MEDITERRANEAN DIET AND DIETARY PROTEIN SUPPLEMENTATION AS POSSIBLE PREDICTING VARIABLES OF WEIGHT MANAGEMENT: AN UPDATE OF PROTEIN PROJECT

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ABSTRACT

Introduction: *The Mediterranean diet is known to help the prevention of several chronic diseases and excessive weight gain. However, investigations were only performed in a clinical setting and did not consider healthy and physically active individuals. The aim of this study was therefore to understand the effects of protein supplements intake on body mass index (BMI) in healthy active individuals following the Mediterranean diet.*

Materials and methods: *A face-to-face questionnaire was administered to 667 subjects, 627 living in a Mediterranean area (MD) and 40 in a non-Mediterranean area (NMD); questionnaire enquired dietary behaviors, including a comparison between dietary patterns and protein consumption between these two populations and within each population.*

Results: *Dietary patterns significantly varied between the MD and NMD populations ($p < 0.001$), although, BMI was not significantly different. The major significant differences were found between the BMI of protein supplement users and non-protein supplement users within and between the two populations ($p < 0.01$). No differences were found between the BMI of the protein supplement users of MD and NMD, while moderate differences were displayed between the non-supplement users of the two populations ($p < 0.05$).*

Conclusions*: The Mediterranean diet does not appear to affect BMI. However, BMI significantly differed between protein supplement users and non-protein supplements users indicating a direct influence of such products on body weight and consequently BMI.*

Key words*: Protein project, questionnaire, supplements, dietary patterns, health.*

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Introduction

The traditional Mediterranean diet (MD) has been defined as that dietary pattern adopted by the inhabitants of the Mediterranean area before the 1960s[(1)]. Such dietary regimen is characterized by a high consumption of vegetables, legumes, fruits, nuts, cereals, olive oil and fish with moderate consumption of dairy products and low intakes of meats[(2)].

This particular nutritional pattern was first adopted due to the poor economic status of the Mediterranean population, as meat and poultry was too cost expensive unlike locally grown vegetables and fruits[(3)]. The mean macronutrient composition of this kind of diet has a moderate to high intake of lipids (30-40%), with a high prevalence of mono- and low saturated fats[(4)]. Carbohydrates (CHO) contribute between 40 and 55% to the caloric intake and mainly originate from complex CHOs, which show a

relatively low glycemic load. The remaining proportion is covered by protein intake[5]. Over the last decades the MD has been studied mainly under clinical and medical conditions and it was found to be effective in reducing: 1) morbidity and mortality of cardiovascular diseases, 2) peripheral artery diseases, 3) the occurrence of the metabolic syndrome and 4) obesity[6-8]. With particular regards to the effectiveness of such dietary regimen for weight loss, various authors such as Greco et al[9], Grosso et al[10] and Bekkouche et al (11) stated that after a period of adherence to the MD, body weight (BW) and consequently Body Mass Index (BMI), significantly decreased. However, to-date there is some inconsistency evident in the literature when applying these findings to healthy physically active individuals. Another factor that is known to influence BW is protein supplementation. Some authors state a reduction in BW after the consumption of such nutritional components[12-15]. Conversely, Eisenberg et al[16] demonstrated that adolescents using protein supplementation had greater BMI values compared to their non-user counterpart, a finding that is also supported by Arnberg et al[17].

Based on these conflicting findings, the aim of this study was to understand whether and to what extent the MD and protein supplement intake influences values of BMI in two populations of healthy and physically active subjects, one who adhered to a Mediterranean dietary pattern and one who followed a different dietary pattern.

Materials and methods

Participants

Permissions to conduct a survey were obtained from the managers of a representative number of commercial gyms located in Italy (Palermo and Pavia) and in Poland (Danzica). In Italy, suitable gyms were identified using a database of the CONI register (National Olympic Committee Register for Sport and Fitness Associations) while gyms in Poland were identified randomly through a sealed envelope method. To reduce heterogeneity and number of aerobic activities only gym attendees taking part in strength training courses (Gym, functional fitness, weightlifting, etc.…) were included for this investigation. Gym users performing aerobic activities were consequently excluded. Based on these inclusion/exclusion criteria, 667 participants were retained for the present investigation; 627 from the MD[18-20] and 40 from NMD.

Subjects' ages ranged from 13 to 68 years old (table 1). The gender-split resulted in 502 male and 165 females subjects out of which 189 male and 38 female subjects declared to use protein supplements.

Questionnaire procedure

As in our previous works[18, 19, 21], the face to face interview method was adopted[22] to evaluate the frequency consumption of protein supplements amongst participants, dietary behaviors and other related information. Easy understandable definitions of the supplements (common and commercial names of products or substances included within the definition of supplement: product intended to supplement the diet that contains one or more dietary ingredients[23]) and foods were provided to participants. The completion of the questionnaire indicated the agreement of the gym user to participate in the study. According to the Italian and Polish regulations, ethical approval was not required for this study. The same investigator for each area administered the questionnaire over a period of ten months.

