



FACULDADE DE CIÊNCIAS DA NUTRIÇÃO E ALIMENTAÇÃO
UNIVERSIDADE DO PORTO

Trabalho de Investigação

**Variação Mundial da Adesão à Dieta Mediterrânica,
em 1961-65 e 2000-03.**

**Worldwide Variation of Adherence to the Mediterranean Diet,
in 1961-65 and 2000-03**

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DEDICATÓRIA

À minha Mãe.

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LISTA DE ABREVIATURAS

DM – Dieta Mediterrânea

FAO – Food and Agriculture Organization

FBS – Food Balance Sheets

GNP – Gross National Product

IAM - Índice de Adequação Mediterrânea

MAI – Mediterranean Adequacy Index

MD – Mediterranean Diet

MDP – Mediterranean Dietary Pattern

PAM – Padrão Alimentar Mediterrânico

SFR – Socialist Federal Republic

UK – United Kingdom

USA – United States of America

RESUMO EM PORTUGUÊS

Objectivo: Análise às tendências mundiais de adesão à Dieta Mediterrânica (DM), em 1961-65 e 2000-03

Métodos: Os dados foram recolhidos das Balanças Alimentares da Organização para a Agricultura e Alimentação para dois períodos de tempo: 1961-65 e 2000-03. Para obter uma amostra do mundo, 41 países foram escolhidos. A média de energia disponível (Kcalorias/capita/dia) para os diferentes grupos alimentares, foi calculada para todos os países. Esses valores foram utilizados para avaliar a adesão à DM, através de uma variação do Índice de Adequação Mediterrânica (IAM).

Resultados: A maioria dos 41 países estudados tendem a afastar-se do padrão alimentar Mediterrânico.

Os grupos de países Europa Mediterrânea e Outros Mediterrâneos sofreram uma diminuição significativa dos seus valores de IAM. A Europa Mediterrânea e especialmente a Grécia apresentam a maior diminuição no valor de IAM. Os Outros Países Mediterrâneos apresentam os valores de IAM mais elevados nos dois períodos de tempo.

No período mais recente, o Irão foi o país que obteve o maior aumento de IAM, enquanto que o Egipto ocupou o primeiro lugar do ranking.

Apesar de não ser estatisticamente significativo, o grupo da Europa do Norte foi o único que registou um aumento no IAM.

Conclusões: Novos padrões alimentares, com características semelhantes ao Padrão Alimentar Mediterrânico (PAM), estão a surgir lentamente. O PAM está a enfraquecer, especialmente na Bacia do Mediterrâneo. Políticas nutricionais para combater a Ocidentalização e para preservar o PAM – padrão saudável e preventivo - são necessárias.

RESUMO EM INGLÊS

Objective: Analysis of the worldwide trends of adherence to the Mediterranean Diet (MD), in 1961-65 and 2000-03.

Methods: Data was obtained from the Food and Agriculture Organization Food Balance Sheets in two time periods: 1961-65 and 2000-03. To have a sample of the world, 41 countries were selected. The average of available energy (Kcalories/capita/day), for different food groups, was calculated for all selected countries. Those values were used to evaluate the adherence to the Mediterranean Diet through a variation of Mediterranean Adequacy Index (MAI).

Results: The majority of the 41 countries in this study tend to drift away from a Mediterranean like dietary pattern.

Mediterranean Europe and the Other Mediterranean country groups suffered a significant decrease in their MAI values. The Mediterranean European Group and especially Greece show the highest decrease in MAI value. In both time periods, the Other Mediterranean countries showed the highest MAI values. In the most recent period, Iran was the country that had the highest increase in MAI and Egypt occupied the first place in the ranking.

The Northern European group was the only one that, although not statistically significant, registered an increase in MAI.

Conclusions: New dietary patterns seem to be slowly emerging with characteristics similar to the Mediterranean dietary pattern (MDP), which is losing strength especially around the Mediterranean basin. Nutrition policy actions to fight Westernization and to preserve the healthy prudent MDP are required.

PALAVRAS-CHAVE EM PORTUGUÊS

Dieta Mediterrânea, Índice de Adequação Mediterrâneo, Balanças Alimentares, Ocidentalização.

PALAVRAS-CHAVE EM INGLÊS

Mediterranean Diet, Mediterranean Adequacy Index, Food Balance Sheets, Westernization.

INTRODUCTION

The definition of Mediterranean Diet (MD) is not consensual, partly because this dietary pattern is quite heterogeneous among Mediterranean countries and also within the countries themselves^{1, 2}. Many studies define this pattern identifying several common features. High consumption of plant foods such as legumes, cereals, fruits and vegetables, nuts and seeds, low consumption of meat and dairy products, olive oil as main source of fat and moderate consumption of wine are some of the key parameters that define the MD³⁻⁶. Overall, the Mediterranean dietary pattern is considered a healthy prudent dietary pattern and a great adherence to it has been associated with a better health status, due to the protective effect that this pattern shows against various chronic diseases⁷⁻⁹.

Based on the above features, many food indexes have been developed to evaluate the benefits of this dietary pattern¹⁰. The Mediterranean Adequacy Index (MAI) is one of such indexes, and has been used to study the adherence of a country or a population to the MD¹¹⁻¹⁴. However, it is important to remember that the definition presented by Ancel Keys, in the 1960's, for the MD and the concept of the traditional Mediterranean dietary pattern is changing and has being influenced by globalization⁵.

OBJECTIVE

This study was integrated in the Third Strategic Report of the Mediterranean Diet Surveillance System and aims to evaluate how the adherence to the MD has changed on a worldwide scale, in two time periods: 1961-65 and 2000-03.

MATERIAL AND METHODS

The data was obtained from the Food and Agriculture Organization's (FAO) Food Balance Sheets (FBS) that contains information about national food availability in the world. This food availability reflects production, supply and different human utilization of foodstuff during a certain time period in a specific country. Foodstuff that is exported, for non-human use, for seed and lost is subtracted from the quantity of foodstuff produced and imported. The final value indicates the quantity of food available for human consumption. Subsequently, to obtain the per capita supply for each food group, the available energy value, for each group is divided by the total population of the country in the corresponding time period^{12, 15}.

