

## Original

# Assessment of the Mediterranean Diet Adequacy Index of a collective of young cyclists

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## Abstract

**Objective:** To assess, the degree of adequacy to Mediterranean Diet (MD), by young cyclists team, and its comparison with the one of young Spanish males of the “enKID study”.

**Background:** Now days it has been observed that, the abandoning of the MD, together with sedentary lifestyle, provokes a rapid increase of obesity among the Spanish youth. The progressive abandoning of the MD was firstly evident, in longitudinal studies of the “seven counties”, involving active rural populations in Italy.

**Methods:** The Mediterranean Adequacy Index (MAI), is computed by dividing the sum of the percentage of total energy from typical Mediterranean food Groups (Cereals, Legumes, Fruits, Fish), by the sum of the percentage of total energy from non-typical Mediterranean food groups (Meats, Eggs, Cookies, industrial dishes). The collective under the study was 45 young cyclists in the area of Madrid, and homologous young Spanish males of the “enKID study”.

**Results:** The average value of MAI of the collective of male cyclists was 2,31(modest value); and the MAI of homologous young males of the “enKID study” is 1.51 (low value). The MAI in Italy several decades ago was 7.2 (very good), when the adequacy to the MD was high; Those results demonstrate that unfortunately the Spanish young people are abandoning the adherence to the Mediterranean Diet. Around 20% of the cyclists have almost null adequacy to the MD, as their MAI was 1.08 (very low value).

The quality of the diet Index(DQI) of the cyclists team was 67 over 100, which means that their diet was “good, but it needs to be improved”.

The lipid profile (measured by the cocient of intake of MUFA and PUFA divided by SFA) of the cyclists team was 1,71 (lower than the recommended value which should be > 2), quite similar to the cocient of homologous young males of the enKID study Diet which was 1,69. This illustrates the poor lipid profile of young people diets.

## EVALUACIÓN DEL ÍNDICE DE ADECUACIÓN A LA DIETA MEDITERRÁNEA DE UN COLECTIVO DE CICLISTAS JÓVENES

### Resumen

**Objetivo:** Determinar el grado de adhesión a la dieta mediterránea (DM), de un grupo de jóvenes ciclistas y del colectivo de jóvenes homólogos del estudio enKID.

**Introducción:** Actualmente se observa con frecuencia que el abandono de los hábitos de vida saludable representado por la DM y el ejercicio físico, tiene como consecuencia el incremento rápido de la obesidad entre los jóvenes españoles. Este abandono se evidenció en primer lugar, al analizar los estudios longitudinales de los “siete países”, en poblaciones rurales de Italia y de otros seis países.

**Métodos:** Determinación del Índice de adhesión a la DM (IAM), que se calcula dividiendo el porcentaje de la energía consumida de los grupos de alimentos típicos de la DM (Cereales, Legumbres, Frutos, Pescado), por el porcentaje de la energía consumida de los grupos de alimentos que no suelen ser de la DM (Carnes, Huevos, Bollería, platos pre-cocinados).

Colectivo formado por 45 jóvenes ciclistas y jóvenes varones del estudio “enKID”.

**Resultados:** La media del IAM del colectivo ciclista fue de 2,31(valor modesto) y la media del IAM del colectivo “enKID” fue de 1.51 (valor bajo, a mejorar); mientras que la media del IAM del colectivo rural de Italia hace cuatro décadas fue de 7.2 (valor muy alto, que fue decreciendo con el paso del tiempo). Estos resultados confirman desgraciadamente el abandono progresivo de la DM especialmente entre los jóvenes españoles. Hasta un 20% de los ciclistas no siguen en absoluto la DM, dado que su IAM solamente fue de 1,08, que es muy bajo.

El índice de calidad de la dieta (ICD) del equipo ciclista fue de 67 sobre 100, es decir “buena, pero que necesita mejorar”

El Perfil lipídico, medido por el cociente cantidad de (Ácidos grasos poli-insaturados mas los mono- insaturados) dividido por cantidad de Ácidos grasos saturados, de los ciclistas fue de 1,71 (mientras que el valor recomendado es de > 2); en el colectivo del estudio “enKID” de

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**Discussion and conclusions:** Spanish youth are abandoning the traditional MD. Therefore there is an urgent need to organize Educational campaigns among the youth, their parents, teachers, and coaches in order to reverse this situation, in order to recover the healthy MD lifestyle. The adherence to the traditional MD (rich in vegetable, fruits, fish, nuts, and olive oil), together with physical activity, contributes to the prevention of cardiovascular diseases and obesity.

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Key words: *Nutritional assessment. Mediterranean Diet Adequacy Index. Index of quality of the Diet Index. Young cyclists. Lipid profile.*

## Introduction

For the young people practicing cycling, the success not only depends on a suitable training but, it is as well the consequence, of a correct feeding, healthful habits of life, and psychological aptitudes; that are developed by a complex emotional learning.

Although the cyclists of the current work do not have overweight, neither obesity it is important for them to follow healthy nutritional habits, because when they stop the practice of sports they usually end gaining excess body fat and overweight. According to the study published in Finland a cohort of athletes which were active from 1920 till 1965 had gain 5.2 points in their BMI 20 years later; another group of coetaneous athletes which were able to control their weight had a BMI gain of 3.3 points, while controls had a BMI gain of 4.2 points.<sup>1</sup>

The Spanish ministry of Food and Agriculture has stated campaign in the Schools to inform the children and parents of the need to follow the MD. The results up to date are not fully satisfactory. There is little support from parents and the adverse publicity of foods rich in fats and sugars still has a great influence in children choices of foods.

In the Seven Countries Study, 16 cohorts of men were examined in 1958-1961 with a standardized procedure. In five of these cohorts food consumption was subsequently assessed longitudinally. The same method of dietary survey, the diet history method, was used. First, the eating patterns of all men in the two rural Italian cohorts were assessed in 1965 to determine if dietary recommendations developed by a group of experts assembled by the World Health Organization (WHO) were met.<sup>2</sup>

In order to proceed the Mediterranean Adequacy Index (MAI), was defined as a very suitable index that was obtained by dividing the sum of the percentage of total energy from typical Mediterranean food groups by the sum of the percentage of total energy from non-typical Mediterranean food groups.

jóvenes homólogos fue de 1,69. Esto indica el bajo valor del perfil lipídico en la dieta de los jóvenes.

