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Does Mediterranean Diet Alone Lower the Risk of Diabetes?

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ABSTRACT

In Lebanon, Type 2 diabetes (T2D) has a major public health impact through high disease prevalence, significant downstream pathophysiologic effects, and enormous financial responsibilities. Diet is an important environmental factor in the development and prevention of T2D. This study aimed to investigate the association between the adherence to the Mediterranean diet and the risk of T2DM in Lebanese non-diabetic men and women and to compare the adherence to the Mediterranean Diet among non-diabetic versus diabetic as well as to validate the Arabic version of a 14-point Mediterranean Diet Adherence Screener (MEDAS) questionnaire. This cross-sectional study was conducted in the greater area of Beirut region. Study subjects were 150 diabetic and 150 non-diabetic aged ≥40 years. They were matched by age and gender. The level of adherence to the Mediterranean Diet was identified using the MEDAS questionnaire and the risk of diabetes was identified using a short diabetes risk assessment questionnaire. Compared to Non-diabetic men, the majority of women in our population were obese (44%) and 63% of them were inactive (p=0.01).The majority of men had overweight (52%) (p=0.004). No significant differences between genders concerning body weight (p=0.002). Moreover, no significant differences between men and women concerning the family history of diabetes, the occurrence of high blood pressure or the risk of diabetes (p=0.4, p=0.6, p=0.2 respectively). The level of adherence to the Mediterranean diet among non-diabetic subjects shows no statistical differences among MEDAS score categories between genders, age categories, body weight and BMI (p>0.05). Unadjusted binary logistic regression shows that diabetic participants had low adherence to the Mediterranean diet by 0.53 times more than non-diabetic participants (OR=0. 53, 95% CI 0.288-0.994). In addition, regression shows that more than 70% of non-diabetic subjects with low adherence score had a high risk of diabetes (OR=0.35, [95% CI 0.12-1.0]) compared to those with moderate and high score. Concerning the validation of the MEDAS questionnaire, Cronbach's alpha was not statistically significant in our population. These findings confirm that lifestyle modifications provide potentially useful and relevant information on the relationship between diet and disease prevention among Lebanese adults.

Introduction

Diabetes mellitus is a worldwide public health problem and one of the leading causes of death (1). Diabetes was responsible for 342,000 deaths in 2015. Over half (51.3%) of all deaths from diabetes in the region occurred in people under 60. Four out of ten adults with diabetes in the Middle-East and North Africa are undiagnosed. Approximately 35.4 (24.3–47.4) million people, or 9.1% (6.3–12.2%) of adults aged 20-79, are living with diabetes in the Middle East and North Africa Region in 2015. Over 40.6% of these are undiagnosed (2). According to the International Diabetes Federation the prevalence of T2D in Lebanese adult population was estimated to be 15.8% and that of the projected prevalence for year 2020 is 20.4% (3).

Patients with type 2 diabetes mellitus are at a high risk of developing life-threatening complications, such as cardiovascular disease, cerebrovascular diseases, nephropathy, and blindness. Lifestyle changes as calorie-dense foods and increased portion sizes foods accompanied by a sedentary lifestyle are the main cause of the drastic increase in the incidence of type 2 diabetes in recent years (4). Currently, the Mediterranean diet is one of the most studied dietary patterns with diabetes. The Mediterranean diet was first revealed in the 1960s by the American scientist Ancel Keys based on his observation of dietary patterns in the Mediterranean region. It is a typical diet of the dietary patterns in the Mediterranean region and slightly varies among regions of the Mediterranean basin. However, the principles are the same: daily intake of vegetables, legumes, fruits and nuts, and whole grain and low fat dairy products; weekly consumption of fish, seafood, and poultry; daily fat mainly from olive oil, which is high in monounsaturated fat; low intake of saturated fats; regular but moderate intake of alcohol in the form of wine, generally with a meal; and low intake of meat and meat products (5). Two prospective studies from Southern Europe suggested a lower incidence of diabetes with increasing adherence to the Mediterranean Diet in previously healthy individuals (6) Or myocardial infarction survivors (7).

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Recently, a clinical trial showed that, compared with a low-fat diet, a Mediterranean Diet allowed better glycemic control and delayed the need for anti-diabetes drug treatment in patients with newly diagnosed diabetes (8).