41 countries were selected to constitute a worldwide sample and were firstly divided as being Mediterranean or Non Mediterranean. Then a second division was made which included 5 areas, dividing Mediterranean countries in Mediterranean Europe (Albania, Cyprus, France, Greece, Italy, Malta, Portugal, Spain, Turkey, Yugoslavia SFR) and Other (African and Middle East Mediterranean countries (Algeria, Egypt, Israel, Lebanon, Libyan Arab Jamahiriya, Morocco, Syria, Tunisia). Non Mediterranean countries were divided into Central Europe (Austria, Bulgaria, Czechoslovakia, Germany, Hungary, Poland, Romania, Switzerland), Northern Europe (Denmark, Finland, Ireland, Norway, Sweden, UK) and Other World countries (Argentina, Australia, Canada, Chile, Islamic Republic of Iran, Japan, Mauritania, South Africa, USA). Geographical, cultural and socio-economic factors were taken into account for these groupings¹².

Yugoslavia SFR and Czechoslovakia suffered political changes between the studied periods and subsequently divided into several other countries. The FAO data used pertains to the former areas of Yugoslavia SFR which group: Bosnia-Herzegovina, Croatia, Kosovo, Macedonia, Montenegro, Serbia and Slovenia and the former Czechoslovakia, which includes Czech Republic and Slovakia¹⁵.

The average of energy availability (calories/capita/day) from the different food groups was calculated, for all countries, in two time periods: 1961-65 and 2000-03. Adherence to the Mediterranean Diet was calculated through a variation of the Mediterranean Adequacy Index (MAI). An adaptation of the index defined by Alberti-Fidanza *et al.* was applied¹⁶. MAI is calculated by dividing the energy provided by the total sum of Mediterranean food groups by the energy from the Non Mediterranean food groups^{13, 17, 18}. The higher a country's MAI value indicates a greater adherence to the Mediterranean dietary pattern.

The Mediterranean food groups considered were olive oil, olives, cereals (beer was excluded from the cereal group), starchy roots, herbs and spices, fruits (except wine grapes), vegetables, nuts, fish and seafood, legumes and wine. The Non Mediterranean food groups were other sources of fat apart from olive oil, sugar and sweeteners, alcoholic beverages (except wine and beer), meat, beer, sugar crops, oil crops, offal, stimulants (coffee, cocoa beans, tea), animal fat and miscellaneous products. Eggs and dairy products were not considered in this study because they were considered elements common to all dietary patterns.

Different statistical tests were used to analyze the data with the statistical software S.P.S.S.[®] (version 16 for Macintosh). Univariate analysis of variance with *post hoc* analysis by the Bonferroni test was applied to compare the MAI values in the different areas for both periods. A t-test for independent samples was used to verify the MAI differences between Mediterranean and Non Mediterranean countries in both time periods. T-tests for Paired Samples were used to compare the MAI value of each group of countries between the two periods of time. Finally, One Sample T-tests were computed to compare worldwide MAI in both time periods with the MAI of each area. The worldwide MAI value used in these tests came from FAO data provided by all the countries in the world and not just the countries selected for the study. Significance was set at the 0.05 level.

RESULTS

Comparison between Worldwide MAI and the MAI in different countries groups

The worldwide MAI value calculated with data from over 210 countries and regions was 2.86 in the first period (1961-65) and 2.03 in the second period (2000-03).

Initially the average MAI of all selected countries in this study was 2.38 ± 1.47 but in the second period it dropped to 1.51 ± 0.88 ($p < 0.05$) (Table 1).

Comparing the worldwide MAI and the MAI for all selected countries, in both time periods, it is possible to verify that globally the World presents the highest values (Table 1).

In the first time period, the MAI of the Mediterranean Countries was higher than that of the World (Table 1), although not statistically significant. In the Non Mediterranean groups MAI values were significantly lower ($p < 0.05$) than that of the worldwide MAI.

In the second time period both groups of Mediterranean and Non Mediterranean countries, had lower MAI values than the worldwide MAI value (Table 1), however only the difference presented by the Non Mediterranean countries was statistically significant.

Only the Other Mediterranean countries presented a MAI value above the worldwide MAI ($p>0.05$). The differences between the World and Central and Northern Europe were statistically significant.

Comparison between the MAI values of Mediterranean and Non Mediterranean Countries

Mediterranean countries showed the highest MAI values in both periods. However between the four decades a significant decrease was observed (Table 1). This was more marked in Mediterranean countries compared to the remaining ones (1.45 ± 0.99 and 0.41 ± 0.76 , respectively).

Periods	Groups	N	Mean $\pm$ SD	Min	Max
1961-65	World	210	$2.86 \pm \text{NA}$	NA	NA
	All Selected Countries	41	2.38 ± 1.47	0.63	5.54
	Mediterranean Countries	18	3.44 ± 1.24	1.28	5.54
	Non Mediterranean Countries	23	1.55 ± 1.06	0.63	4.11
	Mediterranean Europe	10	3.41 ± 1.45	1.28	5.54
	Other Mediterranean Countries	8	3.48 ± 1.01	1.62	4.81
	Central Europe	8	1.71 ± 1.08	0.82	3.89
	North Europe	6	0.83 ± 0.16	0.67	1.04
	Other World Countries	9	1.90 ± 1.22	0.63	4.11
2000-03	World	210	$2.03 \pm \text{NA}$	NA	NA
	All Selected Countries	41	1.51 ± 0.88	0.64	4.09
	Mediterranean Countries	18	1.98 ± 0.90	0.82	4.09
	Non Mediterranean Countries	23	1.14 ± 0.67	0.64	3.65
	Mediterranean Europe	10	1.58 ± 0.67	0.82	2.80
	Other Mediterranean Countries	8	2.49 ± 0.93	1.09	4.09
	Central Europe	8	1.01 ± 0.45	0.72	2.02
	North Europe	6	0.85 ± 0.07	0.76	0.97
	Other World Countries	9	1.45 ± 0.94	0.64	3.65

NA: Not Available

Table 1. Descriptive statistics for all studied country groups in both periods.

Comparison of the adherence to a Mediterranean like food pattern among the five defined groups

Mediterranean Europe, Other Mediterranean countries and Central Europe suffered a significant decrease of MAI during the studied period. Northern Europe was the only group that suffered an increase of MAI, although this was not significant.