Definition procedure

According to Trichopoulou et al[4] the MD can be defined as a high prevalence of vegetables, fruits and nuts, legumes, and unprocessed cereals intake and a low intake of meat and meat products and dairy products (with the exception of cheeses). Total intake of lipids can be high (around 40% of total energy intake, as in Greece), or moderate (around 30% of total energy intake, as in Italy) but, the overall ratio of beneficial mono unsaturated to non-beneficial saturated lipids is high (due to the high mono unsaturated content of used olive oil). MD can also be expressed through the use of a pyramid such as that of Willet et al[24]. The non-Mediterranean diet presented in this study is typical for Central and Eastern Europe. It is characterized by consumption of sugar and saturated fatty acids as well as a low intake of fruits and vegetables[25-27].

Data analysis

Data analysis was performed using the EpiInfo software version 7.0 (CDC, Atlanta, GA, US) and the STATISTICA software 8.0 software for Windows (Tulsa, OK, US). The descriptive analysis was performed by calculating the means and standard deviations (SD). Frequency of weekly food intake was assessed and the chi-square test was per-

formed in order to verify differences between dietary patterns of both populations; subsequently differences between BMI of MD and NMD groups were assessed through an unpaired t-test. The comparisons were made between groups and within groups, stratifying each sample for protein supplement and non-protein supplement users. Statistical significance was set at a P value < 0.05.

Results

Participants

The anthropometric characteristics of participants are described in table 1.

	Age (years)	Height (Cm)	Weight (Kg)	BMI	Gender (M/F)
Mediterranean	28±9.9	174±9	72.5±12.6	23.9±3.1	480/147
Non-Mediterranean	29±7.1	175±9	74.1±16.1	24.1±3.5	22/18
p	Ns	Ns	Ns	Ns	n/a

Table 1: Anthropometric characteristics of participants. *Ns = Not significant, n/a = Not applicable.*

Dietary patterns

Dietary patterns significantly varied between the analyzed populations (tables 2, 3 and 4). MD population declared a high consumption of MD key foods[3] (3 times per week or more) whereas in the NMD population an inverse trend is shown. Although, no differences in BMI are shown between the MD group and the NMD group, respectively.

Frequency per week	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Foods								
Bakery	33.41	13.1	11.14	8.73	4.59	22.05	0.66	6.33
Chicken	3.28	16.38	27.07	27.07	11.35	11.14	0.87	2.84
Cheese	15.5	11.57	21.83	21.4	9.17	14.19	0.87	5.46
Cold cuts	23.58	20.09	19.87	15.07	8.08	9.17	1.53	2.62
Fresh Fish	11.57	34.5	31.88	13.97	5.46	1.97	0.66	0
Legumes	15.28	23.58	26.42	18.56	8.3	7.21	0	0.66
Meat	5.02	13.32	27.51	30.13	10.26	9.17	2.18	2.4
Milk	22.27	5.9	5.46	8.52	2.84	34.5	1.31	19.21
Nuts	63.54	15.5	9.83	4.59	1.09	3.93	0.22	1.31
Canned Tuna	30.13	26.64	21.62	10.7	4.59	4.8	0.44	1.09
Eggs	17.25	33.84	28.6	11.79	2.62	3.93	0	1.97
Yogurt	40.83	9.61	11.35	11.79	5.02	13.97	0.87	6.55

Table 2: Percentage of food consumption of the Mediterranean area (n=627).

Frequency per week	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Foods								
Bakery	15	5	7.5	15	5	15	7.5	30
Chicken	7.5	2.5	17.5	25	17.5	10	5	15
Cheese	7.5	2.5	17.5	22.5	22.5	12.26	1.89	7.55
Cold cuts	16.98	12.26	18.87	17.92	12.26	17.5	0	10
Fresh Fish	22.5	15	17.5	10	10	2.5	2.5	20
Legumes	10	35	40	5	2.5	2.5	0	5
Meat	12.5	28.5	18	10	10	5	2.5	12.5
Milk	22.5	2.5	10	15	2.5	20	2.5	25
Nuts	27.5	17.5	20	10	5	2.5	0	17.5
Canned Tuna	15	22.5	17.5	17.5	15	2.5	5	5
Eggs	2.5	2.5	15	7.5	7.5	20	5	40
Yogurt	17.5	10	15	10	5	12.5	5	25

Table 3: Percentage of food consumption of the Non-Mediterranean area (n=40).

