BMC Nutrition

RESEARCH

Open Access

Development of a tool to assess the compliance of cafeteria menus with the Mediterranean Diet

S. S. Silva[1], A. Rocha[1], L. Ferreira[1], B. Neto[2], D. Dikmen[3], S. Vidacek Filipec[4], Z. Satalic[4] and C. Viegas[5*]

Abstract

Background The Mediterranean diet (MD) has been considered one of the healthiest dietary patterns, and an excellent model of sustainability. Higher Education food services present an excellent scenario to encourage students healthy eating habits and modulate food choices. The purpose of this work was to develop an index to evaluate MD compliance with cafeteria menus.

Methods Three major axes were considered: MD key points, existing indexes on individual adherence to the MD and, existing indexes on menu assessment. The index includes four levels: (I) assesses the availability (IA), variety and frequency (IB) of food; (II) evaluates menu's nutritional quality; (III) assesses the menu's quality through information provided in the dishes' technical specifications and (IV) allows a more detailed evaluation through on-site visits and documentation consultation. The components receive a score between − 2 and 3, according to the given answers. The final score may vary between − 33.5 and 41.5 points depending on the degree of compliance with the MD key points. The index was applied to 60 menus from different contexts using complete assessments of each menu, performed independently by 3 researchers, using the same pre-prepared Microsoft Excel® spreadsheet. Inter-rater reliability was assessed using Cohen's Kappa and internal consistency with Cronbach's alpha.

Results Assessment for level I) returned a Cohen's Kappa coefficient of 0.92 ($p < 0.05$) and a Cronbach's alpha coefficient of 0.88. Dimension I is mostly influenced by subdimension IB ($r = 0{,}97$). The availability of non-starchy vegetables and fresh fruits has a stronger correlation with IA (availability of foods), and higher availability of fish, pulses and fruit has a strong positive correlation with IB (variety and frequency of foods).

Conclusion Researchers believe that the index is a useful tool to assess compliance of menus to the MD and help identify the key points that need to be addressed and improved in cafeterias.

Keywords Index, Menus, Evaluation, Mediterranean Diet

*Correspondence:
C. Viegas
claudia.viegas@estesl.ipl.pt
[1]GreenUPorto/Inov4Agro, Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto, Rua do Campo Alegre, n.º 823, Porto 4150-180, Portugal
[2]Escola Superior de Tecnologia da Saúde, Instituto Politécnico de Lisboa, Av. D. João II, Lote 4.69.0.1 Parque das Nações, Lisboa 1990-096, Portugal
[3]Faculty of Health Sciences, Department of Nutrition and Dietetics, Hacettepe University, Türkiye Hacettepe University, Ankara 06230, Ankara, Türkiye, Turkey
[4]Faculty of Food Technology and Biotechnology, University of Zagreb, Pierottijeva 6, Zagreb 10000, Croatia
[5]H&TRC - Health & Technology Research Center, ESTeSL—Escola Superior de Tecnologia da Saúde, Instituto Politécnico de Lisboa, Av. D. João II, Lote 4.69.0.1 Parque das Nações, Lisboa 1990-096, Portugal

Background

Numerous studies have identified the Mediterranean dietary pattern as a prudent one, as a synonym for a healthy diet, associated with longevity, number healthy years, and a reduced risk of developing chronic diseases [1–7]. It is also an excellent sustainability model since it has a low ecological footprint [8–11]. The Mediterranean diet (MD), first studied by Ancel Keys (1904–2004), is a food pattern characterised by high consumption of fresh, local, and seasonal foods, low in energy, and high consumption of plant foods, namely vegetables, whole-grains cereals, pulses, nuts, and fruit, moderate consumption of fish and low-fat dairy products, low consumption of meat, with lean meat being privileged over red and processed meats. MD is also characterised by prioritising the consumption of vegetable fats, such as olive oil, limiting the consumption of saturated fats, and reducing the consumption of salt and added sugars. Moderate consumption of wine, as a component of a meal, is also characteristic [12–14].

Many indexes of adherence to the MD have been developed to understand how individuals' practices align with this dietary pattern [15]. There is some lack of consistency between the different indexes, due to lack of uniformity in the components (foods, food groups, or nutrients), quantities and number of foods portions, food groups evaluation scales, and contribution of each component to the final score [16]. Nevertheless, the indexes have been used to assess the adherence to the MD and the overall quality of the diet, practically and quickly, by health professionals and political decision-makers [17].

Over the years, people have eaten out more and several studies have shown that the food offered in restaurants impacts individual choices and food habits [18–20]. Despite the existence of some indexes [21–27], none of them assess menu compliance with the MD. Studies reinforce that food services (FS) are ideal for fostering healthy eating habits [28] and the FS menu is a tool that identifies appropriate food availability and plays a leading role in offering healthy choices that promote healthy eating habits. It may also be a useful tool in nutrition literacy and education [26, 29].

This research aims to develop and validate a tool to assess the degree of compliance of cafeteria menus with the key points of the MD. We intend to obtain an indicator to characterise the menus resemblance with the MD, allowing for the identification of opportunities for promoting healthy and sustainable eating patterns.

Methods

Development of the index

To create this index the authors considered three major axes:

1. MD key points.
2. Existing indexes on individual adherence to the MD.
3. Existing indexes on menu assessment.

An extensive literature review was conducted on three major axes. Many studies describe the key points of the MD. The various indexes for assessing adherence to the MD were reviewed and used as a reference for the construction of the proposed tool, considering different components and their respective scores [30–38] (Supl. Table 1) and the indexes for menu assessment were compiled in Supl. Table 2.

MeDCIn index for evaluating compliance of menus with MD

After compiling information from the three axes researchers structured the index into 4 dimensions. The first dimension considers the MD key points, namely the consumption of local and seasonal foods, plant foods like vegetables, whole grains, pulses, fruit, nuts, seeds, herbs and spices, consumption of fish over meat and lean meat over red and processed meats, eggs as a good source of sustainable protein, olive oil as the preferred fat, prioritising the consumption of monounsaturated fats and fibre, and reduced consumption of saturated fats, cholesterol and free sugars. The presence of typical dishes from the MD was also considered, using characteristic cooking techniques, and ingredients such as olive oil, onion, garlic, and tomato [12, 14, 39, 40]. The wine was not considered because it is not intended to be promoted in public food services and due to the conflicting outcomes of alcohol consumption [41–43], even though it is included in the Mediterranean dietary pattern in moderate quantities, and as a part of the meal [8]. Dairy products were not considered because in Portugal it is not usual to consume these foods at lunchtime, and in Croatia are also a staple for breakfast and snacks, but not for lunch.

Although it is not usual to describe the type of fat used on menus, the authors considered it important to add this evaluation item, to influence the discrimination of the kind of fats used. Sweet desserts as sources of added sugars and saturated fats were also considered.