In 1961-65, both groups of Mediterranean countries (Mediterranean Europe and Other Mediterranean countries) presented a significantly higher adherence to the Mediterranean pattern in comparison with the Non Mediterranean Europe (Central and Northern Europe) (Figure 1). However, in the second period, only the Other Mediterranean countries group presented a significantly higher value of MAI than all the Non Mediterranean groups of countries.

In both periods, the group of Other Mediterranean countries presented the highest adherence to the MD of all studied areas and despite the absence of statistical significance, the difference between Other Mediterranean countries and Mediterranean Europe MAI values increased with time.

Mediterranean Europe experienced a significantly greater change in MAI, from one period to the other compared to the Non Mediterranean country groups (Central Europe, Northern Europe and Other World countries) (Figures 1 and 2).

The area covering the Mediterranean basin was the one that experienced the greatest MAI changes in the studied time frames (Figures 1 and 2).

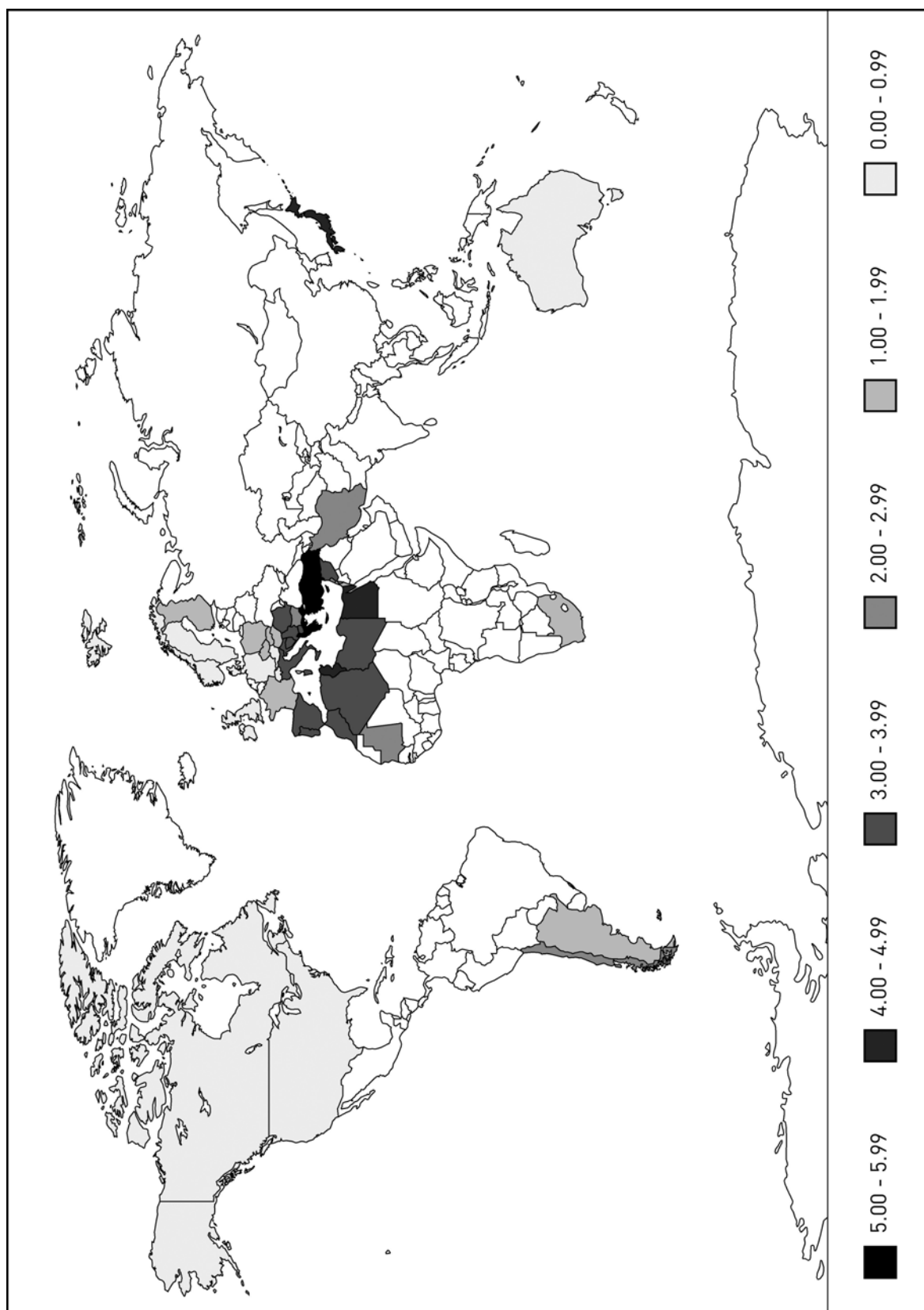


Figure 1. World Map of the adherence to the Mediterranean dietary pattern, comparing Mediterranean adequacy index value, in the period of 1961-65.