**Discusión y conclusiones:** Este trabajo muestra el progresivo abandono de la DM por parte de los jóvenes. Es pues urgente organizar campañas educativas entre jóvenes, padres y entrenadores/profesores. La adherencia a la tradicional DM (rica en vegetales, legumbres, verduras, frutos secos y aceite de oliva), junto con el ejercicio físico, previene las enfermedades cardiovasculares y la obesidad.

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Palabras clave: *Evaluación nutricional. Dieta mediterránea. Índice de adecuación a la DM. Índice de Calidad de la Dieta. Perfil lipídico.*

The diets of 40-59-year-old men from Nicotera in 1960—the reference Italian-Mediterranean diet—and the diets of men from Crevalcore and Montegiorgio of the Seven Countries Study in 1965, 1970 and 1991 were analyzed using the MAI. The weighed record method in a sub sample of 40-59-year-old men in Nicotera was used for dietary appraisal; and to obtain the data of the longitudinal groups.<sup>3</sup> In the same way a longitudinal study was as well performed in Puglia, Italy.<sup>4</sup> It is concluded that the diet of the population groups examined in Italy over the last four decades has changed, progressively abandoning the nutritional characteristics of the reference Italian-Mediterranean diet. This is particularly worrisome for the typical Mediterranean areas of Italy.<sup>4</sup> The MAI method, as well as some of the results from those studies,<sup>5</sup> were used in the present work to confirm the unfortunately evolution along the last four decades of the Mediterranean Adequacy Index.

There is a great concern about the nutritional lifestyle in the Spanish population, which together with sedentary habits is increasing the obesity among the youth as the enKID study.<sup>6</sup>

The obesity has associated in the long term other risk factors such as, Diabetes mellitus 2, high blood pressure, insulin resistance, and chronic inflammation.<sup>7</sup>

The nutritional diet has a big impact in the immune system;<sup>8</sup> and given that the exhaustive exercise, such a cycling generates transient acute inflammation and oxidative stress,<sup>9</sup> it is important to limit those effects to muscle injury repair, and mitigate excessive inflammation by a correct diet with plenty of fruits and vegetables, in line with the MD.

The correct diet for a cyclist is the one that provides the sufficient energy and the suitable nutrients (carbohydrates, proteins, fats, vitamins, minerals and water) according to his age, gender, weight, and amount of activity.<sup>10</sup>

The group of sportsmen is one of the most motivated to follow a correct diet; but for a long time it has been one of the groups that commit the greater errors, and

believe in myths with respect to which it is a correct feeding.<sup>11</sup>

There is a direct relationship between the intake of fruits, vegetables and legumes; and healthy lifestyle of the MD, which is rich in cereals, vegetables, fruits, fish, nuts, and olive oil.<sup>12,13</sup>

Equally with the MD there is a bigger intake fiber, antioxidant vitamins,<sup>14,15</sup> as well as vitamins involved in the metabolic production of energy (B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, Folic acid, B<sub>12</sub>) and minerals such as Magnesium and Phosphorus.<sup>16</sup>

## Methods

The cyclists have a regular program of training with technical Directors; the cyclist were training about six days a week. Along the year they participate in about 12 competitions in the community of Madrid (Spain) and other six Spanish national competitions. They cycle more than 25,000 km per year.

All cyclists have made a medical checking to participate in the cycling club. They combine their studies with practices of cycling, and their goal is to become professional cyclists.

All are healthy, without disease. They have signed an informed voluntary consent, together with their parents or tutors, if they are under 18 years of age. The study is part of an on going PH Thesis, registered upon the comity of the faculty of Pharmacy in the university of Madrid UCM. The indications of Helsinki have been followed.

*Design:* Computation of the Mediterranean Adequacy Index (MAI), by dividing the sum of the percentage of total energy from typical Mediterranean food Groups (Cereals, Legumes, Fruits, Fish) by the sum of the percentage of total energy from non-typical Mediterranean (Meats, Eggs, Cookies, industrial processed dishes) food groups.<sup>5</sup> The computed energy represents the 70% of the total energy consumed daily. The remaining 30% are mainly from the lipid and dairy products.

The consumption of dairy milk was excluded because the cyclists intake is mostly of whole milk of cow, instead of typical Mediterranean goats milk. The consumption of lipids were excluded because there was no differentiation of which part correspond to Mediterranean food ( the olive oil) and witch part are animal lipids witch are non-Mediterranean food (butter). Instead the lipid profile has been used to take into account the importance of the type of lipids consumed.

$MAI = \frac{\text{SUM \% Energy (Cereals+ Legumes+ Fruits+ Fish)}}{\text{SUM \% Energy (Meats+ Eggs + Cookies + processed dishes)}}$

The MAI has a few minor limitations:<sup>5</sup>

- If the mean values of food groups are available only as Kcal/day. The different energy densities of foods could be a confounding factor.
- The percentage of energy for each food group and

for each individual is required to compute the percentile distribution. This is needed particularly in longitudinal studies when consistent changes in energy intake occur.

- A national reference index must be based on the diet followed by a population with low risk factors of chronic diseases. When the values of MAI are higher than a reference index for a population, the reason can be found in the influence of too high an intake of certain Mediterranean foods such as cereals or wine and/or too low an intake of certain non-Mediterranean foods such as animal foods. Therefore the interpretation of the ratio has to be based not only on typical Mediterranean and non-Mediterranean foods, but also on the distribution of the same typical Mediterranean foods.

Therefore to complement the MAI results, other Diet parameters are as well considered to asses the quality of the cyclists Diets<sup>17</sup> namely,

- The lipid profile measured as the cocient of (Mono-insaturated fatty acids, MUFA plus Poli-insaturated fatty acids, PUFA) divided by saturated fatty acids (SFA).
- The Diet Quality Index (DQI).

The input Data are obtained from several nutritional Questionnaires.

Every cyclist participating in the study fills up the following questionnaires:

- Questionnaire of *nutritional habits and physical activity*: where it is recorded the frequency of intake of different groups of foods, some anthropometrical data, as well as the amount and intensity of the physical activity performed by the cyclist.
- Questionnaire of *Record of food consumption during* of 7 consecutive days. This record list all the foods and drinks ingested and its quantities; including supplements, appetizers and snacks; Other useful information are as well included, such as lunch start/end time, the place where they eat.