Dimension I items are divided into two parts, assessing availability (part A) and variety and frequency (part B) of foods/food groups. Dimension II assesses the nutritional quality of the menus based on their nutrient declaration. Dimension III assesses the food portions and culinary options (fats and seasoning) based on the information provided by the technical specifications of the dishes and Dimension IV allows for the on-site verification of some of the previous information and additional documentation related to the use of local food suppliers and available beverages, namely water and fruit juices. Lastly, the adequacy of the food portions served to the target population is also a part of the index evaluation.

Table 1 Description and scores of dimension I of the MeDCIn

Dimension I - FOODS and VARIETY				
IA – Foods				
Item		**Score if YES**	**Score if NO**	**Non-applicable**
A1	Availability of traditional Mediterranean dishes	1	-1	-
A2	Availability of vegetables soup	1	-1	-
A3	Availability of non-starchy vegetables (side dish or on dish)	1	-1	-
A4	Availability of seafood dishes	1	-1	-
A5	Availability of dishes with eggs as the main protein source	1	-1	-
A6	Availability of meat dishes	1	-1	-
A7	Availability of dishes containing pulses	1	-1	-
A8	Availability of fresh fruit as dessert	1	-1	-
A9	Availability of whole grains	1	-1	0
A10	Availability of nuts and seeds	1	-1	-
A11	Availability of olive oil (cooking and seasoning)	1	-1	0
A12	Use of seasonal products	1	-1	0
IB – Variety and Frequency				
Item		**Score if YES**	**Score if NO**	**Score if Non-applicable[a]**
B1	Stewed dishes with tomato and/or onion and/or garlic and/or leek **at least 3 times a week**	1	0	-
B2	Traditional soups of the MD (vegetables soup, use of pulses in some soups) **at least 3 or 4 times a week**	1	0	-
B31	Non-starchy vegetables – more than 1 daily and not repeated in consecutive days different in at least 3 weekdays	2	Go to B32	-
B32	Non-starchy vegetables – more than 1 daily and not repeated on consecutive days	1	0	-
B4	**Higher** number of seafood dishes than meat dishes	2	-2	-
B5	Dishes with eggs as the main protein source **at least once a week**	1,5	-1,5	-
B61	Lean meat dishes in a **higher** number than red meat dishes	1	-1	-
B62	**No use** of processed meat	1	Go to B63	-
B63	Use of processed meat dishes **no more than once a week**	1	-1	-
B71	Pulses – 3 or more times a week	2	Go to B72	-
B72	Pulses – 1 to 2 times a week	1	-2	-
B81	Fresh fruit – Daily	3	Go to B82	-
B82	Fresh fruit – 3 to 4 times a week	1,5	Go to B83	
B83	Fresh fruit – 1 to 2 times a week or less (no fruit)	-1		
B84	Sweet desserts **no more than 3 times per month**	1	Go to B85	-
B85	Sweet desserts **no more than once a week**	0,5	Go to B86	
B86	Sweet desserts **2 to 3 times/week**	-0,5	Go to B87	
B87	Sweet desserts **more than 3 times/week**	-1,5		
B9	Whole grains – 2 or more times a week	1	0	-
B10	Nuts and seeds - once or more a week	1	0	-

a – non-applicable may be considered for some items if information is not available

Table 2 Description and scores of dimension II of the MeDCIn

Dimension II - Nutrients	**Score if YES**	**Score if NO**
Ratio monounsaturated/saturated fat > 2	1	0
Cholesterol < 90 mg	1	-1
Fibre > 7,5 g	1	-1
Salt < 1,5 g	1	-1

The items that compose the index are meant to be evaluated considering a four-week cycle, one main meal per day, but this can be adapted according to each food service specifications.

Dimension I – availability, variety and frequency of food/food groups

This first dimension includes 12 items for availability and 10 items for the variety and frequency of food /food groups based on the MD key points. For the availability of food or food groups (A), the index includes items covering the availability of traditional Mediterranean dishes and soups availability of non-starchy vegetables, seafood, egg and meat dishes, availability of pulses, availability of fresh fruit as dessert, whole grains, nuts and seeds, olive oil and seasonal products. Positive points are attributed to Mediterranean compliance on the menu, while non-Mediterranean compliance is negatively scored. Each menu item is evaluated individually, and since part A, assesses only the availability of options, a positive point is attributed if the item is available and a negative point if not.

For the variety and frequency (B), a score, between −2 and 3, is attributed according to the degree of compliance with each item. The score is attributed to each item according to the item's importance in the MD. This part, scores higher points for more variety and frequency and fewer points for the opposite, namely, higher variety and frequency of non-starchy vegetables score 2 points while less variety and frequency scores one point. In the MD, fish is a preferred option over meat. Therefore, a higher number of seafood dishes scores two points, while the opposite penalizes two negative points. The same rationale occurs for lean meat dishes over red meat dishes with one positive point attributed if the menu has more lean meat over red meat while a negative point is attributed if not. Another important item of the MD is pulses, so a frequency of 3 times a week scores two points, a lower frequency of 1 or two times a week scores one point and, if not present at all a penalty of two points is attributed. MD supports the consumption of fresh fruit as dessert, so 3 points are attributed to the availability of fresh fruit daily, 1.5 points for 3 to 4 times a week, while a negative point is attributed if the fruit is not present or only available 1 to 2 times a week. Moreover, the high frequency of sweet desserts is penalized from −0.5 to -1.5, while the lower frequency scores from 0.5 to 1.

In part A, three items allow for a non-applicable answer, meaning no points are attributed but also no penalty is applied. This is the case of the availability of whole grains and nuts on the menu since it is not usual for their inclusion in the description. Nevertheless, the authors consider it important to encourage the presence and reference of these foods on the menu. The description of dimension I of the index is represented in Table 1.

Dimension II - nutrients

The second dimension of the MeDCIn aims to evaluate the nutrient ratio of menus based on their nutritional declaration. Table 2 describes the second dimension of the index.

The authors considered 30% of the recommended daily value for monounsaturated and saturated fat, cholesterol, and fibre as adequate for main meals (lunch or dinner) [44, 45].

Dimension III – food portions and culinary options (technical specifications)

The third dimension evaluates food portion sizes and culinary options on the menus by considering the technical specifications of the dishes that make up the menu plan. This includes evaluating the presence of herbs, spices, and oilseeds in salads, as well as determining the appropriate quantities of each food group for the target population. The items and scores for dimension III are presented in Table 3.

Dimension IV – implementation and additional information (on-site verification)

The fourth dimension of this tool aims to evaluate the menu by confirming its implementation in the food service unit and consulting additional documentation to verify compliance with the use of local food products. This dimension completes the assessment of the compliance of the menu with MD.

The verification that food portions are adequate for the age groups should be done by weighing and averaging the food quantities for each food/food group from 3 dishes collected randomly from the self-service. Table 4 presents the description of dimension IV of the index.