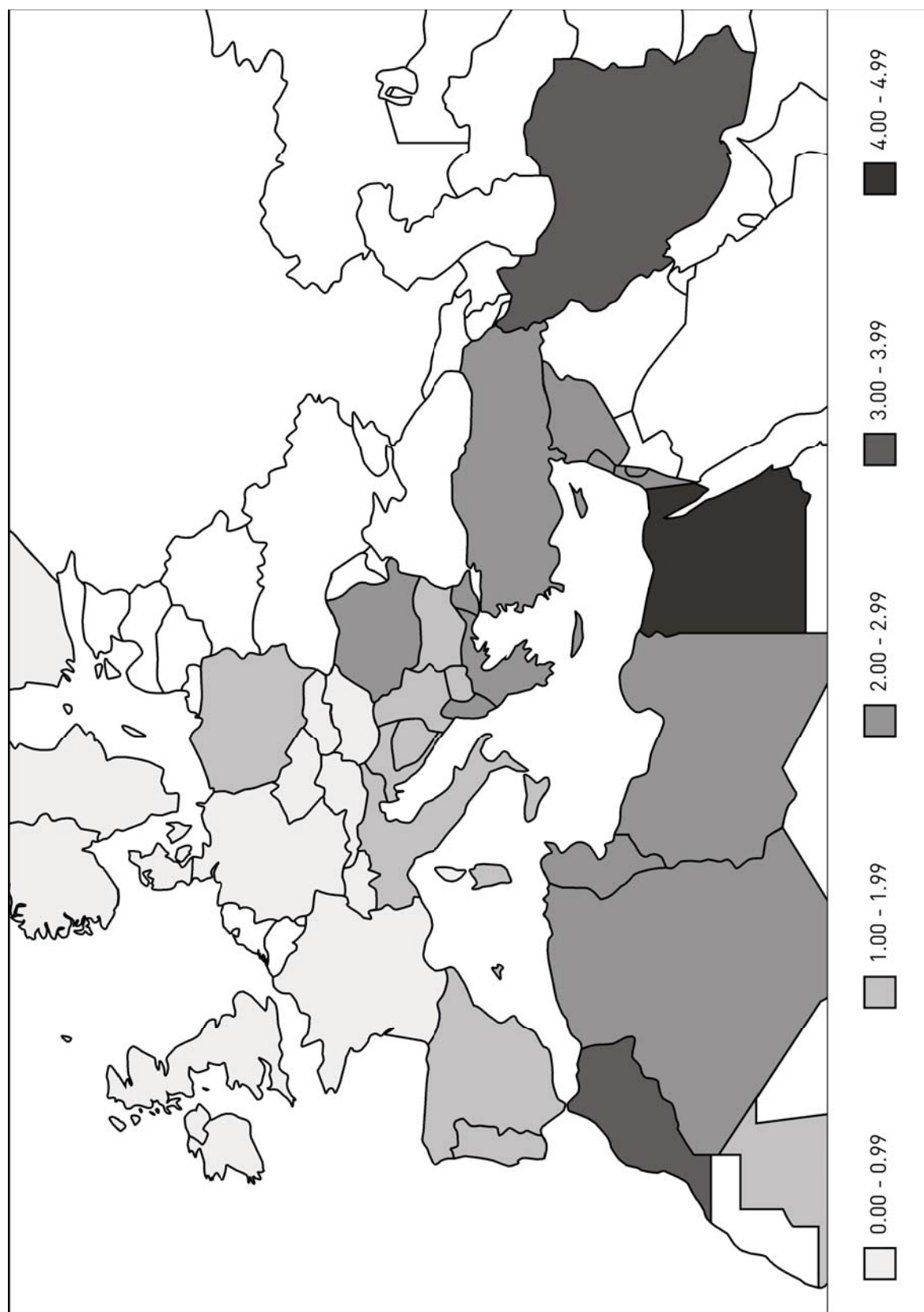


Figure 2. Map of the adherence to the Mediterranean dietary pattern, comparing Mediterranean adequacy index values, in the period of 2000-03.

The average MAI in the different areas, listed from the highest to the lowest, is the following: Other Mediterranean Countries, Mediterranean Europe, Other World Countries, Central Europe and Northern Europe. Despite all the internal changes that each group of countries may have experienced throughout the two time periods, the order of the ranking has remained the same.

Ranking of Countries by MAI

Table 2, shows that in the period of 1961-65, there were 15 countries with MAI values higher than 3. Of note is that 3 of these countries (Greece, Albania and Turkey) had MAI values over 5 and they were all countries from Mediterranean Europe. Only 2 of the countries with MAI above 3.00 were not Mediterranean ones. Japan and Romania, which were located in the sixth and seventh place in the ranking, with MAI values of 4.11 and 3.89, respectively. The remaining 13 Mediterranean countries were distributed similarly between, European (7 countries) and Non European (6 countries).

The Central European countries with the highest MAI values were Romania and Bulgaria, with MAI values of 3.89 and 2.68, respectively.

In the second time period no country had a MAI value over 5 and only Egypt (4.09) presented a MAI value above 4. The group of 15 countries with MAI values higher than 3.00, was reduced to a group of 3 which, besides Egypt includes Iran (3.65) and Morocco (3.25) (Table 2). In the first block of 15 countries of the ranking there were 7 countries from the group of Other Mediterranean countries and only 3 were

from Mediterranean Europe. Over time, the number of Non Mediterranean countries within the top 15 doubled, from 2 to 4.

Romania and Bulgaria maintained the highest MAI values within the Central European countries, despite experiencing the largest decrease from one period to the other (1.87 and 1.48, respectively).

Countries	1961-65		2000-03	
	Ranking	MAI	Ranking	MAI
Greece	1	5.54	10	2.04
Albania	2	5.07	7	2.51
Turkey	3	5.03	5	2.80
Egypt	4	4.81	1	4.09
Tunisia	5	4.57	6	2.65
Japan	6	4.11	16	1.51
Romania	7	3.89	11	2.02
Libya	8	3.81	9	2.09
Algeria	9	3.61	4	2.81
Portugal	10	3.39	18	1.27
Morocco	11	3.37	3	3.25
Syria	12	3.35	8	2.25
Spain	13	3.35	21	1.19
Italy	14	3.30	15	1.62
Yugoslavia	15	3.13	22	1.15
Iran	16	2.87	2	3.65
Mauritania	17	2.87	13	1.77
Lebanon	18	2.70	14	1.72
Bulgaria	19	2.68	20	1.20
Cyprus	20	2.39	27	0.96
Chile	21	2.24	19	1.27
South Africa	22	1.87	12	1.78
Poland	23	1.84	23	1.12
Israel	24	1.62	24	1.09
Malta	25	1.56	17	1.42
Hungary	26	1.48	37	0.73
France	27	1.28	32	0.82
Argentina	28	1.13	25	0.97
Czechoslovakia	29	1.10	30	0.83
Finland	30	1.04	29	0.87
Austria	31	0.98	38	0.73
Ireland	32	0.97	33	0.80
Norway	33	0.88	26	0.97
Switzerland	34	0.88	39	0.72
Germany	35	0.82	34	0.76
Sweden	36	0.72	31	0.82
Canada	37	0.71	36	0.75
Australia	38	0.68	40	0.70
UK	39	0.68	28	0.87
Denmark	40	0.67	35	0.76
USA	41	0.63	41	0.64

Table 2. Ranking of countries by MAI values in both time periods.

Between 1961-65 and 2000-03 all the Mediterranean countries and most of the Non Mediterranean countries suffered a decrease in their MAI values. Greece showed the largest decrease, followed by Japan, Albania and Turkey (Figure 3). These countries were in the first 6 places in the ranking during the first period but in the second one fell to fifth (Turkey), seventh (Albania), tenth (Greece) and sixteenth place (Japan) (Table 2).