The Questionnaires data are input into the DIAL program, which after processing it outputs a Result Report detailing the Energy intake, nutrient and the Quality of the Diet (DQI), based on the recommendations applicable to the studied population group.<sup>18</sup>

To compute the Diet Quality Index (DQI),<sup>19</sup> ten parameters (corresponding to the Food groups in the food pyramid), are evaluated: cereals & legumes, vegetables, fruits, dairy products milk, meat, fish, eggs, Energy from fats, Energy from saturated fats, cholesterol, sodium, variety of food types in diet.

Each parameter is evaluated from 0 (minimum adequacy to the recommended intake), till 10 points

**Table I**  
Groups of foods consumed by cyclist team (n = 45)

| Diet of cyclist Team (n = 45)             | Cereals % legumes (servings/d) | Vegetables (servings/d) | Fruits (servings/d) | Dairy (servings/d) | Meat, fish, eggs (servings/d) | % E. from fats | % E. from Saturated fats | Cholesterol (mg/d) | Sodium (mg/d) | Variety of food types in diet |
|---|--------------------------------|-------------------------|---------------------|--------------------|-------------------------------|----------------|--------------------------|--------------------|---------------|-------------------------------|
| Daily Intake (means ± sd)                 | 11.4 ± 3.1                     | 4.9 ± 3.2               | 2.6 ± 1.4           | 2.9 ± 1.2          | 6.3 ± 2.3                     | 35 ± 5.8       | 12 ± 2                   | 589 ± 180          | 4,604 ± 227   | 16 ± 3                        |
| RDA (average)                             | 12                             | 6                       | 4                   | 4                  | 3                             | <30            | <10                      | <300               | <4,800        | >16                           |
| DQI of food Group (0 til 10) (Means ± sd) | 9.1                            | 7.5                     | 6.5                 | 8.2                | 9.8                           | 6.2            | 6.1                      | 1.3                | 3.3           | 8.9                           |

Note: The quantities showed in this table have been rounded to one decimal value.  
Note: The serving sizes are based on information provided by the University of Leon, Spain<sup>20</sup> (García MT, 2004).

(maximum adequacy to the recommended intake). Therefore the overall DQI value, of the evaluation for all ten parameters, has a range from 0 till 100 points. The DQI allows classifying the Diets as, poor diet (< 50 points), diet that needs to be improved (51-80 points), and excellent diet (80-100 points).<sup>19</sup>

The recommended daily Allowances (RDA) is determined taking into account the anthropometrical data and the energy requirements of the cyclists.<sup>10,18</sup>

The statistical results are presented as Average and Standard deviation.

## Results

The intake of different groups of foods (measured in serving per day), as well as the recommended daily Allowances, and the associated qualification of the Diet by means of the DQI; are shown in the table I.

From those results it becomes evident that cyclists have taken as average an *excessive amount of saturated Fats (mainly from meats and eggs)*, while they have not taken the *recommended quantities of vegetables and fruits* (which are typical of the MD). Additionally there is a big variation (measured as the standard deviation) in the intake of Cereals, vegetables, meat, fish and eggs.

Therefore there is a big difference among cyclist intake of major food groups. This variability is reflected later on when the MAI is computed.

The consumption of sodium is unfortunately high 4,604 ± 227 mg (the recommended value is less than

2,300 mg) indicating the excessive consumption of industrially precooked food dishes.

The consumption of cholesterol is unfortunately high 589 ± 180 mg (the recommended value is less than 300 mg) indicating the excessive consumption of meat and eggs.

This situation if not improved, in the long term, it may be a factor of risk of hypertension, arteriosclerosis, dyslipidaemias, and in general with cardiovascular diseases. In any case sedentarism in the young people is the main risk of Coronary Heart Diseases (CHD) in the long term.<sup>21</sup>

Additional information of the unbalances in the Diet of the studied cyclists is available in complementary articles.<sup>22,23</sup>

Other publications have as well warned about the progressive abandoning by Spanish children of the “Mediterranean Diet” in favour of industrial products.<sup>24</sup>

The nutritional knowledge of Spanish young people are not influencing their eating habits and behavior.<sup>25</sup>

The MD adherence is a good instrument to identify groups at risk with regard to nutritional quality, measured by biochemical nutrition markers in plasma.<sup>26</sup>

## Evaluation of the MAI of young cyclists compared to the MAI in a longitudinal study in Italy

Table II shows the results of MAI for the studied Cyclists, Spanish youth of “enkid study”, and Italian rural populations of the “seven countries longitudinal

**Table II**  
MAI values of cyclists, spanish young people, and italian men

| Diet adequacy parameter     | Cyclists (n = 45) | Enkid study Spain (n=436 young men) | Nicotera Italy in 1960 (n = 144 men under 60 y) | Pollica Italy in 1967 (n = x men) | Pollica Italy in 1999 (n = x men) |
|-----------------------------|-------------------|-------------------------------------|---|-----------------------------------|-----------------------------------|
| MAI (average ± sd) or range | 2.31 ± 0.7*       | 1.51 ± 0.5*                         | 7.2   | 5.6 to 6.3                        | 2.4 to 4.5                        |

\* p < 0.001 statistical difference.