The aim of this study is to evaluate the risk of developing diabetes in non-diabetic subjects based on their adherence to the Mediterranean Diet and to compare this adherence between non-diabetic subjects versus diabetic subjects. In addition, we aimed to validate the Arabic version of the MEDAS questionnaire on the study population.

Materials and Methods

Study design and population*:* This is a cross-sectional study that investigated the association between the adherence to the Mediterranean diet and the risk of T2DM in Lebanese diabetic men and women versus non diabetics in the greater Area of Beirut region. A population of 300 subjects who aged ≥40 years (150 diabetics and 150 non-diabetics) was recruited.

Diabetic subjects were previously diagnosed with T2DM and were attending the primary health care centers Haret Hreik, and Al-Makased-Beshoura for follow up of their diseases or they are outpatients visiting the outpatient department in the hospital (Sahel General Hospital) in Beirut city. Non-diabetic individuals were randomly selected from the general population and were matched to the diabetic group by age and gender so that, the number of participants in each age-group is the same in both groups and the same for gender (75 men and 75 women in each group). Recruitment for both groups took place within 5 months from February 2016 to June 2016.

The 300 study subjects where consented and interviewed then they were asked to complete the MEDAS questionnaire. The diabetes risk questionnaire was also completed by the non-diabetic study subjects in order to calculate the diabetes risk. Subjects who have any history of cardiovascular disease, severe chronic illness, drug or alcohol abuse, allergy or intolerance to olive oil or nuts and pregnant women were excluded.

Data Collection

An analysis of the medical records at the primary health care centers identified 150 diabetic patients in the age-group ≥40 years. Another population of 150 individuals in the same age group (≥40 years) was randomly selected from the same geographical area.

Study subjects were stratified into two groups: 150 having diabetes (75 men and 75 women) and 150 who are non-diabetics (75 men and 75 women). Specifically, we defined known diabetes as subjects who answered “yes” to the question “Other than during pregnancy, have you ever been told by a doctor that you have diabetes?” or reported using insulin or other anti-diabetic medications.

For medical history variables, we classified subjects as having hypertension if they reported a history of hypertension, using prescribed medication for hypertension, had a systolic blood pressure ≥ 140 mmHg, or had a diastolic blood pressure ≥ 90 mmHg. We defined hyperlipidemia if HDL-cholesterol (HDL-C) < 40 mg/dL in men or < 50 mg/dL in women, LDL-cholesterol > 160 mg/dL, treatment with hypolipidemia drugs and a family history of premature coronary heart disease.

Measurement of the adherence to the Mediterranean diet: Baseline adherence to the Mediterranean diet was measured by the Mediterranean Diet Adherence Screener (MEDAS); an adaptation of a previously validated 9-item index (9). The 14-item screener includes 5 additional items that are critical to an assessment of adherence to the traditional Mediterranean diet in the present population. Adherence to the Mediterranean diet was measured by a 14-point MEDAS. The MEDAS consists of 12 questions on food consumption frequency and 2 questions on food intake habits considered characteristic of the Spanish Mediterranean diet. Each question was scored 0 or 1. One point was given for the following options: using olive oil as the principal source of fat for cooking, preferring white meat over red meat, or for consuming: ≥ 4 or more tablespoons (1 tablespoon = 13.5 g) of olive oil/d (including that used in frying, salads, meals eaten away from home, etc.); ≥ 2 or more servings of vegetables/day; ≥ 3 or more pieces of fruit/day; ≤ 1 serving of red meat or sausages/day; ≤1 serving of animal fat/day; ≤ 1 cup (1 cup = 100 mL) of sugar-sweetened beverages/day; ≥ 7 or more servings of red wine/week; ≥ 3 or more servings of pulses/week; ≥ 3 or more servings of fish/week; ≤ fewer than 3 commercial pastries/week; ≥ 3 or more servings of nuts/week; or ≥ 2 or more servings/week of a dish with a traditional sauce of tomatoes, garlic, onion, or leeks sautéed in olive oil. If the condition was not met, no points (giving them 0) were recorded for the category. The final score ranged between 0 and 14(Data Not Shown).