Final scores

After evaluation of all components, a sum of each score is calculated. The final score can vary between −33.5 and 41.5 points depending on the degree of compliance with MD key points. The scoring system for the four dimensions is as follows: the first-dimension scores from −20.5 to 27 points, the second-dimension scores from −3 to 4

Table 3 Description and scores of dimension III of the MeDCIn

Dimension III – Food portions and culinary options	Score if YES	Score if NO
Use of aromatic plants and spices	1	0
Use of nuts and seeds in salads	1	0
Food portions adequate to the age group[b] 0–25%	0	-2
26–50%	0	-1
51–75%	1	0
76–100%	2	0

b – Food portions should only consider the main meal proportion (30–35% [46]). The percentage referred for scoring is related to the percentage of dishes that comply with food portions

Table 4 Description and scores of dimension IV of the MeDCIn

Dimension IV - In loco checking /documentation	Score if YES	Score if NO
Available food offer corresponds to menu plan	1	-1
Use of aromatic plants and spices	1	-1
Use of local food products	1	-1
Use of traditional MD sauces (tahini, vinaigrette, etc.)	1	-1
Use of seasonal food products	1	-1
Available drinks water	1	-1
sodas, industrial juices	-1	0
other alcoholic drinks	-1	0
natural fruit juices	0,5	0
Food portions adequate to the age group (average weighing of the food components from 3 dishes collected randomly from the self-service)[c]	1	-1

c - Food portions should only consider the main meal proportion (30–35% [46])

points, the third-dimension scores from −2 to 4 points, and the fourth one scores from −8 to 6,5 points.

Data collection

The menus were collected in three countries (Croatia, Portugal and Turkey)[1] within different geographical regions (north, centre and south). Researchers retrieved 60 menus from different cafeterias (schools, nursing homes, higher education cafeterias and companies). Menus were retrieved from direct contact with the cafeterias or online.

Validity and reliability

Supported by previous research on index development [24, 47], the authors conducted several types of analysis to validate the index – content validity, internal consistency, and inter-rater reliability. As stated before, MeDCIn content validity was supported by an extensive literature review, to confirm that the index components reflect the key points, traditional foods, nutritional characteristics, and sustainability aspects of the MD. The index was also evaluated by food service dietitians and experts in the field, who provided insights and contributions about the tool and its performance.

Inter-rater reliability was conducted by two complete assessments of each menu, performed independently by two researchers, using the same pre-prepared Microsoft Excel® spreadsheet with the index scores and calculations. The pilot assessment evaluated the first dimension of the tool. Each researcher received a brief explanation of the index using four menu examples and how to fill the spreadsheet. The researchers were given 60 menus from different food service units and countries that were independently and completely analysed. The menus selected covered various target audiences and various types of food units such as cafeterias from elementary to high education institutes, social services, and the private sector. The menus applied in university cafeterias were collected from food service institutions, websites, and physical locations.

Inter-rater reliability was assessed by a Cohen's Kappa agreement above 0.75 [48] and, alpha-Cronbach coefficient values above 0.80 for internal consistency.

Data analysis

Data analysis was computed using Microsoft Excel version 16 and R software version 4.3.1. Cohen's Kappa and Cronbach's alpha were used to assess inter-rater reliability. Spearman correlation was used to evaluate the dimensions and item correlations of the developed index. Statistical significance was considered at $p<0.05$.

Ethics

This study was approved by the ethics committee of the Faculty of Nutrition and Food Science of the University of Porto (126/2023/CEFCNAUP).

Results

MeDCIn applicability, internal consistency and inter-rater reliability

This index was designed to be used quickly and practically by nutritionists or other food service technicians and can be applied to all types of menus and for different age groups.

The tool has high internal consistency (alpha-Cronbach coefficient=0,88) and high inter-rater reliability (Cohen's Kappa agreement=0,92).

Characterisation of the menus

60 menus, from different types of Food Service, 23% ($n=14$) higher education cafeterias, 42% ($n=25$) undergraduate schools, 30% ($n=18$) nursing homes and, 5% ($n=3$) private companies, were evaluated with MeDCIn.

Figure 1 presents the characterisation of the pilot assessment, while Fig. 2 represents the correlations of subdimensions IA and IB with Dimension I and correlations of each item with its subdimension.

Results showed that dimension I is more influenced by subdimension IB ($r=0,97$). Specifically, about subdimension IA, which evaluates the availability of food, the items that showed the strongest correlation with the tool are the availability of fresh fruit ($r=0,73$), the availability of non-starchy vegetables ($r=0,59$) and the availability of dishes with egg as the main protein source ($r=0,5$). About subdimension IB, which evaluates the variety of foods offered, the items that showed the strongest correlation with the tool are the offer of fresh fruit ($r=0,72$), the use of processed meats ($r=0,52$), the offer of sweet

[1] Consortium from the Project MedDietMenus4Campus.