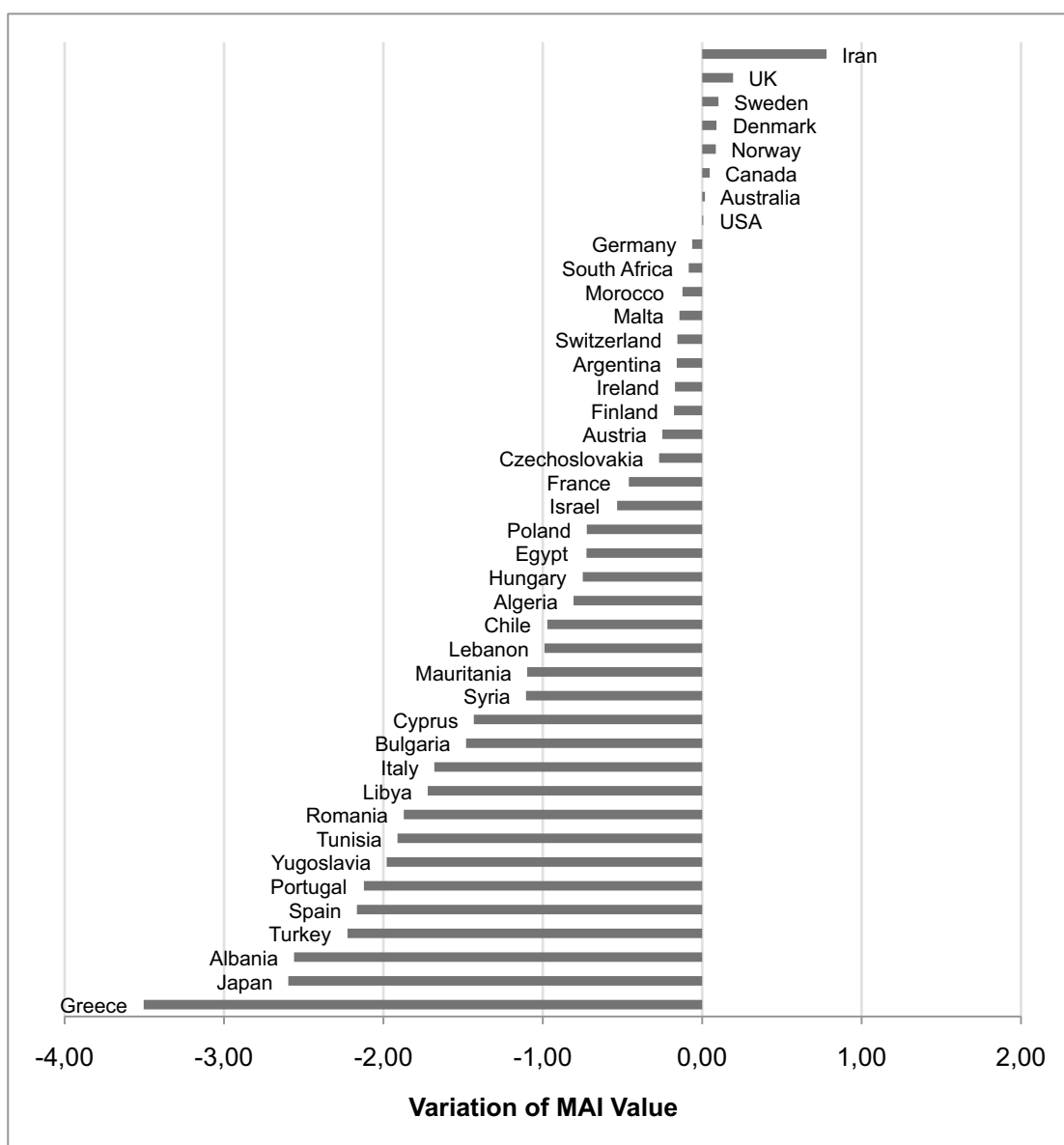


Figure 3. Variation of MAI for all countries between the periods of 1961-65 and 2000-2003.

The USA occupied the last position in the rank in both periods showing just a slight improvement.

From the first to the second time period, all the Mediterranean countries decreased their MAI values, whereas among the Non Mediterranean ones there is a decrease in the MAI values in 15 countries but 8 other countries underwent improvements in the adherence to the Mediterranean pattern.

Morocco and Malta were the Mediterranean countries that suffered the smallest decreases in MAI, experiencing drops of 0.12 and 0.14, respectively. France was the third country with least loss of MAI value (0.46), although it has remained the lowest MAI last of all the Mediterranean countries.

It is interesting to note that only 8 countries, all of which were Non Mediterranean, increased their adherence to the Mediterranean dietary pattern: 4 Northern European and 4 Other World countries, (Figure 3). Iran showed the highest increase in MAI (0.78), improving its place in the rank from the sixteenth to the second place. The other 7 countries had smaller increases, all below 0.2.

All Mediterranean and Central European countries suffered a departure from the MD. Greece was the country with highest MAI (5.54) in the first period and suffered the largest drop, of 3.50 of its MAI value, stepping down from 1st to 10th place in the ranking.

DISCUSSION AND CONCLUSIONS

In order to assess how close the diet of several countries in the world was to a Mediterranean like dietary pattern, the Mediterranean Adequacy Index (MAI) was applied^{10, 13, 16}. As it is computed using the energy provided by foods, it avoids the limitation of differences in energy densities¹²⁻¹⁴. It is based on a very simple to apply ratio between components, the Mediterranean foods (carbohydrate and protective food groups) versus the Non Mediterranean foods (specially foods of animal origin and sweets)¹⁶.

Although MAI has not been validated and has several limitations, it is a useful tool to compare availability trends between different countries^{11, 18}. The concept of MD in itself is not consensual and varies in time, therefore influencing the construction of such indexes. As other dietary indexes, MAI is limited by the decision on what food groups should be considered Mediterranean and what food should be viewed as Non Mediterranean⁶. Moreover, the MD should not be summarized as a list of products since it is also about proportions between food items¹⁸. Seed oils were included in the denominator in order to reduce some limitations of previous studies¹². Red meat and poultry were not separated and included in the broad category of meats¹⁹. The same importance is given to all index components independently of their proportions in the diet and the scientific evidence of diet-disease relationship¹⁷.