Assessment of diabetes risk: A valid and short diabetes risk questionnaire (10) was used to assess the risk of diabetes among non-diabetic individuals. It consists of 6-small questions on gender (Male/Female), age (4 subgroups: < 40, 40-49, 50-59 and ≥ 60 years), presence of any family history of diabetes, presence of diagnosed hypertension, Body Mass index (BMI) and the activity level. For this study we made small modification for the questionnaire concerning the age. Instead of 4 subgroups we took only 3 subgroups (40-49, 50-59 and ≥ 60 years). Assessment of risk was based on the final score; if the score is ≥5 then the subjects is at high risk of having undiagnosed diabetes (Data Not Shown).

Anthropometric measurements: Height and weight were measured using standardized and calibrated equipment. Subjects were weighed in light indoor clothing and with bare feet or stockings. Using a stadiometer, height was measured without shoes, then Body mass index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (meters).

Statistical analysis:

Categorical variables were expressed as “N, percentages and frequencies”. Subjects were then grouped based on their scores for the Mediterranean diet adherence where subjects were categorized as having low score if they got ≤ 5 points, moderate score if between 6 and 9 points and high score if ≥ 10 points. The association between the presence or the absence of the diabetes disease and the adherence to the Mediterranean diet as well as the association between diabetes risk and the adherence to the Mediterranean diet were evaluated using chi squared test. For validation of the MEDAS questionnaire, Cronbach’s alpha was computed. Cronbach's alpha is the most common measure of internal consistency ("reliability"). It is most commonly used in a survey/questionnaire that form a scale and when we wish to determine if the scale is reliable.

Statistical analyses were performed using SPSS version 23.0(IBM, USA).

Ethics

The proposal of the study was approved by the ethical committee at the Lebanese University and the participant’s response to the initial questionnaire was considered as informed consent to participate in the study.

Results

300 subjects were recruited, 150 having diabetes (75 men and 75 women) and 150 who are non-diabetic (75 men and 75 women). Both age and gender were matched for both diabetic and non-diabetic subjects. Table 1 shows the characteristics of the non-diabetic study subjects. 44% of overall non-diabetic subjects (44% of women and 45% of men) have the highest proportion of body weight which the range was between 58 and 133 kg. Also there was a significant differences between genders concerning body weight (p=0.002). In addition, 63% of non-diabetic subjects were inactive where the majority was from women (p=0.01). Table 2 shows the risk of diabetes in non-diabetic men and women according to the diabetes risk assessment score. There were no significant differences between men and women concerning the family history of diabetes, the occurrence of high blood pressure or the risk of diabetes (p=0.4, p=0.6, p=0.2 respectively). The majority of non-diabetic women in our population were obese (44%) but the majority of non-diabetic men had overweight (52%) (p=0.004).

Table 1. Characteristics of non-diabetic study subjects.

Study variables	Overall (N=150)	Men (N=75)	Women (N=75)	P-value*
Body weight Categories				
48-100	66 (44%)	39 (52%)	27 (36%)	0.002
58-133	67 (44.7%)	34 (45%)	33 (44%)	
>78->134	17 (11.3%)	2 (3%)	15 (20%)	
Physical Activity				
No	95 (63.3%)	40 (53.3%)	55 (73.3%)	0.01
Yes	55 (36.7%)	35 (46.7%)	20 (26.7%)	

*p value was obtained using Chi2 test.

Table 3 shows the characteristics of non-diabetic subjects according to their level of adherence to the Mediterranean diet pattern. There was no statistical differences among MEDAS score categories between genders, age categories, body weight and BMI (p>0.05).However, we observed that the majority of physically active subjects had a high adherence rate in comparison to other categories (p=0.03) and the majority of those who have the lowest score, had a previous history of T2D (p=0.01). Concerning the dietary intake used to test the adherence to the Mediterranean diet pattern, results show that non-diabetic and diabetic subjects with high adherence score consumed more olive oil (cooking or raw), more fruits, boiled vegetables, chicken and less red meat, butter and margarine, carbonated and sweetened beverages and commercial pastry compared to those with low adherence score (Tables 3 and 4).