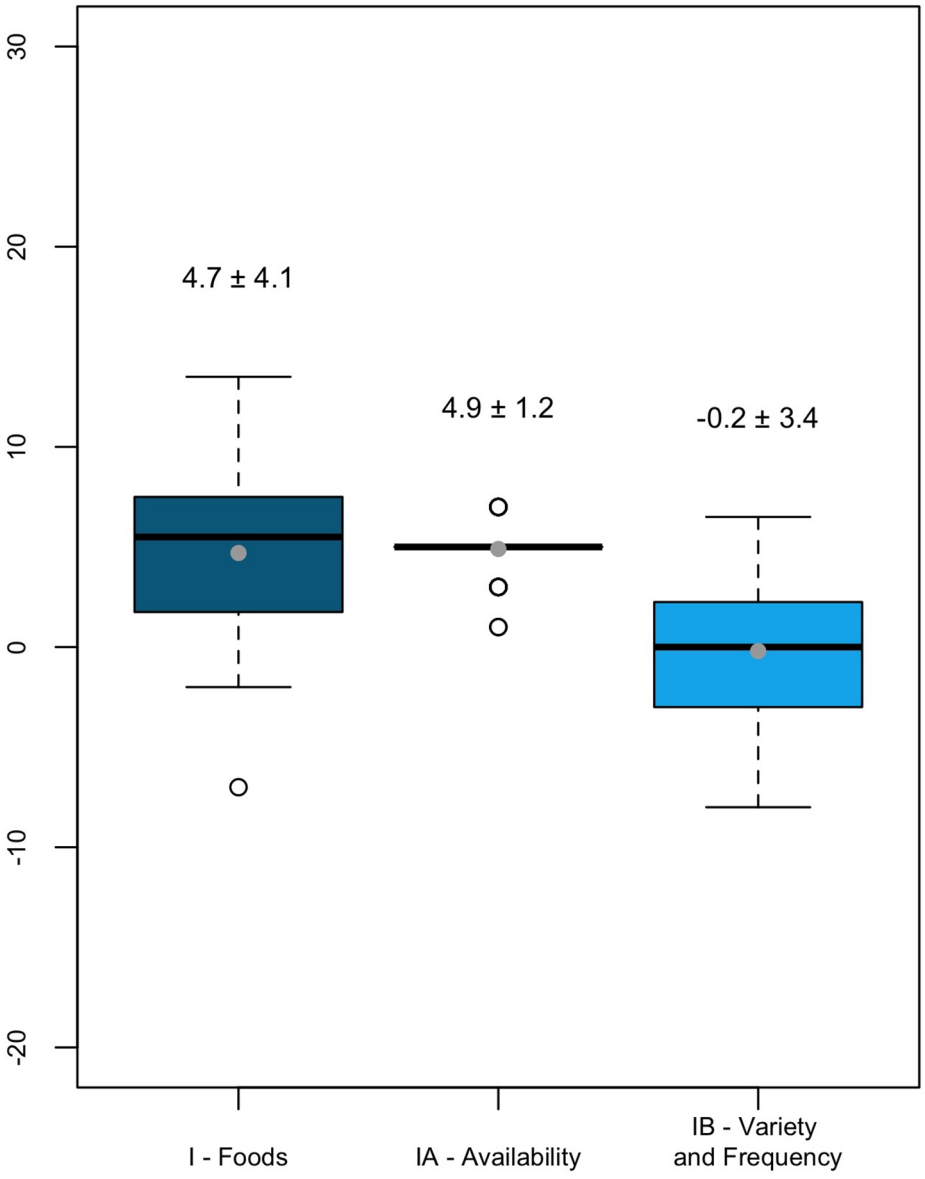

Fig. 1 Boxplots representing results for Dimension I (Foods) and subdimensions IA (availability) and IB (variety and frequency)

deserts (r=0,51) and, a higher offer of seafood dishes compared to meat dishes (r=0,48).

Some of the criteria showed a low correlation with the tool but the research team decided to maintain all the criteria to fulfil all the MD key points previously mentioned.

Discussion

MeDCIn was developed and validated as an objective tool for assessing the degree of compliance of cafeteria menus with the key points of the MD. According to the results, the MeDCIn total score has a high internal consistency, evidenced by a Cronbach's alpha coefficient of 0.88 (>0.80), indicating that the items consistently measure what they are intended to measure [49, 50]. The high inter-rater reliability, evidenced by a Cohen's Kappa of 0,92 (>0,75), indicates that the MeDCIn is consistent and reliable, with a high level of agreement between researchers [51]. The results of internal consistency and inter-rater reliability are high, demonstrating that the MeDCIn has reproducibility, which proves its potential to be used by different users to assess the degree of compliance of menus with the key points of the MD.

The menus showed low agreement with the MD, with a wide range of results, ranging from −7 to 13.5 with an average of 4.65±4.2. These findings are in line with other studies which have reported that university students

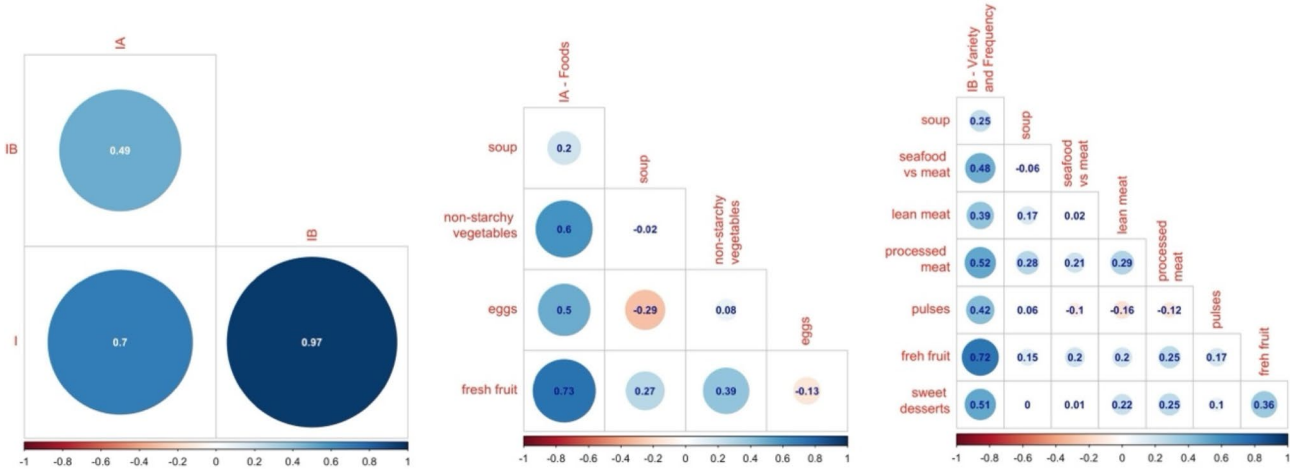

Fig. 2 Dimension and items correlations

have a low intake of healthy foods such as vegetables, fruit, pulses, whole grains and dairy products, and a high intake of foods high in fat, sugar, and salt [52] and low adherence to the MD [53].

The subdimension IA - food availability, varied between 1.0 and 7.0 with an average of 4.87 ± 1.2, indicating a moderate availability of foods characteristic of the MD. The item that showed the strongest correlation with the final score is the availability of fresh fruit (r=0,735). In most indices assessing adherence to the MD, fruit is an important component, as it is the desired dessert in the MD, emphasising its importance in the diet [32–37, 54–57]. To promote fruit, 3 points are attributed if the fruit is present daily, -1,5 points if the fruit is present 3 to 4 times a week, and a penalty of −1,5 points if 1 to 2 times a week or less (not present). The offer of fresh fruit is one of the factors that most influence the final score of the MeDCIn index. In the subdimension IB - variety and frequency of food offered, fruit showed the strongest correlation with the final score (r=0,723). Although the presence of fruit is important, its variety and seasonality are also relevant [58]. To improve this tool, it would be important to integrate a new item that considers the varieties of fruit available. This addition aims to promote more diversity but must be considered carefully not to compromise seasonality in menus.

In subdimension IA, the availability of non-starchy vegetables (r=0.597) is another item that has impact on subdimension IA score. Vegetables are an important part of a sustainable, healthy lifestyle [58] and an important component of the MD [12]. They are mentioned in most of the studies that assess adherence to the MD and constitute its pilar [30, 32–38, 54–57, 59, 60]. Therefore, if more than 1 non-starchy vegetables are present daily and not repeated on consecutive days in at least 3 weekdays, the menu is scored with 1 point, while if more than 1 non-starchy vegetable is present daily and not repeated on consecutive days 2 points are attributed to the menu, to emphasise their importance and variety.

