International Journal of Gastronomy and Food Science 43 (2026) 101380

Contents lists available at ScienceDirect

International Journal of Gastronomy and Food Science

journal homepage: www.elsevier.com/locate/ijgfs

Higher education settings menus have low compliance with the Mediterranean Diet and high carbon and water footprint: a case study from Portugal, Croatia and Turkey

B. Neto [a], D. Dikmen [b], L. Ferreira [c,d], C. Viegas [e,*], S. Filipec [f], L. Drobac [f], Z. Šatalić [f], A. Rocha [c,d]

[a] Escola Superior de Tecnologia da Saúde de Lisboa, Portugal
[b] Hacettepe University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Türkiye
[c] Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto, Portugal
[d] GreenUPorto Sustainable Agrifood Production Research Centre/Inov4Agro, Portugal
[e] H&TRC—Health & Technology Research Center, ESTeSL—Escola Superior de Tecnologia da Saúde, Instituto Politécnico de Lisboa, Portugal
[f] University of Zagreb, Faculty of Food Technology and Biotechnology, Croatia

A B S T R A C T

This study focuses on evaluating the compliance of menus from Higher Education Institutions (HEI) with the Mediterranean Diet (MD) and calculates their respective carbon and water footprints. From September 2023 to June 2024, menus from 52 HEI's across Portugal, Croatia and Turkey were analysed using a Mediterranean Diet Compliance Index (MeDCIn). Also, the footprints of 300 meals from 30 different menus were calculated.

Overall results show a low compliance with the MD (mean score 2.7 ± 3.4). Turkish menus scored the highest values (5.2 ± 1.7) while Portuguese menus scored the lowest (1.10 ± 3.7) (MeDCIn varies between −20.5 and 27). The limited availability of dishes with eggs, wholegrains, olive oil, nuts, seeds, and seasonal products was a key factor contributing to the low compliance observed, as well as insufficient variety in Mediterranean dishes, vegetables, pulses, seafood and lean meat.

The average water footprint was 1785.41 ± 909.3 m3/ton, with Turkish menus having the highest consumption (2271.90 ± 1016.11 m3/ton) and Portuguese menus the lowest (1485.46 ± 767.28 m3/ton). The average carbon footprint was 1.9 kg CO2-eq, with Turkish menus again scoring the highest (2.91 ± 2.13 kg CO2-eq) and Portuguese menus the lowest (1.42 ± 1.26 kg CO2-eq).

The findings reveal a complex relationship between MD compliance and environmental footprints, with moderate positive correlations observed. These results provide valuable insights to develop targeted interventions to improve menu options in HEI cafeterias and reduce their environmental impact.

Implications for gastronomy

The findings reveal a complex relationship between MD compliance and environmental footprints, providing valuable insights to develop targeted interventions to improve menu options in HEI cafeterias and reduce their environmental impact.

Low compliance and variations across the three countries emphasise the importance of introducing changes to the menus to improve university food services, highlighting the importance of tailored interventions that consider culinary traditions, gastronomy practices, food availability and cultural preferences.

The results suggest that there is a complex relationship between MD compliance and environmental sustainability that requires further investigation.

1. Introduction

For decades, the Mediterranean Diet (MD) has gained attention from researchers worldwide in terms of both individual benefits and public health perspective. Initially, conceptualised by Ancel Keys (1904–2004), a high intake of fresh, local, and seasonal foods, including vegetables, whole-grain cereals, pulses, nuts, and fruit, characterises this food pattern. It also emphasises moderate fish and low-fat dairy products consumption, while limiting meat intake to lean varieties. Central aspects are also the preference for vegetable oils, particularly olive oil, over saturated fats; moderate wine consumption with emphasis that the consumption occurs within meals, and reduced salt and added sugar intake. In recognition of its cultural significance and health-promoting

* Corresponding author. Escola Superior de Tecnologia da Saúde de Lisboa, Av. D. João II, Lote 4.69.0.1, Parque das Nações, 1990-096, Lisboa, Portugal.
E-mail address: Claudia.viegas@essl.ipl.pt (C. Viegas).

https://doi.org/10.1016/j.ijgfs.2025.101380
Received 11 September 2025; Received in revised form 30 November 2025; Accepted 1 December 2025
Available online 8 December 2025
1878-450X/

properties, the MD was designated as a UNESCO Intangible Cultural Heritage in 2010, each country adapting the diet to its culinary traditions, food seasonality and availability (García-Meseguer et al., 2014; Willett et al., 1995; Bach-Faig et al., 2011).