Unadjusted binary logistic regression test used to investigate the relation between 3 MEDAS score (low, moderate and high) with the presence or absence of diabetes, shows no significant association (p=0.10). However, after adding the moderate score to the high score and comparing both to the low score, regression shows that diabetic participants had low adherence to the Mediterranean diet by 0.53 times more than non-diabetic participants (OR=0. 53, 95% CI 0.288-0.994). In addition, binary logistic regression shows that more than 70% of non-diabetic subjects with low adherence score had a high risk of diabetes (OR=0.35, [95% CI 0.12-1.0]) compared to those with moderate + high score [Data not shown]. Concerning the validation of the MEDAS questionnaire, Cronbach's alpha was not statistically significant in our population.

Table 2. Diabetes Risk Assessment Score for the Non-diabetic subjects.

Score Items	Overall (N=150)	Women (N=75)	Men (N=75)	P-value*
Family History of Diabetes (Parents/sibling) No Yes	79 (52.7%) 71 (47.3%)	37 (49.3%) 38 (50.7%)	42 (56%) 33 (44%)	0.4
Diagnosed high blood pressure or on medication No Yes	89 (59.3%) 61 (40.7%)	43 (57.3%) 32 (42.7%)	46 (61.3%) 29 (38.7%)	0.6
Overweight or Obese# Healthy Overweight Obese Extremely obese	1 (0.7%) 66 (44%) 66 (44%) 17 (11.3%)	0 27 (36%) 33 (44%) 15 (20%)	1 (1.3%) 39 (52%) 33 (44%) 2 (2.7%)	0.004
Physical activity No Yes	95 (63.3%) 55 (36.7%)	40 (53.3%) 35 (46.7%)	55 (73.3%) 20 (26.7%)	0.01
Risk& Low Risk High Risk	71 (47.3%) 79 (52.7%)	39 (52%) 36 (48%)	32 (42.7%) 43 (57.3%)	0.25

*p-value was obtained using chi2 test.

#Healthy: 18.5<BMI<24.9 Kg/m2; Overweight: 25≤BMI≤30 kg/m2; Obese: 30≤BMI<40 kg/m2; Extremely obese: BMI≥40 kg/m2

&Low Risk is equivalent to a score of <5 points and High Risk is equivalent to a score of ≥ 5 points.

Discussion

This cross-sectional study showed that diabetic participants have low adherence score by 0.53 times more than non-diabetic participants. In addition, 70% of non-diabetic subjects with low adherence score had a high risk of diabetes compared to moderate and high scores. As observed in the above tables, the majority of the diabetic and non-diabetic subjects were in the moderate adherence category of the Mediterranean diet. This is due to the location of Lebanon in the Middle East region where such patterns are predominantly available. Interestingly, our population (diabetic vs. non-diabetic) has adherence to the Mediterranean diet although it is a moderate adherence.

The Traditional Lebanese pattern encompasses many features of the generally known Mediterranean diet. These features include consumption of fruits, vegetables, olives and olive oil, and whole bread that may protect against the development of diabetes, possibly through the amelioration of insulin sensitivity and their anti-inflammatory actions (11, 12). Our results indicated that non-diabetic and diabetic subjects with high adherence score consumed more olive oil (cooking or raw), more fruits, more boiled vegetables, more chicken and seafood; and less red meat, butter and margarine, carbonated and sweetened beverages and commercial pastry compared to those with low adherence score. Also they have low consumption of alcohol that has been shown to be associated with lower risk of diabetes and lower levels of pro-inflammatory markers (13,14).

Table 3. Characteristics of non-diabetic study subjects according to their adherence to the Mediterranean diet pattern.