Several items, such as eggs and dairy products, were not included in the MAI, partly because the FBS present information on availability of raw food products,

which do not necessarily fall into the food groups used to construct the MAI. For instance, the availability of milk is presented but not dairy products and the availability of eggs is presented but not the food groups in which it is found, such as cakes and pastries. In addition, evidence on the health benefits of dairy products is controversial²⁰.

The FBS are inherently limited by the inaccuracy of the underlying data sources (such as data on production, storage, losses and crops)^{15, 21}. It is also important to highlight the fact that the data provided only gives us an estimate of the energy available for human consumption, which is not equivalent to the energy consumed^{21, 22}. Indeed, a comparative analysis made by two research groups shows that FBS present an overestimation for food consumption compared to the individual dietary surveys^{23, 24}. Another limitation of FBS is related to the estimate of per capita availability and therefore the lack of information to be able to analyze population subgroups by gender, age and education, for example^{21, 25}. Furthermore, parameters such as home production and tourists are not taken into account by the FBS. Despite this they are a cost-effective tool that allows longitudinal consistent comparisons and are the best source of data, if not the only one, available for the studied period^{12, 21, 26}.

The study shows that countries from all over the world drifted away from a Mediterranean like dietary pattern. It also shows that some countries located outside the Mediterranean basin, such as Japan, Iran and Chile share some of the characteristics of the Mediterranean diet, a prudent healthy dietary pattern. The changes in adherence to the MD, over the last 40 years, varied considerably

between the countries (Figure 3), the Mediterranean ones showing the greatest departure from the Mediterranean diet²². In addition, the Mediterranean countries that had the greatest adherence in the 60's experienced the greatest decreases in MAI values, as did Greece, for instances while Malta and France, which were the Mediterranean countries with the lowest MAI values, had slight changes (Figures 1 and 2). Only a few of the selected countries increased their adherence to the Mediterranean dietary pattern, but these were minimal and occurred, in general, in those countries with lowest MAI in the first period.

The fact that the availability of several Mediterranean dietary components has increased or been maintained, such as fruits, vegetables and olive oil^{19, 27-30}, could lead to a greater adherence to the Mediterranean dietary pattern. This however is not the case, as availability of the Non Mediterranean foods has increased, even more than the Mediterranean foods^{27, 28, 30}.

The upward trend of MAI in Northern Europe was the result of increased availability of Mediterranean food products like fruits and vegetables^{12, 30}.

The study shows that the MAI values in Mediterranean Europe were higher than the MAI values presented by Northern and Central Europe. Northern Europe tends to have slightly higher MAI values nowadays than in the early 1960's, although this change was not statistically significant^{21, 31}. The trends in MAI values are similar to those reported in the study by Balanza *et al.* which covers similar areas to those covered in this study (although it considers Central Europe as Eastern Europe)¹². However, caution should be taken when making comparisons between studies

using different variations of an index (i.e. differences in food groups included in our study and Balanza's one¹².

The deviation from the Mediterranean dietary pattern by the Mediterranean countries is general (Figures 1 and 2) and has also been documented in previous studies^{2, 28, 32}. In the four decades under consideration, the Mediterranean countries moved away from the Mediterranean dietary pattern in the order of 42.5%. Within this area, it is the European countries that are primarily responsible for this departure. The Other Mediterranean countries have, in both periods, the highest adherence to the MD³² and the differences between mean MAI values in Other Mediterranean countries and in Mediterranean Europe has widened over time. Mediterranean countries are suffering a process of Westernization, with changes in cultural, social and political factors, which are likely to have a heavy influence on food habit changes^{2, 28}. Compared to the first time period, Mediterranean products are now providing less energy to the diet and the opposite occurs with Non Mediterranean foods^{19, 30}.

Among the Mediterranean countries, Greece suffered the largest decrease in the MAI value since the 1960's. This distancing from the Mediterranean dietary pattern is mainly due to the increase in energy available from the Non Mediterranean food group. The energy available from the Mediterranean food group was almost the same in both time periods while the energy value from the Non Mediterranean almost tripled. The greatest increases occurred in the meat, sugar and sweeteners groups and, in a general way, in vegetable oils (excluding olive oil)³¹ with highest increase in sunflower and corn germ oils (data non shown).

In contrast, countries such as France and Malta, which ranked very low in the 1960's, have experienced very small changes. In relation to Malta, the migratory movements may have influenced these changes and the current low Mediterranean diet adherence observed, as shown by Tessier S and Gerber M³³. As for France, this may be due to the fact that it is a large country with considerable geographic, climatic, agricultural and food habit variations from region to region³⁴. Furthermore, only a small part of France is in contact with the Mediterranean Sea. These factors may explain why the mean MAI value in France is similar to that found in Central and Northern European countries³⁵. In previous studies^{28, 31} the Gross National Product (GNP) seemed to be inversely related to the degree of adherence to the Mediterranean pattern, and France had the highest value of GNP and the lowest MAI among the Mediterranean countries²¹.

Egypt, one of the Other Mediterranean countries, stands out as having the highest MAI of all the countries studied, meaning that it is the country that best adheres to the Mediterranean like dietary pattern. Moreover, other research shows that Egypt has the closest compliance to dietary recommendations such as those from the Diabetes and Nutrition Study Group and World Health Organization^{2, 19}. Egypt's high Mediterranean adherence could be indirectly associated with its low GNP³¹, and the influence it has on the type of foods available.

All Central European countries experienced a decrease in Mediterranean diet adherence, and currently have an intermediate ranking. The mean MAI value of Central Europe is now close to 1.00, which indicates that the balance between

Mediterranean and Non Mediterranean food products is similar. Romania and Bulgaria experienced the greatest decreases in adherence within the Central Non Mediterranean European countries, similar in magnitude to decreases experienced in the Mediterranean countries. Food patterns of these countries have been shown to share some characteristics with the Mediterranean dietary pattern³⁶. Furthermore, some studies actually consider them as being Mediterranean because of the impact of the similarities of the Black Sea and the Mediterranean Sea^{2, 36}.

Northern European countries had the lowest adherence to the Mediterranean diet and the MAI values have hardly changed over the last 40 years, however with some exceptions³⁷. The MAI values in the two time periods are less than 1.00 indicating that the Non Mediterranean products contribute more to the diet than the Mediterranean products.