In addition to all the health benefits that MD has, it is also considered a sustainable diet as it is mainly based on a high consumption of vegetables and fruits and a reduced consumption of meat and its products. In this study we specifically focus on the environmental dimension. In general, a plant-based diet is associated with lower carbon emissions and water use in food production, leading to smaller carbon and water footprints compared to other diets with a predominant meat based meals consumption (Willett et al., 2019; Alcorta et al., 2021). However the authors acknowledge that the overall environmental impact of plant-based diets can vary depending on factors such as the origin of the plants products (i.e. importation of crops), the type of production (e.g. the high use of agrochemicals) and the utilization of Genetically Modified Organisms (GMOs), which have their own set of environmental considerations (Jwaideh and Dalin, 2025; Lacour et al., 2018).

Numerous studies have linked adherence to the MD with various health benefits, including reducing risk of chronic diseases such as cardiovascular diseases, cancer and obesity. Ensuring a healthy diet is essential at every stage of the life cycle (Antonopoulou et al., 2020; Gotsis et al., 2015; Schwingshackl and Hoffmann, 2015; Trichopoulou et al., 2005; Widmer et al., 2015; Mendez et al., 2006).

The transition to university represents a vital period in a young adult's life, marked by significant changes and new challenges at the environmental, psychological, physiological and many other levels. During this phase, students often change their lifestyle and habits for example, by modifying their eating habits. Generally, these are influenced by increased autonomy as they leave their parents' house; the perception of preparing and cooking food as a time-consuming activity; busy schedule and/or economic reasons. All of this may lead to an increase in the consumption of pre-prepared meals, fast food and eating out (García-Meseguer et al., 2014; de Liz Martins, 2009; Sogari et al., 2018; SHARMA et al., 2008). Many authors documented changes in Body Mass Index (BMI), with weight gain, less consumption of vegetables and fruit and increased consumption of alcohol in this period of life (Alves, 2014; Kasparek et al., 2008; Deliens et al., 2013; Fernandes, 2011; Borrego et al., 2012).

A study conducted in Indonesia demonstrated that universities cafeterias frequently provide an inadequate food offer, characterized by imbalances in the nutritional content, in both micro and macronutrients as well as excessive salt content (Sakai et al., 2022). Similarly, another study in Portugal corroborates these findings, highlighting an inadequate offer of fruit and vegetables, in smaller portions, far from the recommendations. In contrast, meat and fish remain the most prevalent component on the dishes and it is also noted that there is a lack of plant-based options, when compared to the abundance of the animal-based options (Silva et al., 2024).

More comprehensive research demonstrates the notorious differences in nutrient density and quality among various campus dining venues, with dining halls being the providers of a wider variety of main meals and offering the most nutritious options. It's also important to understand the variations in terms of food options in the different types of locations, which will help to implement specific interventions to improve the students food habits (Andersen et al., 2025).

All of these findings reinforce the influential role of universities in shaping students' dietary habits, underscoring their responsibility to actively provide a healthy offer to their students. Considering they are strategic settings to induce dietary changes, campuses should not only expand the availability of nutritious meal options in the cafeterias but also promote more sustainable food patterns, discouraging the consumption of less healthy foods with higher environmental impact (Li et al., 2022). As we seen before, the MD is one of the healthiest and most sustainable food patterns, and the efforts of universities should be directed towards the implementation of this dietary pattern into their cafeteria menus (Sakai et al., 2022; Fonseca et al., 2021).

To achieve this goal, the authors have developed the Mediterranean Diet Compliance Index (MeDCIn), a pioneering tool designed to assess adherence to the MD among cafeteria menus (Neto et al., 2024). It helps understand the gaps and improvements needed on universities menus while providing guidance on the transition towards more mediterranean menus. The current study seeks to apply the MeDCIn to menus from different university cafeterias across 3 countries - Portugal, Croatia and Turkey - to assess their alignment with the MD key points and to calculate the Water and Carbon Footprint of these menus. The findings from this analysis hold significant implications for understanding the current food offered at higher education cafeterias as the starting point to develop and further implement tailored interventions to improve meal options and promote adherence to the MD among university students.