Variables	**Low (≤ 5)N (%)**	**Moderate (6-9)N (%)**	**High (≥ 10)N (%)**	**P-value***
Gender (%)	N= 19	N= 117	N=14	
Men	10 (52.6%)	57 (48.7%)	8 (57.1%)	0.81
Women	9 (47.4%)	60 (51.3%)	6 (42.9%)	
Age (years)				
40-49	3(15.8%)	43(36.7%)	4(28.6%)	
50-59	10(52.6%)	36(30.8%)	4(28.6%)	0.27
>= 60	6(31.6%)	38(32.5%)	6(42.8%)	
Body mass index (kg/m^2)				
Healthy	0	1(0.9%)	0	
Overweight	7(36.8%)	53(45.2%)	6(42.9%)	0.97
Obese	9(47.4%)	51(43.6%)	6(42.9%)	
Extremely obese	3(15.8%)	12(10.3%)	2(14.2%)	
Weight (kg)				
48-100	7(36.8%)	53(45.3%)	6(42.9%)	
58-133	9(47.4%)	52(44.4%)	6(42.9%)	0.92
>78 to > 134	3(15.8%)	12(10.3%)	2(14.2%)	
Physical activity (%)				
No	15 (79%)	75 (64%)	5 (36%)	**0.03**
Yes	4 (21%)	42 (36%)	9 (64%)	
Family history of diabetes (%)				
No	4 (21%)	66 (56.4%)	9 (64%)	**0.01**
Yes	15(79%)	51 (43.6%)	5 (36%)	
Hypertension (%)				
No	12 (63%)	68 (58%)	9 (64%)	0.84
Yes	7 (37%)	49 (42%)	5 (36%)	
Dietary intake:				
Olive oil as source of fat in cooking				
No	17(89.5%)	76(65%)	5(35.7%)	**0.006**
Yes	2(10.5%)	41(35%)	9(64.3%)	
Olive oil				
<4	13(68.4%)	29(24.8%)	0(0%)	**<0.001**
≥ 4 tbsp[&].	6(31.6%)	88(75.2%)	14(100%)	
Vegetables				
<2	4(21.1%)	31(26.5%)	0(0%)	0.08
≥ 2 servings**/day	15(78.9%)	86(73.5%)	14(100%)	
Fruits				
<3	16(84.2%)	59(50.4%)	4(28.6%)	
≥ 3 servings/day	3(15.8%)	58(49.6%)	10(71.4%)	**0.004**
Red meat				
≥ 1	12(63.2%)	63(53.8%)	1(7.1%)	
<1 servings[†]/day	7(36.8%)	54(46.2%)	13(92.9%)	**0.002**
Butter, margarine, or cream	11(57.9%)	31(26.5%)	0(0%)	
≥ 1	8(42.1%)	86(73.5%)	14(100%)	
<1 serving[‡]/day				**0.001**
Carbonated and/or sugar-sweetened beverages				
≥ 1	14(73.7%)	36(30.8%)	0(0%)	**<0.001**
<1	5(26.3%)	81(69.2%)	14(100%)	
Wine				
<7	19(100%)	115(98.3%)	14(100%)	0.75
≥ 7 cups[§]/week	0(0%)	2(1.7%)	0(0%)	
Pulses				
<3	10(52.6%)	42(35.9%)	3(21.4%)	0.12
≥ 3 servings [¶] /week	9(47.4%)	75(64.1%)	11(78.6%)	
Fish/seafood				
<3	17(89.5%)	95(81.2%)	13(92.9%)	0.40
≥ 3 servings [¶] /week	2(10.5%)	22(18.8%)	1(7.1%)	
Commercial pastry				
<3	4(21.1%)	90(76.9%)	14(100%)	**<0.001**
≥3 servings/week	15(78.9%)	27(23.1%)	0(0%)	
Nuts				
<3	15(78.9%)	78(66.7%)	11(78.6%)	0.41
≥3serving[?]/ week	4(21.1%)	39(33.3%)	3(21.4%)	
Chicken				
No	13(68.4%)	58(49.6%)	2(14.3%)	**0.008**
Yes	6(31.6%)	59(50.4%)	12(85.7%)	
Boiled vegetables, pasta, rice, or other dishes with a sauce of tomato, garlic, onion, or leeks sautéed in olive oil				
< 2 ≥ 2 times/week	5(26.3%)	26(22.2%)	0(0%)	
	14(73.7%)	91(77.8%)	14(100%)	**0.006**

*p-value was obtained using chi2 test.&1 tablespoon = 13.5 g § 1 Cup = 100 ml

** 1 Serving = 200 g ¶ 1 Serving = 150 g

† 1 Serving = 100-150 g ?1 serving = 30 g

‡1 Serving =12g

Table 4. Characteristics of diabetic study subjects according to their adherence to the Mediterranean diet pattern.