The availability of dishes with eggs as the main protein source also positively influences the subdimension IA of this tool (r=0,495). In Portugal, results from the National Survey on Food and Physical Activity 2015–2016, reveal that eggs have a small contribution to the diet [61]. In Croatia, 78% of adults report consumption of eggs and with a mean intake of 24.9 g/day (one egg approximately weighs 63 g [62]. Data on egg consumption in 2021 shows that Portugal had a higher egg consumption (10.83 kg/capita) than the global average (10.34 kg/capita), but was still far below the European average (13.89), while Turkey and Croatia had an even lower consumption than the global average (9.78 and 8.60) [63] eggs are traditionally regarded as supreme protein source, however, with a major drawback of having a high cholesterol content, however, there occurred a paradigm shift regarding the atherogenic potential of dietary cholesterol, and eggs are gaining in popularity among consumers because they provide choline, vitamin D, lutein and zeaxanthin, etc. Although they are an important part of the MD, they are only mentioned in some studies assessing adherence to the MD [54–57]. These dishes are typically underrepresented in menus and should be more often considered to promote healthy and sustainable diets [58, 64].

In sub-dimension IA, the availability of whole grains and olive oil (for cooking and seasoning) and the use of seasonal products are difficult to assess in the menus. Nevertheless, the authors considered it relevant to have these items in the tool, to promote its use in meal preparation and its disclosure for consumers in menus. Furthermore, whole grain products are included in some of the indices of MD adherence [33, 37, 38, 55, 57, 60], and olive oil is mentioned in all of them [8, 31, 33–38, 54,

55, 57, 60]. In MeDCIn whole grains, nuts, and seeds are positively scored with one point if present respectively, 2 or more times a week and once or more a week to promote the availability of these products in the menus. Seasonal products and Mediterranean dishes and soups aren't included in these individual MD adherence tools [34], but as a tool to evaluate menus, authors believe relevant to include this information.

The sub-dimention IB - variety and frequency of foods offered, varied between −8.0 and 6.5, with an average of 0.22±3.4, indicating a limited variety, low frequency of key food groups and high-frequency of food groups that should be limited, which is the factor that most influences the dimension I of the MeDCin (r=0.97). In this sub-dimension IB, apart from fruit (already mentioned), the use of processed meats is the item that showed the strongest correlation with the score (r=0,516). According to the IAN-AF 15/16, the consumption of processed meats by the Portuguese population is significant, revealing that 56% of Portuguese regularly consume processed meats [61] and, in Europe, the average processed meat consumption exceeds the recommendations [58]. Although it is part of some typical MD dishes, it must be consumed sparingly due to its association with various health problems, including cardiovascular disease and cancer, and its impact on planetary health [58]. Some indicators measuring adherence to MD also include this item to assess the impact of the diet but as a less favourable component [38, 54, 57, 60]. The MeDCIn scores positively with 1 point for the non-use of processed meats and 0.5 if they are used no more than once a week, while a negative point is attributed if processed meats are used more than once a week. This score aims to raise awareness of the importance of reducing the consumption of these foods, promoting the MD, and contributing to dietary changes towards a healthy diet from sustainable food systems [12, 58, 65].

Also, the offer of sweet desserts showed a moderate correlation with the score (r=0,513). Like processed meat, average sugar intake in Europe exceeds recommendations and its consumption has a negative impact on health [58] and, is not recommended in MD. It is therefore important to moderate its availability [12, 58, 65]. Some indicators of adherence to the MD also include sugar, but as an undesirable component of the diet [35, 38, 54–57, 66]. In MeDCIn, sweet desserts are part of the menu no more than 3 times per month they are scored with 1 point and, score 0.5 if present no more than once a week. However, the more frequently they are available on the menu, the higher the negative points attributed (-0.5 for 2 to 3 times a week; -1.5 for more than 3 times a week).

Another item that showed a relevant correlation with the score is the offer of seafood dishes in higher proportion than the meat dishes (r=0,481). Seafood consumption is associated with a lower risk of cardiovascular disease [67], although, meat consumption is higher than seafood consumption [58, 61]. Fish consumption varies significantly across different Mediterranean countries. Portuguese diet includes a wide variety of fish and seafood with a national average consumption of around 59 kg. In Croatia, fish consumption is also significant, accounting for approximately 20.1 kg per capita per year. In contrast, Turkey's diet has the lowest consumption with an average of 6.2 kg per capita per year [68, 69]. According to the MD key points, seafood consumption should be encouraged [12]. All MD adherence indices include seafood, although they differ in measurement scale and contribution to the final score [30–38, 54–57, 59, 60, 66]. In MeDCIn, a higher proportion of seafood dishes is scored with 2 points, and −2 if this item is not fulfilled.

Pulses and other items showed a low correlation with the final score, probably because all menus scored poorly on these items. Pulses have a low footprint and are an important part of a healthy and sustainable diet and, are one of the key food groups in MD, considered one the most important foods as an alternative protein source [58, 70], included in most MD adherence indices [32, 34, 35] and some menu evaluation tools [25]. In the future, if pulses become more available on menus, the MeDCIn could integrate the varieties of pulses, to promote diversity.

The dispersion of the results shows the diversity of the food offered in the different menus analysed. The results also indicate a low degree of compliance between the menus evaluated and the MD, suggesting opportunities for improvement in the menus, especially in the variety and frequency of foods.

The menu served in food service institutions is one of the tools that plays a vital role in the development of healthy eating habits and is a valuable instrument for nutrition education [26, 71–74]. Vegetables, whole grains, pulses, fruits, nuts and seeds are the basis of the MD. These are also the food items that are less prevailed in the analysed menus, which makes this analysis a valuable tool to evaluate the quality of the food offer and identify opportunities to intervene. The validated menu assessment tool for food services is critical for implementing menus that offer healthier and more sustainable options, contributing to promoting dietary intakes that are adequate, healthy and, sustainable [23, 75].

The MeDCIn tool is relevant because although several indices assess individual adherence to DM, few are dedicated to evaluating menus [21–26, 47]. From these tools, only the KIMEHS assesses menus in the context of MD, but for children [25]. Comparing MeDCIn with other tools, the authors consider it as a broader tool that allows

a detailed and practical assessment of menus, facilitating the identification of opportunities to promote healthy and sustainable eating patterns. Nutrition Environment Measures Study in Restaurants (NEMS-R) has a more general scope than MeDCIn. It focuses on the restaurant environment and has no specific link to a particular dietary pattern in food service. The NEMS-R includes a detailed qualitative assessment of the food environment and the availability of nutritional information and food promotions. It assesses items such as the availability of healthy main dishes, salads, and drinks, and the presence of barriers and facilitators to healthy eating [24]. The Full Restaurant Evaluation Supporting a Healthy (FRESH) is broader in scope and, assesses not only the menu but also the environmental support measures such as signage, labelling and portion sizes. This tool considers variables in menu choices (i.e. lean meats, vegetarian options, fruits, vegetables, salad bar, grains and cereals, side dishes, fried foods, beverages, desserts and, condiments) [76].

As part of the MD key points and, in addition to their positive nutritional properties, aromatic plants and spices can contribute to reduce the amount of salt used in cooking, adding flavour and aroma not only to salads but also to dishes [12], which is why in MeDCIn their use scores 1 point to promote their use and information in the menu.