2. Methods

2.1. Sample and data collection

A quantitative cross-sectional study was conducted, using menus from different higher education institutes (HEI). Menus were collected from several higher education institutes in different cities in each country to provide a broader sample, representing different regions and universities within the respective countries. Invites were sent to all public universities from the 3 countries and menus were retrieved from the one who accepted to participate in the study. The menus from the three countries were collected from various regions, to ensure that the evaluated menus covered foods traditionally consumed in each country. 52 HEIs provided their menus (24 from Portugal – 8 from the North; 6 from the Center; 8 from the South, 2 from the Islands; 14 from Turkey – 5 from the North; 4 from the South; 3 from the West; 2 from the East, and 14 from Croatia – 8 from the East; 4 from the South; 1 from the North). All 52 menus included in the analysis followed a cycle of 4 weeks, varying from September 2023 to June 2024. The application of the index considered only one meal per day, such as lunch or dinner, and included only the regular options from the menus, excluding specific options such as vegetarian, diet, etc.

For the water and carbon footprints calculation, the researchers used a subsample of the previously collected menus from cafeterias in Portugal, Croatia, and Turkey. The dataset comprised two weeks of menus, the equivalent of 10 working days referring to menus from May and June. In all the countries, each meal included one to four main courses options that could be chosen by the consumer (e.g. beef course, seafood course, vegetarian course), and each option was considered separately as an independent meal in the evaluation. Standard recipes were obtained from university cafeterias and recorded in Excel format for the calculations. Before the assessment, the countries translated all the menus and standard recipes into English. For the purpose of cross-country comparison, results were presented at the country level rather than at the level of dishes or weekly menus.

2.2. Assessment of compliance with the Mediterranean Diet

The first dimension of the Mediterranean Diet Compliance Index (MeDCIn) was applied to all the menus, aiming to provide a score on Availability and Variety (Neto et al., 2024). This dimension evaluates the availability (12 items) and the variety (10 items) of meal options available on the menus, based on the key principles of the MD. The menus are classified based on the final score of this dimension in terms of their compliance with the MD. The scale classifies menus that score −20 points to 4.5 as very low compliance; 5 points to 11 as low compliance; 12 points to 19 points as moderate compliance; 20 points to 24 points as good compliance and 25 to 27 as very good compliance with the MD.

Two researchers were provided with guidelines and a prior explanation on how to use the index to ensure uniformity in the tool's application.

The menus were evaluated using an Excel® spreadsheet that automatically calculates the respective scores for each item and the total score of each dimension of the index.

2.3. Carbon and water footprint calculation

2.3.1. Carbon footprint calculation

The carbon footprint of the menus was assessed using the Life Cycle Assessment (LCA) approach (ISO 14040) (ISO 14040, 2006), a scientifically robust method that evaluates the environmental impact of each food product at every stage of its life cycle (from raw material to disposal). The life cycle approach considers all stages of a product's life, from raw material extraction to production, transportation, consumption, and final disposal. The food service industry has significant environmental impacts tied to various stages, including agricultural practices, energy use in cooking, maintaining food storage, and transportation logistics. The life cycle approach allows food service organisations to identify and quantify emissions across the entire supply chain, rather than just focusing on a single phase when preparing the menu. The carbon footprint of all the dishes on each menu was calculated using the data from a systematic review by Clune et al. (2017) (Clune et al., 2017). Spices and some flavourings were excluded from the calculations as they are present in very small quantities in the dishes. Additionally, greenhouse gas emissions values for vermicelli, parsley, tomato paste, noodles, wheat flour, sugar, semolina, tarhana, bread, margarine, pomegranate, coconut, cauliflower, lamb liver, dill, leek, white cheese, and starch were not included as they were not available.

The estimation of the greenhouse gas emissions values was assessed using a bottom-up approach. At the ingredient level, the mass of each ingredient (gr, in grams) was converted into kilograms. At the dish level, the carbon footprint was calculated by multiplying them by the corresponding emission factors (Clune et al., 2017). The emissions of all ingredients were then summed to obtain the total carbon footprint of the per dish (a). The dish level carbon footprint computed as.

(a) $CF_d = \sum_{i=1}^{n} (m_i, kg \times EFC_i)$

Where EFCi is the emission (kg CO_2/kg) for ingredient ***i***.

At the daily level, each menu was composed of a set of courses typically including a first course (e.g. main dish, roasted meat), a second course (e.g. soup, such as lettuce or lentil) and a third course consisting of either dessert or fruit. The daily carbon footprint was determined by summing the footprints of these dishes (b).