Variables	Low (≤ 5) N (%)	Moderate (6-9) N (%)	High (≥ 10) N (%)	P-value*
Gender (%)	N=32	N=102	N=16	
Men	20 (62.5%)	47 (46.1%)	8 (50 %)	0.26
Women	12 (37.5%)	55 (53.9%)	8 (50%)	
Age (years)				
40-49	8(25%)	36(35.3%)	6(37.5%)	0.01
50-59	17(53.1%)	25(24.5%)	8(50%)	
>= 60	7(21.9%)	41(40.2%)	2(12.5%)	
Dietary intake:				
Olive oil as source of fat in cooking				
No	22(68.7%)	71(69.6%)	5(31.3%)	0.01
Yes	10(31.3%)	31(30.4%)	11(68.7%)	
Olive oil				0.01
<4	13(40.6%)	27(26.5%)	0(0%)	
≥ 4 tbsp.	19(59.4%)	75(73.5%)	16(100%)	
Vegetables				0.003
<2	12(37.5%)	13(12.7%)	1(6.3%)	
≥ 2 servings/day	20(62.5%)	89(87.3%)	15(93.7%)	
Fruits				
<3	26(81.3%)	58(56.9%)	3(18.8%)	<0.001
≥ 3 servings/day	6(18.7%)	44(43.1%)	13(81.2%)	
Red meat				
≥ 1	25(78.1%)	47(46.1%)	4(25%)	0.001
<1 servings/day	7(21.9%)	55(53.9%)	12(75%)	
Butter, margarine, or cream				
≥ 1	17(53.1%)	25(24.5%)	1(6.3%)	0.001
<1 serving/day	15(46.9%)	77(75.5%)	15(93.7%)	
Carbonated and/or sugar-sweetened beverages				
≥ 1	18(56.3%)	17(16.7%)	0(0%)	<0.001
<1	14(43.7%)	85(83.3%)	16(100%)	
Wine				
<7	32(100%)	101(99%)	16(100%)	0.79
≥ 7 cups/week	0(0%)	1(1%)	0(0%)	
Pulses <3	25(78.1%)	34(33.3%)	0(0%)	<0.001
≥ 3 servings/week	7(21.9%)	68(66.7%)	16(100%)	
Fish/seafood				
<3	32(100%)	96(94.1%)	14(87.5%)	0.175
≥ 3 servings/week	0(0%)	6(5.1%)	2(12.5%)	
Commercial pastry				
<3	14(43.8%)	85(83.3%)	16(100%)	<0.001
≥3 servings/week	18(56.3%)	17(16.7%)	0(0%)	
Nuts				
<3	30(93.7%)	79(77.5%)	12(75%)	0.104
≥3 servings/week	2(6.3%)	23(22.5%)	4(25%)	
Chicken				
No	24(75%)	60(58.8%)	2(12.5%)	<0.001
Yes	8(25%)	42(41.2%)	14(87.5%)	
Boiled vegetables, pasta, rice, or other dishes with a sauce of tomato, garlic, onion, or leeks sautéed in olive oil				
< 2	12(37.5%)	15(14.7%)	2(12.5%)	
≥ 2 (times/week)	20(62.5%)	87(85.3%)	14(87.5%)	0.013

*p-value was obtained using chi2 test.

Previous prospective studies showed that frequent consumption of red meat increase the risk of diabetes (15-17). However, the consumption of fish and seafood was shown to decrease the risk of the disease (18) due to its component the α-Linolenic acid that have been suggested to have beneficial effects on health outcomes such as reduction in concentrations of inflammatory markers and improvement of insulin sensitivity that protect against diabetes (19). This inverse association between fish intake and the risk of T2D was challenged by a recent meta-analysis by Patel et al., which showed that lean fish, total fish, and shellfish intakes were not associated with incident diabetes but that fatty fish intake may be weakly inversely associated (20). Hence the negative effects of meat and fish consumption could approve the increase in the incidence of diabetes in those subjects. Our findings came hand in hand with the results of the meta-analysis which shows that greater adherence to a Mediterranean diet is associated with a significant reduction in the risk of diabetes (19%).