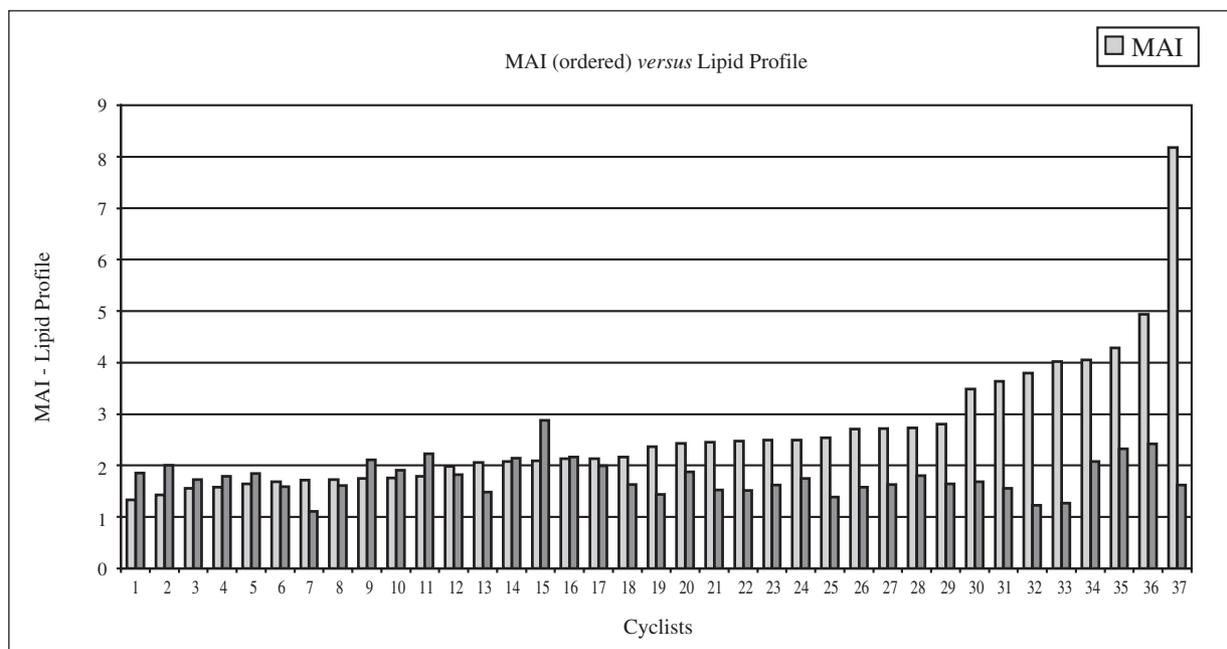


Fig. 1.—MAI (ordered increasing) versus Lipid Profile of the cyclists team.

study”. Figure 1 shows the MAI in an ordered way versus the Lipid Profile; no association between MAI and Lipid profile has appeared (correlation coefficient is 0.1, very low).

As commented previously, the results in previous tables I and II show a big variability (measured from the standard deviation high value) in the intake of main Food groups, as well as in the MAI results, therefore further classification of the cyclists into several groups may help in analyzing those differences.

#### Evaluation of other parameters of the cyclist Diet

Other Parameters of the quality of their diets have been as well included, to show that the Diet followed by the young cyclists is far from being satisfactory.

The lipid profile measured as the cocient PUFAS/SFA, and cocient PUFAS + MUFA/SFA among male cyclists (16-22-years-old) was 0.36 and 1.71 respectively; lower than the recommended values in MD (0.5 and 2 respectively); indicating deficit in consumption of fish (rich in PUFA), and olive oil (rich in MUFA).

For the young males of the enKID study the cocient PUFAS/SFA and cocient PUFAS + MUFA/SFA was 0.38 and 1.6 respectively; indicating the poor lipid profile is common in the youth Diets.

#### Further assessment of the adequacy to the Mediterranean Diet

In order to further analyze the big variability in the MAI of the collective, it has been spit into three groups:

Low MAI group, Average MAI group, and High MAI group. For those groups we obtain the results of MAI; cocient PUFA + MUFA/SFA; and Diet Quality Index (DQI) shown in the table III.

The results show that the MAI has statistical difference between the three groups, Group 2 has the highest adequacy to the MD (MAI = 3.84), while Group 3 has the lowest adequacy to the MD (MAI = 1.08),

The cocient of (MUFA and PUFA) divided by SFA was used to assess the quality of the lipid profile of cyclists Diet. The diet of the cyclists has a cocient of  $1.71 \pm 0.38$ ; quite similar to the cocient of homologous young males of the enKID study Diet which was  $1.69 \pm 0.30$ . This is a poor lipid profile on the cyclist groups diet.

Moreover the cocient (PUFA + MUFA)/SFA has not statistical difference between the three groups, and no group follows the recommended pattern of fatty acids, because all groups exceed the intake of SFA, due to high consumption of meat and eggs. Further analysis of the cocient PUFA + MUFA/SFA is provided hereafter to show that in spite of previous result, some of the cyclists follow the recommended pattern.

There is no association between the Medium and High MAI and the lipid profile; but there is an association between Low MAI and the lipid profile; as shown at the correlation coefficients at the bottom of table III.

All three groups obtain the Diet Quality Index (DQI) considered as “good, but it can be improved” (67.4, 66.7, and 69.9 respectively over 100). No significant differences between the groups are obtained.

**Table III**  
*Classification of the collective of cyclists into 3 groups according the their MAI*

| Diet quality parameter         | Group 1:<br>75 < MAI < 2.75<br>Medium adequacy to MD | Group 2:<br>MAI > 2.75<br>High adequacy to MD | Group 3:<br>MAI < 1.75<br>Low adequacy to MD |
|--------------------------------|--|---|--|
| N (percentage)                 | 23 (51% of collective)                               | 13 (29% of collective)                        | 9 (20% of collective)                        |
| MAI (average ± SD)             | 2.02 ± 0.32*   | 3.84 ± 1.50*                                  | 1.08 ± 0.28*                                 |
| PUFA + MUFA/SFA (average ± SD) | 1.80 ± 0.36**  | 1.73 ± 0.37**                                 | 1.65 ± 0.370**                               |
| DQI (average ± SD)             | 67.4 ± 10.3**  | 66.7 ± 10.3**                                 | 69.9 ± 9.7**                                 |

\* p < 0.001 statistical difference; \*\* no statistical difference among groups.

Coefficient of correlation between MAI and lipid profile (PUFA + MUFA/SFA) for medium, high and low MAI was -0.08, 0.20 and 0.55 respectively.

### Evaluation of the adequacy to the Lipid profile pattern versus the MAI

If we classify the cyclists according to its adequacy to the Lipid profile, we have the following results:

**Group A:** Composed of 11 (6 + 3 + 2) cyclists which are compliant with the recommendations of Diets with lipid profile (their value of PUFA + MUFA/SFA > 2). Table IV shows the results for all subgroups.

Although there are differences between subgroups in the MAI, those differences are not reflected in the lipid profile PUFA + MUFA/SFA compliance by all subgroups of Group A.