(b) $CF\_day, t = CF\_first, t + CF\_second, t + CF\_dessert, t$

The weekly footprint was calculated as the sum of the daily values(c). Finally, at the country level, the weekly totals from the two weeks were summed to obtain the national footprint (d). For the countries with more than one cafeteria, weekly results were first calculated separately for each cafeteria and subsequently aggregated by summation of these to obtain the country-level value.

(c) $CF_{week}, w = \sum_{t \in T_w} CF_{day}, t$

(d) $CF_{country} = CF_{week}, W1 + CF_{week}, W2$

2.3.2. Water footprint calculation

The water footprint values for each food item on the menu were determined using the study by Mekonnen and Hoekstra, 2011, 2012. Their research was based on the guidelines provided by the Water Footprint Network (Aldaya et al., 2012). In our calculations, the water footprint (WF) consists of all water consumed throughout its various production stages, excluding additional water needed for cooking.

The authors conducted a literature search to gather values of the water footprint of fish and seafood and realised that there are few studies on the subject and, in the existing, the value is very low compared to meat and other animal products (Joyce et al., 2019), with some researchers even considering that the value is not relevant for the calculations (Gephart et al., 2014; Troell et al., 2014). After combining the water footprint values from several studies, the authors decided that it would make sense to consider a value in the calculations since most of the fish included in the menus used is either from aquaculture or processed. This study used an average of the values for the two types of fish (freshwater and demersal) from a study by the EAT-Lancet Commission on healthy diets from sustainable food systems (Willett et al.). Additionally, water footprint factors for salt, parsley, tarhana, leek, bulgur, thyme, sumac, vinegar, vermicelli, mushroom, pomegranate, pine nuts, pepper paste, powdered sugar, baking soda, vine leaves, and phyllo dough were also unavailable and therefore not included in the calculations**.**

The water footprint of each dish was estimated by combining the as served amounts of ingredients with their water footprint values (a)obtained from databases (Mekonnen and Hoekstra, 2011, 2012). The dish-level water footprint was then computed as.

(a) $WF_d = \sum_{i=1}^{n} (m_i, kg \times WFC_i)$

Where m*i*, kg is the mass of ingredient *i* expressed in kilograms, and WFC*i* is the water footprint coefficient of the ingredient I (m^3/ton). Daily, weekly and country-level water footprints were subsequently obtained by aggregating the dish-level values, following the same procedure described for the carbon footprint.

2.4. Data analysis

Data was processed using the R software version 4.3.1. Statistical analysis included descriptive statistics, Mann-Whitney, ANOVA for testing for differences among groups, and Spearman correlation. Statistical significance was considered at $p < 0.05$. The scores for the first dimension were calculated separately for each country as well as for all countries combined. Within the first dimension, the two subdimensions - availability and variety - were analysed separately, providing a clear view of the pattern of food offered in higher university institutes in each country. The average daily footprints for each week of the menus were calculated to analyse the correlations between MD compliance (Dimension I) and carbon and water footprint.

3. Results

3.1. Menus compliance with the Mediterranean Diet

The evaluated menus included two meal options (meat or fish-based), complemented with grains or starchy vegetables and non-starchy vegetables, also including a portion of fruit or a sweet dessert and water.

Fig. 1 presents the results for dimension I (I-Foods) for all countries and Fig. 2, presents it separated by country. Related to each component of this first dimension (IA - Availability and IB - Variety), overall compliance of the menus with MD is very low on the three countries (MeDCIn Score = 2.7 ± 3.4) (Fig. 2). Overall Turkey menus score the highest value (MeDCIn Score = 5.2 ± 1.7; low) while Portugal scores the smallest (MeDCIn Score = 1.10 ± 3.7; very low). All the countries have similar values for the availability of foods (IA), and no significant differences were found for this subdimension. However, for variety (IB), countries score differently ($p < 0.05$), with Portugal being the country with the lowest values.