Previous cohort study of survivors of myocardial infarction reported that a higher adherence to a Mediterranean diet was associated with a reduction in the risk of type 2 diabetes (21) and the convergence analysis of prospective studies and interventional trials showed that the Mediterranean diet is able to reduce the incidence of future diabetes by 19–23% but Mediterranean diets could be different from one country to another in the Mediterranean basin (22). In addition, five clinical trials examined the effects of apparently healthy, energy-restricted diets together with increased physical activity in individuals with impaired glucose tolerance, a pre-diabetic stage, showed risk reductions between 30 and 70% (23-27).

Also, the present study aimed to determine the validity of the Arabic version of the 14-items MEDAS questionnaire derived from the 9-items MEDAS questionnaire that was validated in a previous study (28). Our analysis shows that the 14-items MEDAS questionnaire couldn't be validated since there was low correlation and week reliability between its items. The number of test items, item interrelatedness and dimensionality affect the value of alpha (29-31). A low value of alpha could be due to a low number of questions, poor interrelatedness between items or heterogeneous constructs. In this study, the low alpha is due to poor correlation between items then some items should be revised or discarded.

To our knowledge, this is the first national study that investigates the association between adherence to the Mediterranean diet pattern and the calculated diabetes risk in non-diabetic subjects. The limitations of this study can be the cross sectional nature and the low sample size.

Conclusion

Our results seem to be clinically relevant for public health, in particular for encouraging a Mediterranean-like dietary pattern for primary prevention of type 2 diabetes mellitus.

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References

1. Khemayanto Hidayat and Shi Bimin, Role of Mediterranean diet in prevention and management of type 2 diabetes, Chinese Medical Journal 2014;127 (20).

2. Nam Han Cho, David Whiting, Nita Forouhi, Leonor Guariguata, Ian Hambleton, Rui Li et al., IDF Diabetes Atlas, seventh edition, 2015

3. Farah Naja, Nahla Hwalla, Leila Itani, Maya Salem, Sami T Azar, Maya Nabhani Zeidan et al.: Dietary patterns and odds of Type 2 diabetes in Beirut, Lebanon: a case–control study. Nutrition & Metabolism 2012 9:111).

4. Martinez-Gonzalez MA, Bes-Rastrollo M, Serra-Majem L, Lairon D, Estruch R, Trichopoulou A. Mediterranean food pattern and the primary prevention of chronic disease: recent developments. Nutr Rev 2009; 67: S111-S116.

5. Salas-Salvadó J et al., Reduction in the incidence of type 2 diabetes with the Mediterranean diet, Diabetes Care. 2011 Jan; 34 (1):14-9. doi: 10.2337/dc10-1288. Epub 2010 Oct 7.

6. Martínez-Gonzalez MA, de la Fuente-Arrillaga C, Nunez-Cordoba JM, Basterra-Gortari FJ, Beunza JJ, Vazquez et al. Adherence to Mediterranean diet and risk of developing diabetes: prospective cohort study. BMJ 2008; 336:1348–1351.

7. Mozaffarian D, Marfisi R, Levantesi G, Silletta MG, Tavazzi L, Tognoni G, et al. Incidence of new-onset diabetes and impaired fasting glucose in patients with recent myocardial infarction and the effect of clinical and lifestyle risk factors. Lancet 2007; 370:667–675.

8. Esposito K, Maiorino MI, Ciotola M, Di Palo C, Scognamiglio P, Gicchino M et al. Effects of a Mediterranean-style diet on the need for anti-hyperglycemic drug therapy in patients with newly diagnosed type 2 diabetes: a randomized trial. Ann Intern Med 2009; 151:306–314.

9. Martınez-Gonzalez MA, Fernandez-Jarne E, Serrano-Martınez M, Wright M, Gomez-Gracia E. Development of a short dietary intake questionnaire for the quantitative estimation of adherence to a cardioprotective Mediterranean diet. Eur J Clin Nutr. 2004; 58:1550–2.

10. Heejung Bang, Alison M. Edwards, Andrew S. Bomback, Christie M. Ballantyne, David Brillon, Mark A. Callahan et al. A patient self-assessment diabetes screening score. Ann Intern Med 2009; 151(11): 775–783.