**Group B:** Composed of 34 (17 + 10 + 7) cyclists which are NON-compliant with the recommendations

of Diets with lipid profile (their value of PUFA + MUFA)/SFA < 2).

Their diets have a poor relationship of PUFA + MUFA/SFA of 1.64, 1.54 and 1.52 respectively, for each subgroup.

But surprisingly, the first two subgroups composed of 17 + 10 cyclists do comply with the MD, as their MAI are 2.03 and 3.66 respectively, for each subgroup.

The table V shows the details for all subgroups.

Although there are differences between subgroups in the MAI, those differences are not reflected in the lipid profile tat was non-compliant by all subgroups of Group B.

Therefore there is no association between the MAI and the lipid profile PUFA + MUFA/SFA in the diets of the cyclists.

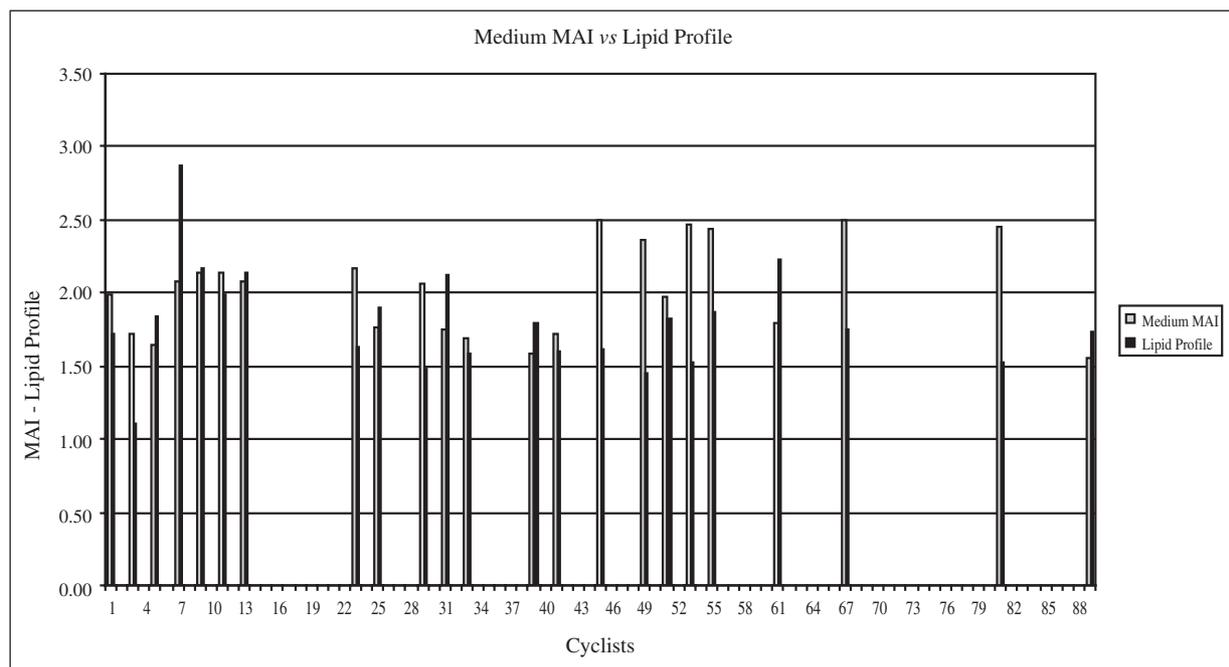


Fig. 2.—Medium MAI vs Lipid Profile of 23 cyclists.

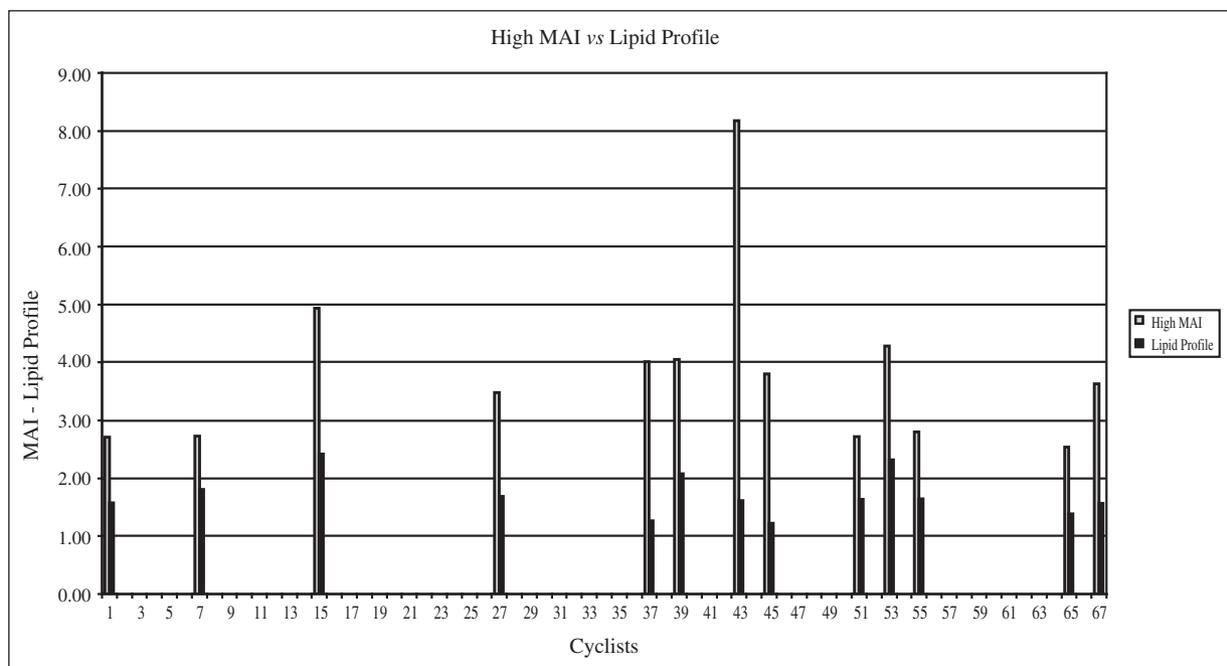


Fig. 2.—High MAI vs Lipid Profile of 13 cyclists.