The Other World countries are a very heterogeneous group in terms of current adherence and changes since the 1960's, as they represent a very broad category, including countries in North and South America, Asia and Africa. For instance, Iran had the largest increase in MAI value and became the country with the second highest adherence to the Mediterranean dietary pattern. Iran registered a large increase in energy availability since 1961. Despite small increases in energy supplied by Non Mediterranean foods, the increase of the energy supplied by the Mediterranean food was much greater. The greater availability of fruits and vegetables, cereals, nuts and fish has probably contributed to the increase in MAI (data non shown).

Australia is one of the countries that suffered a very slight rise in MAI value, caused by the increase of energy available from Mediterranean foods and the maintenance of the energy supplied by the Non Mediterranean food (data non shown) that could be due to the presence of people migrating from Mediterranean countries^{25, 38}.

The dietary pattern in Japan, as with Iran, shares many common features with the Mediterranean dietary pattern, such as a high consumption of cereals, vegetables, fruit and fish¹³. Even though the dominant Japanese grain (cereal) is rice and in the Mediterranean basin it is wheat³⁹, the similarities with the standard MD are mirrored in the MAI value presented by Japan in both periods. As with Mediterranean countries, Japan has also become more westernized, which is reflected, among other things, in the diet of the population and the quantity and type of products consumed³⁹⁻⁴¹. Although the total available energy for Japan did not vary substantially, the energy supplied by Non Mediterranean food has doubled. This increase of available energy was essentially due to meat and vegetable fats (except olive oil) (data non shown).

The worldwide MAI values, calculated with the FAO data from World area, grouping 210 countries and territories, presents higher values of adherence to a Mediterranean like food pattern, in both studied time periods, than the group of the 41 selected countries. It is therefore possible to conclude that there are countries with high MAI values that were not included in the study, which explain these differences.

Given that countries are, in general, decreasing their adherence to the Mediterranean dietary pattern, governments and non-governmental organizations need to promote health and agricultural policy strategies²¹ to counteract the continued dietary Westernization of these countries^{4, 28, 42}. This is specially relevant considering that there is now ample scientific evidence showing that the Mediterranean like dietary pattern is a healthy prudent dietary pattern with a lower chronic disease risk in comparison to a more westernized pattern with higher contribution in animal products and sugars^{43, 44}. All of these policies must take into account the inevitable development and globalization that all countries are subject to nowadays and must be adapted to the current recommendations aiming to improve health and well being^{45, 46}.

REFERENCES

- [1] Noah A, Truswell AS. There are many Mediterranean diets. *Asia Pacific Journal of Clinical Nutrition*. 2001 **10**: 2-9.
- [2] Karamanos B, Thanopoulou A, Angelico F, Assaad-Khalil S, Barbato A, Del Ben M, et al. Nutritional habits in the Mediterranean Basin. The macronutrient composition of diet and its relation with the traditional Mediterranean diet. Multi-centre study of the Mediterranean Group for the Study of Diabetes (MGSD). *Eur J Clin Nutr*. 2002 **56**: 983-91.
- [3] Willett WC, Sacks F, Trichopoulou A, Drescher G, Ferro-Luzzi A, Helsing E, et al. Mediterranean diet pyramid: a cultural model for healthy eating. *Am J Clin Nutr*. 1995 **61**: 1402S-6S.
- [4] Trichopoulou A. Traditional Mediterranean diet and longevity in the elderly: a review. *Public Health Nutr*. 2004 **7**: 943-7.
- [5] Serra-Majem L, Trichopoulou A, Ngo de la Cruz J, Cervera P, Garcia Alvarez A, La Vecchia C, et al. Does the definition of the Mediterranean diet need to be updated? *Public Health Nutr*. 2004 **7**: 927-9.
- [6] Bach-Faig A, Geleva D, Carrasco JL, Ribas-Barba L, Serra-Majem L. Evaluating associations between Mediterranean diet adherence indexes and biomarkers of diet and disease. *Public Health Nutr*. 2006 **9**: 1110-7.
- [7] Keys A, ed. *Seven Countries: A Multivariate Analysis of Death and Coronary Heart Disease*. 1st ed: Cambridge: Harvard University Press 1980.

- [8] Serra-Majem L, Roman B, Estruch R. Scientific evidence of interventions using the Mediterranean diet: a systematic review. *Nutr Rev.* 2006 **64**: S27-47.
- [9] Sofi F, Cesari F, Abbate R, Gensini GF, Casini A. Adherence to Mediterranean diet and health status: meta-analysis. *BMJ.* 2008 **337**: a1344.
- [10] Bach A, Serra-Majem L, Carrasco JL, Roman B, Ngo J, Bertomeu I, et al. The use of indexes evaluating the adherence to the Mediterranean diet in epidemiological studies: a review. *Public Health Nutr.* 2006 **9**: 132-46.
- [11] Bach-Faig A, Fuentes-Bol C, Ramos D, Carrasco JL, Roman B, Geleva D, et al. The Mediterranean Diet in Spain: adherence trends during the past two decades. *Eur J Clin Nutr.* 2008. In the Press.
- [12] Balanza R, Garcia-Lorda P, Perez-Rodrigo C, Aranceta J, Bonet MB, Salas-Salvado J. Trends in food availability determined by the Food and Agriculture Organization's food balance sheets in Mediterranean Europe in comparison with other European areas. *Public Health Nutr.* 2007 **10**: 168-76.
- [13] Fidanza F, Alberti A, Lanti M, Menotti A. Mediterranean Adequacy Index: correlation with 25-year mortality from coronary heart disease in the Seven Countries Study. *Nutr Metab Cardiovasc Dis.* 2004 **14**: 254-8.
- [14] Rodrigues SSP, Caraher M, Trichopoulou A, de Almeida MDV. Portuguese households' diet quality (adherence to Mediterranean food pattern and compliance with WHO population dietary goals): trends, regional disparities and socioeconomic determinants. *Eur J Clin Nutr.* 2007 **62**: 1263-72.