For food availability, the items that most contribute to the low compliance with the MD are the unavailability of dishes with eggs,

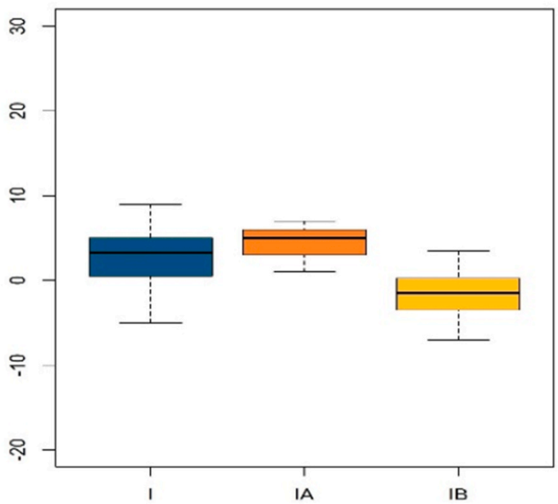

Fig. 1. MeDCIn score (Dimension I) results for all countries and for each country.

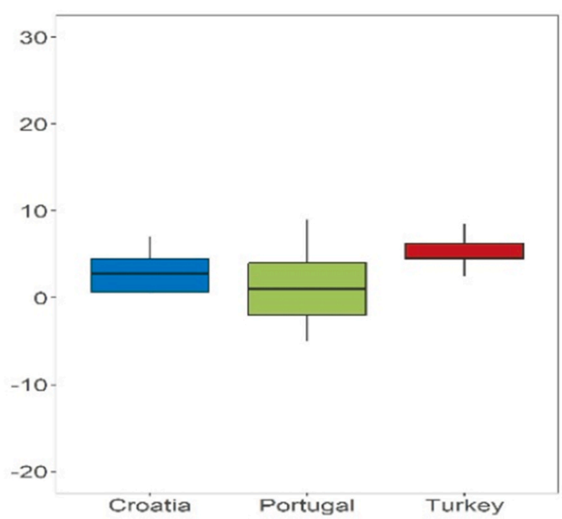

Fig. 2. MeDCIn score (Dimension I) results for each country.

Table 1
Dimension IA Food availability – percentage of item compliance, all countries and by country.

Dimension IA				
Items	Percentage of item compliance			
	All countries (%)	Portugal (%)	Turkey (%)	Croatia (%)
QA1 Availability of traditional Mediterranean dishes	100	100	100	100
QA2 Availability of vegetables soup	94,2	91,7	100	92,9
QA3 Availability of non-starchy vegetables (side dish or on dish)	100	100	100	100
QA4 Availability of seafood dishes	76,9	100	14,3	100
QA5 Availability of dishes with eggs as the main protein source	5,77	12,5	0	0
QA6 Availability of meat dishes	100	100	100	100
QA7 Availability of dishes containing pulses	100	100	100	100
QA8 Availability of fresh fruit as dessert	65,4	54,2	57,1	92,9
QA9 Availability of whole grains	30,8	0	92,9	21,4
QA10 Availability of nuts and seeds	1,92	0	7,1	0
QA11 Availability of olive oil (cooking and seasoning)	23,1	0	85,7	0
QA12 Use of seasonal products	51,9	0	92,9	100

whole grains, olive oil, nuts and seeds and seasonal products (Table 1). Croatia lacks the use of nuts and seeds, dishes with eggs and olive oil; Portugal wholegrains, olive oil, nuts and seeds and seasonal ingredients and Turkey lacks the use of dishes with eggs, seasonal ingredients and olive oil (Table 1).

In terms of variety, the main issues are the variety of Mediterranean dishes, vegetables, pulses, seafood and lean meat (Table 2). Croatia also has an excessive use of processed meat and lacks frequent availability of fruit and Portugal offers insufficient vegetables, pulses and Mediterranean dishes, while also providing excessive use of processed meat. Turkey shows an excessive offer of sweets as dessert, instead of fresh fruit (Table 2).

3.2. Menus carbon and water footprint calculation

Table 3 presents the results for carbon and water footprint menus calculations for all the countries. The average water footprint was 1785.411 ± 909.3 m^3/ton, and the carbon footprint was 1.9 kg CO2-eq. The maximum value for the water footprint was 6548.3 m^3/ton, and the minimum was 362.3 m^3/ton. In terms of carbon, the maximum is 10.5 kg CO_2-eq and the minimum is 0.01 kg CO2-eq.

