvención con Dieta MEDiterránea". I dati mostrano che il 63% dei partecipanti è sovrappeso e obeso, il 57% presenta ipercolesterolemia, il 36% è iperteso e 43% ha livelli alti di glicemia a digiuno.



Dai risultati si può vedere come vi sia un basso consumo di alimenti protettivi nei confronti delle malattie croniche degenerative come frutta, verdura, pesce fresco, legumi e frutta secca oleosa. Complessivamente, solo il 6% dei soggetti che ha visitato l'ambulatorio nutrizionale possiede l'aderenza massima alla dieta Mediterranea, il 73% ha una media aderenza e il 21% ha una bassa aderenza. Dall'analisi multivariata effettuata tra i fattori di rischio e le caratteristiche socio-demografiche dei partecipanti con l'aderenza alla dieta Mediterranea, si può notare come il sesso maschile si comporti come "fattore di rischio" ( $p = 0.002$ , AOR = 2.95) per una bassa aderenza.

Nel questionario sono presenti tre criteri a favore della Dieta Mediterranea da considerare ai nostri fini inadeguati in quanto non si allineano con le Linee guida italiane per una sana alimentazione. Il questionario "PREvenición con Dieta MEDiterránea", se associato ad un questionario di frequenza alimentare o ad una registrazione degli introiti alimentari, potrebbe diventare uno strumento utile per le consulenze nutrizionali nel nostro Paese.

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