## Discussion and conclusions

Table II shows that the diet followed by young cyclists has a relatively low MAI compared with traditional MD followed in Italy several decades ago. The Spanish young males of the “enkid study” have even a poorer MAI.

If this result is compared with the MAI (“seven counties” study) in Italy several decades ago when the adequacy to the MD was very high, the hypothesis that unfortunately the adequacy is decreasing along the decades is confirmed.

The median value of MAI among men from Nicotera in 1960 was 7.2 (higher score never reached); In Pollica, the values in men ranged from 5.6 to 6.3 in 1967 and from 2.4 to 4.5 in 1999.

This confirms the progressive abandoning of the MD lifestyle in the last four decades among the Spanish youth. Around 20% of the cyclist have no adequacy at all to the MD, as their MAI was 1.08.

Unfortunately the same tendency has been observed in other populations around the world, with alarming increase of sedentary; having a consequence the increase of obesity among the youth.

The MD is considered as preventive of cardiovascular risk, due to its high consumption of fruits, vegetables and olive oil, and low consumption of meats with saturated fatty acids, and processed foods. Adequacy to the MD is recommended to all the people starting from the infancy.

Table III shows that the MAI has statistical difference between the three groups.

Given the MAI variability among cyclists, the team is split into three groups in order to analyze it further.

Group 1 is considered as medium adequacy to the MD (MAI = 2.02); their intake of MD food groups is almost the double, measured in energy, than the intake of non-MD food groups. This group has to improve their Diets to come closer to the MD.

Group 2 is considered as having higher adequacy to the MD (MAI = 3.84); this group has been encouraged to continue in this adequacy to the MD.

Group 3 is considered as lowest adequacy to the MD (MAI = 1.08), even poorer than the homologous Spanish young males. This group has to improve substantially their Diets to come closer to the MD.

The percentage of cyclists on each group is showed in figure 6.

In Contrast the cocient PUFA + MUFA/SFA has not statistical difference between the three groups, as no group follows the recommended pattern of fatty acids intake (all groups exceed the intake of SFA, due to high consumption of meat and eggs). There is no association between the Medium and High MAI and the lipid profile; but there is an association between Low MAI and the lipid profile; as shown at the correlation coefficients at the bottom of table III, and in figures 2, 3 and 4.

Table IV shows that the subgroups of cyclists which are compliant with the Lipid profile pattern, have strong variability in their adequacy to the MD for those subgroups. That means that compliance to lipid profile pattern, do not imply adequacy to the MD.

In Table V it is shown that the subgroups of cyclists which are non-compliant with the Lipid profile pattern; have also strong variability in their adequacy to the MD for those subgroups. That means that non-compliance to lipid profile pattern do not imply non-adequacy to the MD.

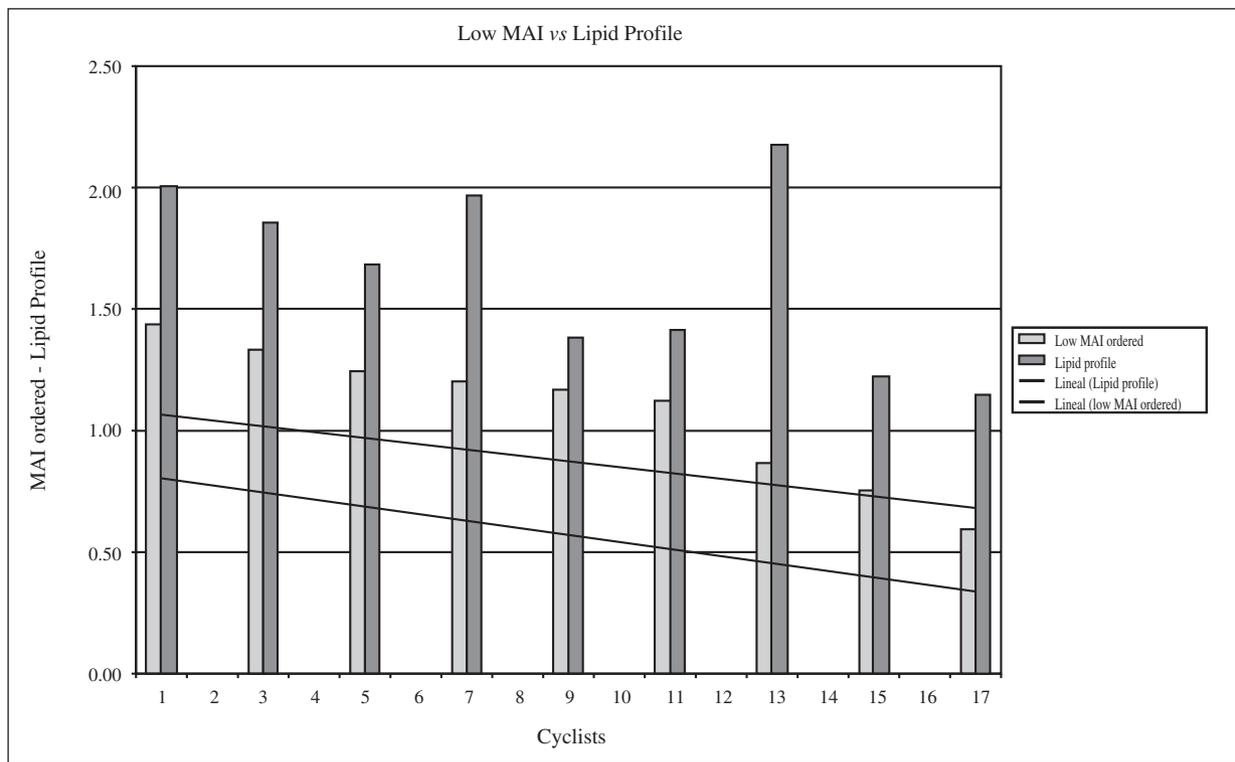


Fig. 4.—Low MAI (ordered decreasing) vs Lipid Profile of 9 cyclists.

It seems that there is no association between the MAI and the Lipid profile of the cyclist subgroups; it is shown in figure 5.

There is little variability of the DQI can be explained by the fact that the ten diet parameters considered to

compute the DQI are representative of the MD and as well of other Healthy Diets that are not necessarily the MD.