- [15] Jacobs K, Sumner DA. The Food Balance Sheets of the Food and Agriculture Organization: A review of Potential Ways to Broaden the Appropriate uses of the Data. *Department of Agricultural Economics*: University of California, 2002
- [16] 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. *Eur J Clin Nutr.* 1999 **53**: 854-60.
- [17] Alberti A, Fruttini D, Fidanza F. The Mediterranean Adequacy Index: Further confirming results of validity. *Nutr Metab Cardiovasc Dis.* 2008 **19**, 61–66.
- [18] Alberti-Fidanza A, Fidanza F. Mediterranean Adequacy Index of Italian diets. *Public Health Nutr.* 2004 **7**: 937-41.
- [19] Chen Q, Marques-Vidal P. Trends in food availability in Portugal in 1966-2003: comparison with other Mediterranean countries. *Eur J Nutr.* 2007 **46**: 418-27.
- [20] Lasheras C, Fernandez S, Patterson AM. Mediterranean diet and age with respect to overall survival in institutionalized, nonsmoking elderly people. *Am J Clin Nutr.* 2000 **71**: 987-92.
- [21] Schmidhuber J, Traill WB. The changing structure of diets in the European Union in relation to healthy eating guidelines. *Public Health Nutr.* 2006 **9**: 584-95.
- [22] Trichopoulos D, Lagiou P. Mediterranean diet and overall mortality differences in the European Union. *Public Health Nutr.* 2004 **7**: 949-51.
- [23] Rodrigues SSP, Lopes C, Naska A, Trichopoulou A, de Almeida MDV. Comparison of national food supply, household food availability and individual food consumption data in Portugal. *Journal of Public Health.* 2007 **15**: 447-55.

- [24] Serra-Majem L, MacLean D, Ribas L, Brule D, Sekula W, Prattala R, et al. Comparative analysis of nutrition data from national, household, and individual levels: results from a WHO-CINDI collaborative project in Canada, Finland, Poland, and Spain. *J Epidemiol Community Health*. 2003 **57**: 74-80.
- [25] Noah A, Truswell S. Commodities consumed in Italy, Greece and other Mediterranean countries compared with Australia in 1960s and 1990s. *Asia Pac J Clin Nutr*. 2003 **12**: 23-9.
- [26] Rodríguez-Artalejo F, Banegas JR, Graciani A, Herndndez-Vecino R, Rey-Calero J. Food supply versus household survey data: Nutrient consumption trends for Spain, 1958–1988. *European Journal of Epidemiology*. 1996 **12**: 367-71.
- [27] Alexandratos N. The Mediterranean diet in a world context. *Public Health Nutr*. 2006 **9**: 111-7.
- [28] Garcia-Closas R, Berenguer A, Gonzalez CA. Changes in food supply in Mediterranean countries from 1961 to 2001. *Public Health Nutr*. 2006 **9**: 53-60.
- [29] Regmi A, Ballenger N, Putnam J. Globalisation and income growth promote the Mediterranean diet. *Public Health Nutr*. 2004 **7**: 977-83.
- [30] Vareiro D, Bach-Faig A, Raido B, Bertomeu I, Buckland G, de Almeida MDV & Serra-Majem L. Availability of Mediterranean and non-Mediterranean foods during the last four decades: comparison of several geographical areas. 2008 (In the Press).
- [31] Helsing E. Traditional diets and disease patterns of the Mediterranean, circa 1960. *Am J Clin Nutr*. 1995 **61**: 1329S-37S.

- [32] Zeghichi-Hamri S, Kallithraka S. Mediterranean diet in the Maghreb: An update. *World Rev Nutr Diet*. 2007 **97**: 139-61.
- [33] Tessier S, Gerber M. Factors determining the nutrition transition in two Mediterranean islands: Sardinia and Malta. *Public Health Nutr*. 2005 **8**: 1286-92.
- [34] de Lorgeril M, Salen P, Paillard F, Laporte F, Boucher F, de Leiris J. Mediterranean diet and the French paradox: two distinct biogeographic concepts for one consolidated scientific theory on the role of nutrition in coronary heart disease. *Cardiovasc Res*. 2002 **54**: 503-15.
- [35] Gerber M. Qualitative methods to evaluate Mediterranean diet in adults. *Public Health Nutr*. 2006 **9**: 147-51.
- [36] Bacaria J, Folch R, París A, Reñaga L, Ulied A, et al., eds. *Atles ambiental de la Mediterrània: L'estructura del territori i del paisatge*. 1st ed: Portic 1999.
- [37] Naska A, Fouskakis D, Oikonomou E, Almeida MDV, Berg MA, Gedrich K, et al. Dietary patterns and their socio-demographic determinants in 10 European countries: data from the DAFNE databank. *Eur J Clin Nutr*. 2005 **60**: 181-90.
- [38] Kouris-Blazos A, Gnardellis C, Wahlqvist ML, Trichopoulos D, Lukito W, Trichopoulou A. Are the advantages of the Mediterranean diet transferable to other populations? A cohort study in Melbourne, Australia. *Br J Nutr*. 1999 **82**: 57-61.
- [39] Tokudome S, Nagaya T, Okuyama H, Tokudome Y, Imaeda N, Kitagawa I, et al. Japanese versus Mediterranean Diets and Cancer. *Asian Pac J Cancer Prev*. 2000 **1**: 61-6.
- [40] Serra-Majem L. Japomediterranean diet? *Eur J Clin Nutr*. 2004 **58**: 1324-5.

- [41] Tokudome S, Ichikawa Y, Okuyama H, Tokudome Y, Goto C, Imaeda N, et al. The Mediterranean vs the Japanese diet. *Eur J Clin Nutr*. 2004 **58**: 1323-.
- [42] Dernini S. Towards the advancement of the Mediterranean food cultures. *Public Health Nutrition*. 2006 **9**: 103-4.
- [43] Hu FB, Rimm EB, Stampfer MJ, Ascherio A, Spiegelman D, Willett WC. Prospective study of major dietary patterns and risk of coronary heart disease in men. *Am J Clin Nutr*. 2000 **72**: 912-21.
- [44] Popkin BM, Gordon-Larsen P. The nutrition transition: worldwide obesity dynamics and their determinants. *Int J Obes Relat Metab Disord*. 2004 **28**: S2-S9.
- [45] Byrd-Bredbenner C, Lagiou P, Trichopoulou A. A comparison of household food availability in 11 countries. *J Hum Nutr Diet*. 2000 **13**: 197-204.
- [46] Lachat C, Van Camp J, De Henauw S, Matthys C, Larondelle Y, Remaut-De Winter AM, et al. A concise overview of national nutrition action plans in the European Union Member States. *Public Health Nutr*. 2005 **8**: 266-74.