The AVACARD, another menu evaluation index, uses a comprehensive approach to assess the quality of menus, considering both quantitative (energy and nutrients) and qualitative (diversity and sustainability) aspects based on the quality, quantity, harmony, adequacy, and sustainability/food culture [23]. The AVACARD tool adopts a food guide for the Brazilian population, which means that it requires constant update with the latest dietary guidelines and recommendations to ensure its relevance and accuracy [23]. Taking this into account, the MeDCIn tool is more versatile and more widely applicable, not only from a cultural point of view but also in different Mediterranean cultures and countries or others that adopt or wish to promote the MD.

The Menu Assessment Scoring Tool (MAST) assesses the nutritional quality of a wide range of food services outlet menus based on dietary risk. It can therefore be used as a screening tool for risk but, does not provide a detailed and accurate assessment of each menu item like MeDCIn. The MAST tool classifies six categories of foods (vegetables, fruit, grains, meat and alternatives, dairy and alternatives, and beverages and miscellaneous) on the menu as nutritious or nutritionally poor according to the Australian Food and Nutrition Recommendations, requiring constant adjustment [77]. In comparison, MeDCIn is a more specific tool for assessing menu quality, focusing more on nutritional, cultural, and sustainability aspects, in line with the Sustainable Development Goals (SDG).

MeDCIn gives a quantitative assessment of menu quality, taking into account the availability of typical DM dishes, the variety of foods offered, the nutritional quality in terms of specific nutrients, and the adequacy of portions. This is done through a combination of menu assessment, documentary assessment, on-site verification, and consulting the technical specifications of the dishes. Both share a concern with promotion of healthy food choices, but MeDCIn stands out for its specific focus on the MD key points, filling an important gap in the assessment of menu quality in food services.

While developing and testing the MeDCIn, researchers discussed different inputs from the team members and new ideas emerged to improve the tool, namely the inclusion of variety of fruits and pulses. Also, it would be wise to incorporate criteria for assessing the presence of processed foods beyond just processed meat. Menu options such as nuggets, fish fingers, breaded items and/or prepared meals, that contain high amounts of saturated fat, salt, and sugar, are food options that move away from the MD key points.

Another relevant consideration is the diversity of Mediterranean countries and the wide variety of dishes that may be part of this food pattern [78], while also considering countries and gastronomy that are not typically Mediterranean but may follow some of the same principles. To comply with all this diversity the index could be specifically adapted and used to evaluate menus promoting a broader picture of the food offered in cafeterias.

Given that this tool represents a new approach to the evaluation of menus within the food service, it´s important to acknowledge that there may be challenges in comparing the results obtained with those reported in the literature, as this remains an understudied topic. This tool is an innovative effort to evolve the understanding and application of dietary assessment tools within food service settings, highlighting both its potential and the need for continued investigation and improvement.

Conclusion

This study aimed to develop and validate a tool for the evaluation of food service menus according to the MD key points. The results of internal consistency and inter-rater reliability were considered relevant to the validity of the instrument, providing evidence of validation. This index is a high-quality and valid tool that can be used by nutritionists and other professionals, to optimise the process of menu design and to improve existing menus. The MeDCIn is a simple, practical, easy-to-understand and quick-to-use tool. This tool can be used in different types of food services such as schools, nursing homes, higher education cafeterias and companies.

This tool makes it possible to understand the food offered and raise awareness of how to improve the food and nutritional profile of menus and meals, within the framework of the MD key points and in line with sustainability and sustainable development goals.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40795-024-00975-2.

Supplementary Material 1

Acknowledgements
Not applicable.

Author contributions
AR, CV, and SSS developed the index. BN, LF and SSS wrote the initial draft of the paper. CV perform statistical analysis. AR and CV performed initial revision. DD, SF and ZS made the final revision.

Funding
This research was funded by PRIMA – partnership for research and innovation in the Mediterranean Area, which is supported by Horizon 2020, the European Union's Framework Programme for Research and Innovation. PRIMA internal reference – 1925.
This research was supported by PRIMA/0008/2022, PRIMA/0009/2022 and FCT/MCTES UIDB/05608/2020, UIDP/05608/2020, UIDB/05748/2020 and UIDP/05748/2020.

Data availability
The data is available on the OSF platform at the following link https://osf.io/bh67j/files/osfstorage/666d4bf30f8c80151a3c965b

Declarations

Ethics approval
This study was approved by the ethics committee of the Faculty of Nutrition and Food Science of the University of Porto (126/2023/CEFCNAUP).

Consent for publication
Authors consent to the publication of the paper.

Competing interests
The authors declare no competing interests.

Received: 4 July 2024 / Accepted: 9 December 2024
Published online: 18 December 2024