The MAI, the Lipid profile, and the DQI parameters are three independent parameters, which measure the

**Table IV**

Classification of the collective of cyclists into (compliant). Subgroups according to their PUFA + MUFA/SFA, and their MAI

| GROUP A | MAI                  |                      |                      | PUFA + MUFA/SFA (COMPLIANT) |                      |                      |
|---------|----------------------|----------------------|----------------------|-----------------------------|----------------------|----------------------|
|         | Subgroup A.1 (n = 6) | Subgroup A.2 (n = 3) | Subgroup A.3 (n = 2) | Subgroup A.1 (n = 6)        | Subgroup A.2 (n = 3) | Subgroup A.3 (n = 2) |
| Average | 1.99**               | 4.43**               | 1.15**               | 2.26**                      | 2.25**               | 2.09**               |
| SD      | 0.18                 | 0.62                 | 0.40                 | 0.35                        | 0.24                 | 0.12                 |

\*\* no statistical difference among groups.

**Table V**

Classification of the collective of cyclists into (non-compliant). Subgroups according to their PUFA + MUFA/SFA, and their MAI

| GROUP B | MAI                   |                       |                      | PUFA + MUFA/SFA (NON-COMPLIANT) |                       |                      |
|---------|-----------------------|-----------------------|----------------------|---------------------------------|-----------------------|----------------------|
|         | Subgroup B.1 (n = 17) | Subgroup B.2 (n = 10) | Subgroup B.3 (n = 7) | Subgroup B.1 (n = 17)           | Subgroup B.2 (n = 10) | Subgroup B.3 (n = 7) |
| Average | 2.03*                 | 3.66*                 | 1.06*                | 1.64**                          | 1.54**                | 1.52**               |
| SD      | 0.36                  | 1.07                  | 0.28                 | 0.20                            | 0.19                  | 0.32                 |

\* p < 0.001 statistical difference; \*\* no statistical difference among groups.

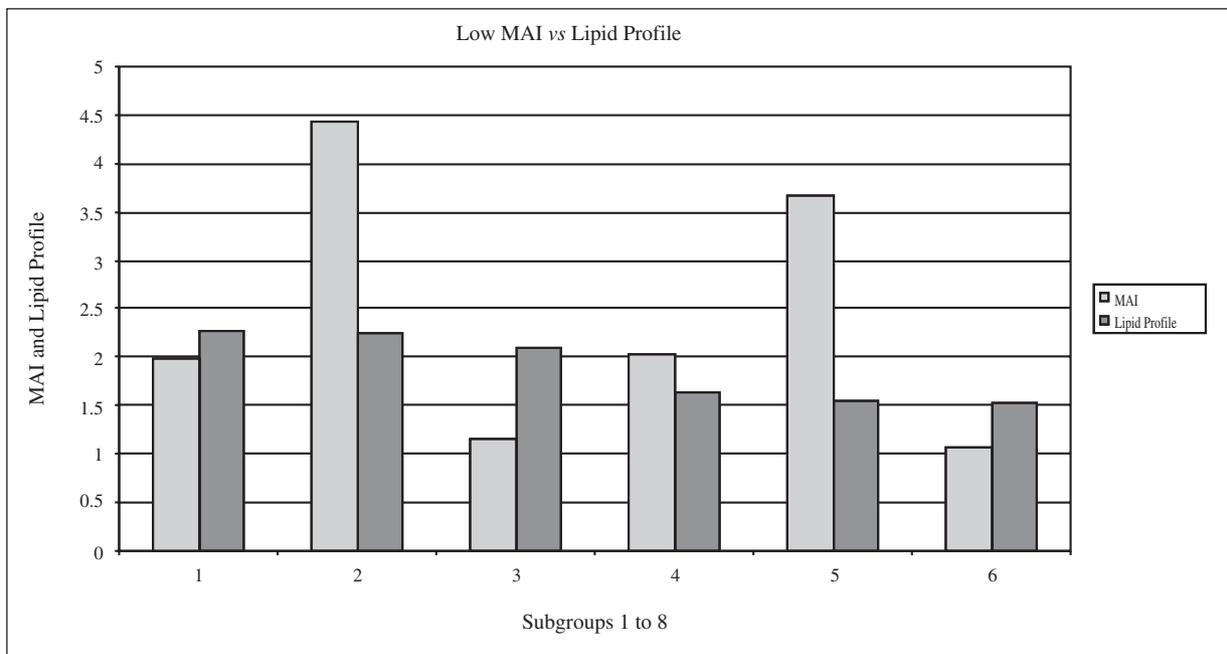


Fig. 5.—No association found between MAI and Lipid Profile, for cyclists subgroups.

suitability of their diets; while the MAI is specifically tailored to adequacy to the MD.

Educational campaigns among the youth, their parents and coaches are recommended to reverse the abandoning of the MD by youth. Mediterranean Society has started to put efforts to recover the healthy MD lifestyle among the young people. The MD is rich in vegetable, fruits, fish, nuts, and olive oil, which will protect them against possible future risk of cardiovascular diseases.

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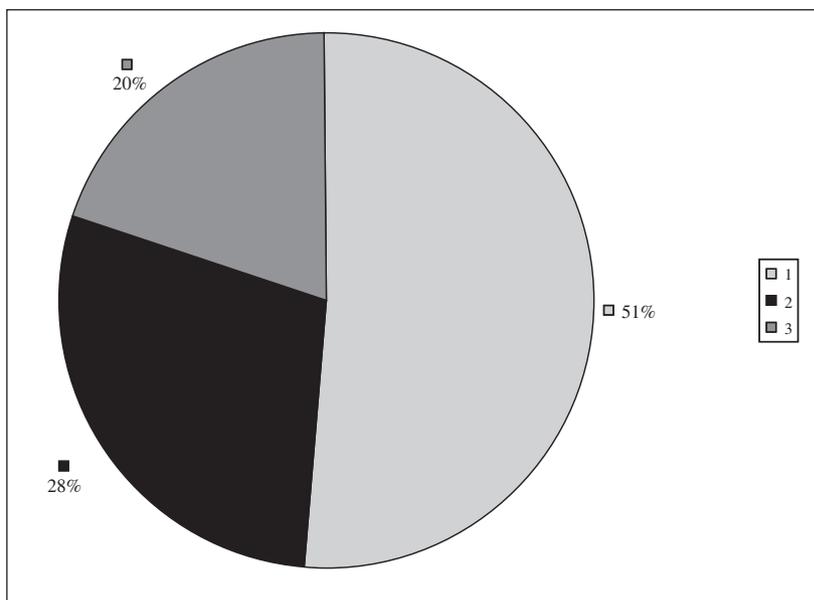


Fig. 6.—Percent of cyclists of 1. Medium MAI; 2. High MAI; 3. Low MAI.