11. Dontas AS, Zerefos NS, Panagiotakos DB, Vlachou C, and Valis DA: Mediterranean diet and prevention of coronary heart disease in the elderly. Clin Interv Aging 2007, 2:109–115.

12. Kastorini CM, Panagiotakos DB: Dietary patterns and prevention of type 2 diabetes: from research to clinical practice; a systematic review. Curr Diabetes Rev 2009, 5(4):221–227).

13. Sato KK, Hayashi T, et al.: Relationship between drinking patterns and the risk of type 2 diabetes: the Kansai Healthcare Study. J Epidemiol Community Health 2012, 66(6):507–511.

14. Nova E, Baccan GC, Veses A, Zapatera B, Marcos A: Potential health benefits of moderate alcohol consumption: current perspectives in research. Proc Nutr Soc 2012, 71(2):307–315).

15. Van Dam RM, Rimm EB, Willett WC, Stampfer MJ, and Hu FB: Dietary patterns and risk for type 2 diabetes mellitus in U.S. men. Ann Intern Med 2002, 136(3):201–209

16. Meyer KA, Kushi LH, Jacobs DR Jr, Folsom AR: Dietary fat and incidence of type 2 diabetes in older Iowa women. Diabetes Care 2001, 24(9):1528–1535

17. Song Y, Manson JE, Buring JE, Liu S: A prospective study of red meat consumption and type 2 diabetes in middle-aged and elderly women: the women's health study. Diabetes Care 2004, 27(9):2108–2115).

18. Esposito K, Kastorini CM, and Panagiotakos DB, Giugliano D: Prevention of type 2 diabetes by dietary patterns: a systematic review of prospective studies and meta-analysis. Metab Syndr Relat Disord 2010, 8(6):471–476)

19. Meydani M: A Mediterranean-style diet and metabolic syndrome. Nutr Rev 2005, 63(9):312–314).

20. Patel PS, Forouhi NG, Kuijsten A, et al. The prospective association between total and type of fish intake and type 2 diabetes in 8 European countries: EPIC-InterAct Study.

21. The American Journal of Clinical Nutrition. 2012;95(6):1445-1453. doi:10.3945/ajcn.111.029314.

22. Mozaffarian D, Marfisi R, Levantesi G, Silletta MG, Tavazzi L, Tognoni G et al. Incidence of new-onset diabetes and impaired fasting glucose in patients with recent myocardial infarction and the effect of clinical and lifestyle risk factors. Lancet 2007; 370:667–675.

23. Kastorini CM, Panagiotakos DB: Mediterranean diet and diabetes prevention: Myth or fact? World J Diabetes 2010, 1(3):65–67).

24. Pan XR, Li GW, Hu YH, Wang JX, Yang WY, An ZX et al. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance.

The Da Qing IGT and Diabetes Study. Diabetes Care 1997; 20: 537–544.
25. Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P et al. Finnish Diabetes Prevention Study Group. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaire glucose tolerance. N Engl J Med 2001; 344:1343–1350.
26. Kosaka K, Noda M, Kuzuya T. Prevention of type 2 diabetes by lifestyle intervention: a Japanese trial in IGT males. Diabetes Res Clin Pract 2005; 67:152–162.
27. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA et al. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002; 346:393–403.
28. Ramachandran A, Snehalatha C, Mary S, Mukesh B, Bhaskar AD, Vijay V et al., The Indian Diabetes Prevention Programme shows that lifestyle modification and metformin prevent type 2 diabetes in Asian Indian subjects with impaired glucose tolerance (IDPP1). Diabetologia 2006; 49:289–297).
29. Martınez-Gonzalez MA, Fernandez-Jarne E, Serrano-Martınez M, Wright M, Gomez-Gracia E. Development of a short dietary intake questionnaire for the quantitative estimation of adherence to a cardioprotective Mediterranean diet. Eur J Clin Nutr. 2004; 58:1550–2).
30. Graham J. Congeneric and (Essentially) Tau-Equivalent estimates of score reliability: what they are and how to use them. Educational Psychological Measurement. 2006; 66:930-44.
31. Bland J, Altman D. Statistics notes: Cronbach's alpha. BMJ. 1997; 314:275.
32. DeVellis R. Scale development: theory and applications: theory and application. Thousand Okas, CA: Sage; 2003.