Food	***p***	**$\chi 2$**
Bakery	<0.001	182.53
Chicken	<0.001	95.85
Cheese	<0.001	33.79
Cold cuts	<0.001	37.53
Fresh Fish	<0.001	38
Legumes	<0.001	59.91
Meat	<0.001	89.63
Milk	0.006	19.62
Nuts	<0.001	252.45
Canned Tuna	<0.001	99.34
Eggs	<0.001	858.61
Yogurt	<0.001	86.52

Table 4: Comparison of dietary patterns between the Mediterranean and Non-Mediterranean population.

Protein consumption

A number of 201 subjects from the MD sample and 26 from the NMD sample declared to use protein supplements. BMI of MD and NMD stratified for protein users was 24.34±2.99 and 25.36±3.48, respectively; BMI of MD and NMD stratified for non-protein users was 23.65±3.19 and 21.61±3,49, respectively. Differences are shown in table 5.

Comparisons	*p*
BMI MD vs. BMI NMD	Ns
BMI pro vs. BMI No pro	< 0.001
BMI MD pro vs. BMI MD No pro	< 0.05
BMI NMD pro vs. BMI NMD No pro	< 0.001
BMI MD pro vs. BMI NMD pro	Ns
BMI MD No pro vs. BMI NMD No pro	<0.05

Table 5: Differences of BMI between groups.
BMI = Body Mass Index; MD = Mediterranean Diet; NMD = Non-Mediterranean Diet; pro = protein supplement users; No pro = Non-protein supplement users; Ns = Not significant.

Discussion

The questionnaire was intended to retrieve data from a MD and NMD area in order to understand the differences between dietary patterns, with particular interest in MD, and how the intake of protein supplements affects the BMI. Our manuscript presents many biases and limitations and we strongly believe that it can be considered only an interesting update of Protein Project, with stimulating inputs for professionals working on the field of sport nutrition and sport performance. Prior to jump to all positive evidences we want to highlight, in details, what we retain the main limits of this investigation. 1) Even though the comparison of food frequency has permitted to identify a Mediterranean like pattern of dietary habits, people living in the Mediterranean area do not necessarily consume a Mediterranean diet. 2) No predictors of weight management and no determinants of health-related quality of life have been studied. 3) The sample of participants coming from Poland cannot be considered statistically relevant to accomplish conclusions or interpretations.

The main outcomes highlight no differences in BMI between those subjects that used the MD (of both the MD and NMD areas) or the NMD group; whilst after a further stratification, significant differences in BMI were found between supplement and non-supplement users. This emphasizes that higher BMI values for the supplement users might be related to their quality of life (dietary behavior, kind of training stimulus and so on). Our results furthermore demonstrate that the use of other diets (mainly rich in proteins or zone diets) also appear to control and manage weight as results did not identify a significant difference the MD and the NMD groups, despite a significant difference in the nutritional composition of the analyzed diets (table 4).

Other strategies could therefore be suggested to be as equally effective in weight loss and weight management as the MD. However, when compared for example to a low fat diet it is the MD diet which has been demonstrated to be more beneficial in reducing markers for cardiovascular diseases[28]. Mayneris-Perxachs et al.[29] for example recently showed a change in lipid profiles in patients suffering with the metabolic syndrome after a one-year MD intervention, despite no changes in body weight. The interesting role of MD in weight management is furthermore confirmed by Roccaldo et al.[30].

The MD due to its composition has a low energy density and also a relatively low glycemic load[31] compared to other dietary patterns. The high proportion of fruit and vegetables furthermore provide higher water content, which leads to an increase in satiation and lower calorie intakes, thus facilitating a positive weight management. Other physiological explanations, which could elucidate the reason of the MD protecting mechanisms of weight, gain and/or weight loss can be suggested by plant-based foods that provide a large quantity of dietary fiber. These have been shown to increase satiety and satiation[32]. The effectiveness of the MD in weight management that arises from numerous studies may be due to the fact that these were performed in overweight and obese subjects with an intention of reducing the caloric intake to reduce the subjects BW[33, 34].

A main concern regarding the presented results was the difference in BMI values between all the protein and non-protein supplement users. Recent research, which investigated protein supplementation, in general, demonstrated no weight gains or weight losses[12, 13, 35-37-39]. These studies were however longitudinal and considered the long-term effects of the consumption of such nutritional components. There are still uncertainties in scientific literature regarding direct comparisons of baseline anthropometric or metabolic parameters between supplement users and non-supplement users in healthy populations and further studies can be suggested which deeper will investigate on that direction. In conclusion, The MD compared to other dietary regimens does not seem to show any base-

line difference regarding BMI values in healthy active individuals. Apart from dietary patterns, the intake of protein supplements seems to be a determinant factor for a positive weight management. A direct comparison between protein and non-protein users showed higher BMI values in MD group. These findings could be of interest for nutritionists involved in the treatment of underweight individuals or athletes.

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