## References

1. Saarni SE, Rissanen A, Sarna S, Koskenvuo M, Kaprio J. Weight cycling of athletes and subsequent weight gain in middle age. *Int J Obes (Lond)* 2006; 30(11):1639-44. Epub 2006 Mar 28.
2. Farchi G, Fidanza F, Grossi P, Lancia A, Mariotti S, Menotti A. Relationship between eating patterns meeting recommendations and subsequent mortality in 20 years. *European Journal of Clinical Nutrition* 1995; 49:408-19.
3. Alberti-Fidanza A, Fidanza F, Chiuchiu MP, Verducci G, Fruttini D. Dietary studies on two rural Italian population groups of the Seven Countries Study. 3. Trend of food and nutrient intake from 1960 to 1991. *European Journal of Clinical Nutrition* 1999; 53:854-60.
4. Fidanza F, Coli R, Maurizi Coli A, Sarchielli P, Simonetti MS. Nutritional status of the elderly in Perugia. *Age & Nutrition* 1992; 3:64-8.
5. Alberti-Fidanza Adalberto and Flaminio Fidanza. Mediterranean Adequacy Index of Italian diets. *Public Health Nutrition* 2004; 7(7):937-41.
6. Serra-Majen L, García-Closas R, Ribas L, Pérez-Rodrigo C, Aranceta J. Food patterns of Spanish schoolchildren and adolescents: The enKid Study. *Public Health Nutr* 2001; 4(6A):1433-8.
7. Bastard JP, Maachi M, Lagathu C, Kim MJ, Caron M, Vidal H, Capeau J Feve B. Recent advances in the relationship between obesity, inflammation, and insulin resistance. *Eur Cytokine Netw* 2006; 17(1):4-12.
8. Marcos A, Nova E, Montero A. Changes in the immune system are conditioned by nutrition. *Eur J Clin Nutr* 2003; 57(1):S66-S69.
9. Brunnigard H. Physical activity and modulation of systemic low-level inflammation. *J Leukoc Biol* 2005; 78(4):819-35. Epub 2005 Jul 20.
10. Ortega RM. Nutrición del deportista. En: *Nutriguía. Manual de Nutrición Clínica en Atención Primaria*. Madrid: Editorial Complutense. 2003. pp. 46-55.
11. Haman F, Peronnet F, Kenny GP, Doucet E, Massicotte D, Lavoie C, Weber JM. Effects of carbohydrate availability on sustained shivering I. Oxidation of plasma glucose, muscle glycogen, and proteins, 2004.
12. Kok FJ, Kromhout D. Atherosclerosis Epidemiological studies on the health effects of a Mediterranean diet. *Eur J Nutr* 2004; 43(Suppl. 1):I2-I5.
13. Ballmer PE. The Mediterranean diet-healthy but and still delicious. *Ther Umsch* 2000; 57(3):167-72.
14. Samman S, Sivarajah G, Man JC, Ahmad ZI, Petocz P, Caterston ID. A mixed fruit and vegetable concentrate increases plasma antioxidant vitamins and folate and lowers plasma homocysteine in men. *J Nutr* 2003; 133(7):2188-93.
15. Kiefer I, Prock P, Lawrence C, Wise J, Bieger W, Bayer P, Rathmanner T, Kunze M, Rieder A. Supplementation with mixed fruit and vegetable juice concentrates increased serum antioxidants and folate in healthy adults. *J Am Coll Nutr* 2004; 23(3):205-11.
16. Srinath Reddy K, Katan MB. Diet, nutrition and the prevention of hypertension and cardiovascular diseases. *Public Health Nutr* 2004; 7(1A):167-86.
17. Sánchez-Benito JL, Sánchez-Soriano E, Ginart Suárez J. Evaluation of the intake of fats and minerals by a group of cyclists of Junior and Sub23 Teams. *Clin Invest Arterioscl* 2007; 19(6):269-77.
18. Ortega RM, Requejo AM, Navia B, López Sobaler AM. Ingestas diarias recomendadas de energía y nutrientes para la población española. La composición de los alimentos. Herramienta básica para la valoración nutricional. Madrid: Editorial Complutense; 2004.
19. Kennedy ET, Ohls J, Carlson S, Fleming K. The Healthy Eating Index: design and applications. *J Am Diet Assoc* 1995; 95:1103-8.
20. García MT, García MC. Pesos y medidas caseras y raciones habituales de consumo personal. En: *Secretariado de Publicaciones y medios Audiovisuales de la Universidad de León*, eds. *Nutrición y dietética*. León: Universidad de León; 2003. pp. 89a-96ª.
21. Bouziotas C, Koutedalis Y, Nevil A, Ageli E, Tigilis N, Nikolau A et al. Greek adolescents fitness, fatness, fat intake, activity and coronary heart disease risk. *Arch Dis Child* 2004; 89:41-4.
22. Sánchez-Benito JL, Sánchez-Soriano E. The excessive intake of macronutrients: does it influence the sportive performances of young cyclists? *Nutr Hosp* 2007; 22(4):461-70.
23. Sánchez-Benito JL, Sánchez-Soriano E. Unbalanced energy and macronutrients in the diet of Spanish cyclists, does it affect their sportive achievements? *Nutr Hosp* 2007; 22(4):461-70.
24. Fernández San Juan PM. Dietary habits and nutritional status of school aged children in Spain. *Nutr Hosp* 2006; 21(3):374-8.
25. Montero Bravo A, Ubeda Martín N, García González A. Evaluation of dietary habits of a population of university students in relation with their nutritional knowledge. *Nutr Hosp* 2006; 21(4):466-73.
26. Gerber M. Qualitative methods to evaluate Mediterranean diet in adults. *Public Health Nutr* 2006; 9(1A):147-51.