References

1. Grosso G, Marventano S, Yang J, Micek A, Pajak A, Scalfi L, et al. A comprehensive meta-analysis on evidence of Mediterranean diet and cardiovascular disease: are individual components equal? Crit Rev Food Sci Nutr. 2017;57(15):3218–32.
2. Nissensohn M, Román-Viñas B, Sánchez-Villegas A, Piscopo S, Serra-Majem L. The Effect of the Mediterranean Diet on Hypertension: a systematic review and Meta-analysis. J Nutr Educ Behav. 2016;48(1):42–e531.
3. Petersson SD, Philippou E, Mediterranean, Diet. Cognitive function, and dementia: a systematic review of the evidence. Adv Nutr. 2016;7(5):889–904.
4. Zeraattalab-Motlagh S, Jayedi A, Shab-Bidar S. Mediterranean dietary pattern and the risk of type 2 diabetes: a systematic review and dose-response meta-analysis of prospective cohort studies. Eur J Nutr. 2022;61(4):1735–48.
5. Trichopoulou A. Traditional Mediterranean diet and longevity in the elderly: a review. Public Health Nutr. 2004;7(7):943–7.
6. Godos J, Zappalà G, Bernardini S, Giambini I, Bes-Rastrollo M, Martinez-Gonzalez M. Adherence to the Mediterranean diet is inversely associated with metabolic syndrome occurrence: a meta-analysis of observational studies. Int J Food Sci Nutr. 2017;68(2):138–48.
7. Schwingshackl L, Schwedhelm C, Galbete C, Hoffmann G. Adherence to Mediterranean Diet and Risk of Cancer: an updated systematic review and Meta-analysis. Nutrients. 2017;9(10).
8. Serra-Majem L, Tomaino L, Dernini S, Berry EM, Lairon D, de la Ngo J et al. Updating the Mediterranean Diet pyramid towards sustainability: focus on environmental concerns. Int J Environ Res Public Health. 2020;17(23).
9. D'Innocenzo S, Biagi C, Lanari M. Obesity and the Mediterranean Diet: a review of evidence of the role and sustainability of the Mediterranean Diet. Nutrients. 2019;11(6).
10. Medina FX. Food consumption and civil society: Mediterranean diet as a sustainable resource for the Mediterranean area. Public Health Nutr. 2011;14(12a):2346–9.
11. Dernini S, Berry EM. Mediterranean Diet: from a healthy Diet to a sustainable Dietary Pattern. Front Nutr. 2015;2:15.
12. Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, Dernini S, et al. Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutr. 2011;14(12a):2274–84.
13. Martínez-González MÁ, Hershey MS, Zazpe I, Trichopoulou A. Transferability of the Mediterranean Diet to Non-mediterranean Countries. What is and what is not the Mediterranean Diet. Nutrients. 2017;9(11):1226.
14. 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(6 Suppl):s1402–6.
15. Martínez-González MA, García-Arellano A, Toledo E, Salas-Salvadó J, Buil-Cosiales P, Corella D, et al. A 14-item Mediterranean diet assessment tool and obesity indexes among high-risk subjects: the PREDIMED trial. PLoS ONE. 2012;7(8):e43134.
16. Aoun C, Papazian T, Helou K, El Osta N, Khabbaz LR. Comparison of five international indices of adherence to the Mediterranean diet among healthy adults: similarities and differences. Nutr Res Pract. 2019;13(4):333–43.
17. Lazarou C, Newby PK. Use of dietary indexes among children in developed countries. Adv Nutr. 2011;2(4):295–303.
18. Wang B, Liu L, Qiao D, Xue Y, Liu X, Zhang D, et al. The association between frequency of away-from home meals and type 2 diabetes mellitus in rural Chinese adults: the Henan Rural Cohort Study. Eur J Nutr. 2020;59(8):3815–25.
19. Zang J, Luo B, Wang Y, Zhu Z, Wang Z, He X et al. Eating out-of-home in adult residents in Shanghai and the nutritional differences among dining places. Nutrients. 2018;10(7).
20. Seguin RA, Aggarwal A, Vermeylen F, Drewnowski A. Consumption frequency of foods away from Home linked with higher body Mass Index and Lower Fruit and Vegetable Intake among adults: a cross-sectional study. J Environ Public Health. 2016;2016:3074241.
21. Horacek TM, Yildirim ED, Simon M, Bredbenner CB, White AA, Shelnutt KP, et al. Development and validation of the full Restaurant evaluation supporting a healthy (FRESH) dining environment audit. J Hunger Environ Nutr. 2019;14(3):381–400.
22. Pulker CE, Aberle LM, Butcher LM, Whitton C, Law KK, Large AL et al. Development of the Menu Assessment Scoring Tool (MAST) to assess the nutritional quality of Food Service Menus. Int J Environ Res Public Health. 2023;20(5).
23. Lima LB, Akutsu RdCCdA, Botelho RA, Nakano EY. AVACARD – menu evaluation index: construction and validation. Int J Gastronomy Food Sci. 2023;31:100671.
24. Saelens BE, Glanz K, Sallis JF, Frank LD. Nutrition Environment measures Study in restaurants (NEMS-R): development and evaluation. Am J Prev Med. 2007;32(4):273–81.
25. Rocha A, Viegas C. KIMEHS-Proposal of an Index for Qualitative Evaluation of Children's Menus-A Pilot Study. Foods. 2020;9(11).
26. Rocha A, Afonso C, Santos MC, Morais C, Franchini B, Chilro R. System of planning and evaluation of school meals. Public Health Nutr. 2014;17(6):1264–70.
27. Mainardi F, Prozorovscaia D, Sweeney G, Green H. Development and validation of a meal quality index with applications to NHANES 2005–2014. PLoS ONE. 2020;15(12):e0244391.
28. Cáceres Jerez MLG-D. Velasco Herrera, Sandra Milena. Satisfaction of university students against an institutional food service and its associated factors. Nutr clín diet hosp. 2018;38(1):160–4.
29. Perez-Cueto FJA. An Umbrella Review of Systematic Reviews on Food Choice and Nutrition published between 2017 and-2019. Nutrients. 2019;11(10).
30. Trichopoulou A, Kouris-Blazos A, Wahlqvist ML, Gnardellis C, Lagiou P, Polychronopoulos E, et al. Diet and overall survival in elderly people. BMJ. 1995;311(7018):1457–60.