Analysing by country, Turkey's menus stand out with the highest water footprint, 2271.90 ± 1016.11 m^3/ton and Portugal with the lowest, 1485.46 ± 767.28 m^3/ton (Table 4). Regarding Carbon calculations, Turkish menus also had the highest carbon footprint 2.91 ± 2.13 kg CO2-eq and Portuguese menus with the lowest, 1.42 ± 1.26 kg CO2-eq (Table 4). In general, the data suggests that Turkey has the highest environmental impact in terms of both water and carbon footprint calculations.

The water footprint by plate, considering the main protein, was also analysed, for example, beef or fish, as seen in Table 5. In general, for all countries, beef is the source of protein that has the highest water footprint ($\bar{x}$ = 4005.98 ± 1324.02 m^3/ton) and the lowest is from the vegetarian dishes ($\bar{x}$ = 836.15 m^3/ton).

4. Discussion

This study aimed to evaluate higher education cafeteria menus compliance with MD and calculate their water and carbon footprint. Although we could identify that there is a variation between the three countries, in general, the results show very low compliance of the menus to the MD. In each country, the low compliance of the dimensions "food availability" and "food variety" is related to different foods. The diversity of results gives us a valuable and clear perspective of what each country needs to improve, adapt or modify in their HEI menus to offer a more healthy and sustainable diet to their students.

Each country, due to its location and numerous factors, has its own cultural and gastronomic traditions, which shapes the consumption

Table 2
MeDCIn score results by country
Table 2 - Dimension IB Food variety – percentage of item compliance, all countries and by country.

Dimension IB				
Items	Percentage of item compliance			
	All countries (%)	Portugal (%)	Turkey (%)	Croatia (%)
QB1 MD dishes (3x week)	46,2	0	92,9	78,6
QB2 Veg soup (3-4x week)	90,4	91,7	92,9	85,7
QB31 Non-starchy veg (not repeated consecutively)	25	0	7,1	85,7
QB32 Non-starchy veg (not repeated 3 consecutive days)	15,4	0	42,9	14,3
QB4 More fish than meat	3,8	8,3	0	0
QB5 Eggs at least 1x week	0	0	0	0
QB61 More lean meat	5,8	12,5	0	0
QB62 No processed meat	28,8	4,2	92,9	7,1
QB63 Processed meat less than 1x week	34,6	58,3	7,1	21,4
QB71 Pulses (1-2x week)	38,5	29,2	71,4	21,4
QB72 Pulses (3 or more a week)	28,8	0	28,6	78,6
QB81 Frui daily	26,9	50	0	14,3
QB82 Fruit 3x week	9,6	4,2	7,1	21,4
QB83 Fruit 1-2x week	38,5	0	92,9	50
QB84 Sweet desserts no more than 3x month	1,9	0	0	7,1
QB85 Sweet desserts no more than 1x week	15,4	8,3	42,9	0
QB86 Sweet desserts 2 to 3x week	28,8	12,5	57,1	28,6
QB87 Sweet desserts more than 3x week	28,8	33,3	0	50
QB9 Whole grains (2 or more in a week)	21,2	0	78,6	0
QB10 Nuts and seeds (once or more a week)	0	0	0	0

patterns of the populations and influence the availability and variety of different foods, present on menus. For example, Portugal, with its extensive coastline, has greater availability and variety of fresh seafood, which is a significant part of its gastronomy and consumption patterns (How much fish do we; Valagão, 2024; Teixeira et al., 2013; Murphy et al., 2023). In Croatia, low adherence with MD is not surprising, since evaluation of diet quality among university student showed low score using Mediterranean Dietary Quality Index (M-DQI) and should be stressed here that no significant difference was observed among student according to region, i.e. when compared Mediterranean and continental region (Šatalić et al., 2004). Nonetheless, the interior regions exhibit a typical consumption of meat (Valagão, 2024; Cavaleiro, 2024).Regional differences in fish consumption are evident in Croatia, where fish is consumed more frequently in the coastal regions than in the eastern (continental) parts of the country (Krešić et al., 2023). The consumption of fish and other seafood per capita in Turkey is quite low comparatively; despite of the fact that Turkey is almost a sea-board country surrounded by seas on three sides and has rich fish resources as well as production (TURKSTAT Corporatea). On the other hand, Turkey has a more pronounced consumption of red meat in many traditional dishes. Mostly beef, chicken meat and mutton were used within the group of meat and meat products in the Turkish cuisine (Çakmak and Sarıışık, 2019).