31. Gerber M. Qualitative methods to evaluate Mediterranean diet in adults. Public Health Nutr. 2006;9(1a):147–51.
32. Serra-Majem L, Ribas L, Ngo J, Ortega RM, García A, Pérez-Rodrigo C, et al. Food, youth and the Mediterranean diet in Spain. Development of KIDMED, Mediterranean Diet Quality Index in children and adolescents. Public Health Nutr. 2004;7(7):931–5.
33. Panagiotakos DB, Pitsavos C, Stefanadis C. Dietary patterns: a Mediterranean diet score and its relation to clinical and biological markers of cardiovascular disease risk. Nutr Metab Cardiovasc Dis. 2006;16(8):559–68.
34. Martínez-González M, Corella D, Salas-Salvadó J, Ros E, Covas MI, Fiol M, et al. Cohort profile: design and methods of the PREDIMED study. Int J Epidemiol. 2012;41(2):377–85.
35. Schröder H, Fitó M, Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, et al. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr. 2011;141(6):1140–5.
36. Agnoli C, Krogh V, Grioni S, Sieri S, Palli D, Masala G, et al. A priori-defined dietary patterns are associated with reduced risk of stroke in a large Italian cohort. J Nutr. 2011;141(8):1552–8.
37. Zito FP, Polese B, Vozzella L, Gala A, Genovese D, Verlezza V, et al. Good adherence to mediterranean diet can prevent gastrointestinal symptoms: a survey from Southern Italy. World J Gastrointest Pharmacol Ther. 2016;7(4):564–71.
38. Leighton F, Polic G, Strobel P, Pérez D, Martínez C, Vásquez L, et al. Health impact of Mediterranean diets in food at work. Public Health Nutr. 2009;12(9a):1635–43.
39. Franchini B, Rodrigues S. A Roda dos Alimentos. 2003.
40. Martínez-González M, Hershey MS, Zazpe I, Trichopoulou A. Transferability of the Mediterranean Diet to Non-mediterranean Countries. What is and what is not the Mediterranean Diet. Nutrients. 2017;9(11).
41. Alcohol use and burden. For 195 countries and territories, 1990–2016: a systematic analysis for the global burden of Disease Study 2016. Lancet. 2018;392(10152):1015–35.
42. Zhang X, Wu S, Gao X. Assessing the relation between alcohol consumption and risk of disease and mortality - reply. Nutr J. 2021;20(1):59.
43. Manolis TA, Manolis AA, Manolis AS. Cardiovascular effects of alcohol: a double-edged sword / how to remain at the nadir point of the J-Curve? Alcohol. 2019;76:117–29.
44. EFSA Panel on Dietetic Products N, Allergies. Scientific opinion on Dietary reference values for carbohydrates and dietary fibre. EFSA J. 2010;8(3):1462.
45. EFSA Panel on Dietetic Products N, Allergies. Scientific opinion on Dietary reference values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, trans fatty acids, and cholesterol. EFSA J. 2010;8(3):1461.
46. Rocha, Damas. Viegas. AlimentaÃ§Ã£o individual e coletiva: nutrir pessoas, planear refeiÃ§Ãµes e gerir serviÃ§os. Lisboa: Lidel; 2024.
47. Cassady D, Housemann R, Dagher C. Measuring cues for healthy choices on restaurant menus: development and testing of a measurement instrument. Am J Health Promot. 2004;18(6):444–9.
48. Maroco J. Análise Estatística Com o SPSS ed t. editor. Portugal,: ReportNumber:Pinheiro,; 2014.
49. Fiorin BH, Moreira RSL, Filho BL, editors. Validity and reliability of the dimensional assessment scale after myocardial infarction2020.
50. Cronbach LJ. Acceleration among the Terman males: correlates in midlife and after. Intellectual talent: psychometric and social issues. Baltimore, MD, US: Johns Hopkins University; 1996. pp. 179–91.
51. McHugh ML. Interrater reliability: the kappa statistic. Biochem Med (Zagreb). 2012;22(3):276–82.
52. Hafiz AA, Gallagher AM, Devine L, Hill AJ. University student practices and perceptions on eating behaviours whilst living away from home. Int J Educational Res. 2023;117:102133.
53. Vilarnau C, Stracker DM, Funtikov A, da Silva R, Estruch R, Bach-Faig A. Worldwide adherence to Mediterranean Diet between 1960 and 2011. Eur J Clin Nutr. 2019;72(Suppl 1):83–91.
54. Sotos-Prieto M, Moreno-Franco B, Ordovás JM, León M, Casasnovas JA, Peñalvo JL. Design and development of an instrument to measure overall lifestyle habits for epidemiological research: the Mediterranean Lifestyle (MEDLIFE) index. Public Health Nutr. 2015;18(6):959–67.
55. Rumawas ME, Dwyer JT, McKeown NM, Meigs JB, Rogers G, Jacques PF. The development of the Mediterranean-style dietary pattern score and its application to the American diet in the Framingham offspring cohort. J Nutr. 2009;139(6):1150–6.
56. Alberti-Fidanza A, Fidanza F, Chiuchiù 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(11):854–60.
57. Goulet J, Lamarche B, Nadeau G, Lemieux S. Effect of a nutritional intervention promoting the Mediterranean food pattern on plasma lipids, lipoproteins and body weight in healthy french-canadian women. Atherosclerosis. 2003;170(1):115–24.
58. Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. Lancet. 2019;393(10170):447–92.
59. Trichopoulou A, Costacou T, Bamia C, Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. N Engl J Med. 2003;348(26):2599–608.
60. Martínez-González MA, Fernández-Jarne E, Serrano-Martínez M, Marti A, Martinez JA, Martín-Moreno JM. Mediterranean diet and reduction in the risk of a first acute myocardial infarction: an operational healthy dietary score. Eur J Nutr. 2002;41(4):153–60.
61. Lopes C, Torres D, Oliveira A, Severo M, Alarcão V, Guiomar S, Mota J, Teixeira P, Rodrigues S, Lobato L, Magalhães V, Correia D, Carvalho C, Pizarro A, Marques A, Vilela S, Oliveira L, Nicola P, Soares S, Ramos E. Inquérito Alimentar Nacional e de Atividade Física, IAN-AF 2015–2016: Relatório de resultados. Porto: Universidade do Porto; 2017.
62. Authority EFS. Use of the EFSA Comprehensive European Food Consumption Database in exposure Assessment. EFSA J. 2011;9(3):2097.
63. Per capita egg consumption, 1961 to 2021 [Internet]. Our World in Data. (2023) [cited 20 May 2024]. https://ourworldindata.org/grapher/per-capita-egg-consumption-kilograms-per-year?tab=chart&region=Europe&country=HRV~OWID_EUR~ESP~TUR~PRT~ITA~FRA~HKG~CHN~NLD
64. Gibson S, Gray J. Evaluating current egg consumption patterns: associations with diet quality, nutrition and health status in the UK National Diet and Nutrition Survey. Nutr Bull. 2020;45(4):374–88.
65. Commission E. Farm to Fork Strategy. For a fair, healthy and environmentally-friendly Food System. Brussels,Belgium.: European Commission:; 2020.
66. Benítez-Arciniega AA, Mendez MA, Baena-Díez JM, Rovira Martori MA, Soler C, Marrugat J, et al. Concurrent and construct validity of Mediterranean diet scores as assessed by an FFQ. Public Health Nutr. 2011;14(11):2015–21.
67. Zheng J, Huang T, Yu Y, Hu X, Yang B, Li D. Fish consumption and CHD mortality: an updated meta-analysis of seventeen cohort studies. Public Health Nutr. 2012;15(4):725–37.
68. Association AeFaAPE. Turkish seafood Aegean Fishery and Animal Products Exporters' Association 2023 [cited 21 May 2024]. https://turkishseafood.org.tr/en/
69. European Commission. Directorate-General for Maritime A, fisheries. Facts and figures on the common fisheries policy – basic statistical data – 2022. Publications Office of the European Union; 2022.
70. Nations U. Goal 12: Ensure sustainable consumption and production patterns. 2015 2015.
71. Barrozo A, Mendonça K. Análise qualitativa de preparações de cardápios de uma unidade de Alimentação e Nutrição. Volume 13. Universitas: Ciências da Saúde; 2015.
72. Ducrot P, Méjean C, Aroumougame V, Ibanez G, Allès B, Kesse-Guyot E, et al. Meal planning is associated with food variety, diet quality and body weight status in a large sample of French adults. Int J Behav Nutr Phys Activity. 2017;14(1):12.
73. Perez-Cueto FJA. An Umbrella Review of Systematic Reviews on Food Choice and Nutrition published between 2017 and-2019. Nutrients [Internet]. 2019; 11(10).
74. Vecchio R, Cavallo C. Increasing healthy food choices through nudges: a systematic review. Food Qual Prefer. 2019;78:103714.
75. Mandracchia F, Tarro L, Llauradó E, Valls RM, Solà R. Interventions to promote healthy meals in full-service restaurants and canteens: a systematic review and Meta-analysis. Nutrients [Internet]. 2021; 13(4).
76. Horacek TM, Dede Yildirim E, Simon M, Byrd Bredbenner C, White AA, Shelnutt KP, et al. Development and validation of the full Restaurant evaluation supporting a healthy (FRESH) dining environment audit. J Hunger Environ Nutr. 2019;14(3):381–400.

77. Pulker C, Aberle L, Butcher LM, Whitton C, Law KK, Large A, et al. Development of the Menu Assessment Scoring Tool (MAST) to assess the nutritional quality of Food Service Menus. Int J Environ Res Public Health. 2023;20:3998.
78. Noah A, Truswell AS. There are many Mediterranean diets. Asia Pac J Clin Nutr. 2001;10(1):2–9.

Publisher's note