Moreover, it is crucial to consider that the availability and cost of specific foods, such as olive oil, nuts and seeds, can vary across countries and are currently influenced by inflation and rising food prices. Especially in Turkey, the consumer price index for seasonal food products increases annually by 72.98 % (TURKSTAT Corporateb). These disparities in food availability and cost can justify some of the variations observed and must be considered when analysing food patterns and implementing interventions in HEI cafeterias.

Specifically, about the low availability of olive oil, in most cases, it was scored as “Not Applicable”, because it was not mentioned in the menu. In Portugal’s HEI cafeterias olive oil is not usually used for cooking, but it is available for salad seasoning. For example, a relatively simple intervention with high impact in Croatian menus would be the introduction of olive oil, not only as a salad dressing, but as a dominant vegetable oil in meal preparation; the current state of menus is that olive oil is an obligatory component only in some dishes (predominantly fish dishes). Like the other countries, olive oil is mainly used as a salad dressing in food service companies.

The lack of dishes with eggs as the main protein source contributes largely to the low score. This may be due to a culturally created concept that eggs are not as good a source of protein as meat or fish (Iannotti et al., 2014; Rondoni et al., 2020). Typically, in different food service contexts, meat and seafood are served as the most important part of the dish. The centrality of meat in meals is a significant barrier to transitioning towards more sustainable, plant-based diets (Graça et al., 2019; Stoll-Kleemann and O’Riordan, 2015).

Seasonality is another important aspect that should be brought into discussion because it has a direct impact on the availability of some foods. Nowadays, we have all types of food available all year and not only in their seasonal period, which can create challenges when evaluating the seasonality of foods such as fruits or vegetables. The use of different types of agricultural techniques, such as greenhouse cultivation, makes it possible to manage growing conditions and increase the periods when food is available. Due to this, it’s difficult to identify if we are including or not seasonal products on menus. For example, in Portugal, bell pepper is a vegetable that has a specific outdoor growing season but is available for a longer period of time due to greenhouse cultivation (Associação Portuguesa de Nutrição, 2021).

When it comes to food variety, the data that shows low variety of Mediterranean dishes, vegetables and pulses are aligned with low compliance to MD reported by this study, as these are some of the most important food groups in the Mediterranean food pattern. About seafood and lean meat consumption, data from national food consumption

Table 3
Carbon and Water Footprint results, all countries.

	n	mean	sd	min	Q1	median	Q3	max
water (m^3/ton)	298	1785.4	909.3	362.3	1176.4	1533.5	2221.6	6548.3
co2 (CO_2-eq)	298	1.9	1.8	0.01	0.8	1.3	2.7	10.5

Table 4
Carbon and Water Footprint results by country.

Country	n	mean	sd	min	Q1	median	Q3	max
Water (m^3/ton)								
Croatia	100	1592.9	711.2	362.3	1174.5	1411.6	1978.8	3549.1
Portugal	98	1485.5	767.3	550.5	1017.9	1233.9	1594.5	4467.3
Turkey	100	2271.9	1016.1	856.7	1575.8	1999.4	2784.7	6548.3
CO2 (CO_2-eq)								
Croatia	100	1.6	1.4	0.01	0.6	1.1	1.9	8.1
Portugal	98	1.4	1.3	0.07	0.7	1.1	1.6	5.7
Turkey	100	2.9	2.1	0.2	1.4	2.3	3.7	10.5

Table 5
Water Footprint by type of plate (main protein).

Type of plate	n	mean	sd	min	Q1	median	Q3	max
Water (m^3/ton)								
Beef	92	2439.7	742.0	1182.9	1785.6	2506.8	3011.0	4467.3
Poultry	55	1467.9	324.1	943.2	1246.3	1420.9	1669.6	2421.4
Pork	42	1681.5	565.4	1065.1	1375.1	1538.0	1740.9	3549.1
Fish	62	1105.0	289.0	362.3	927.8	1129.2	1251.5	2177.8
Vegetarian	23	836.2	317.6	397.2	673.6	747.6	947.6	1988.4

studies corroborate this tendency. A recent Croatian study (Pfeifer et al., 2021) showed a Mediterranean Diet Adherence Screener (MEDAS) score of 5.02 ± 1.97 (n = 4281). The majority (70.1 %) of the respondents preferred lean meat over red meat, while olive oil was not preferred by 52.7 % of the respondents. As expected, most respondents within the high MEDAS group had high consumption of olive oil (73.1 %), vegetables (78.1 %), and fruit (58.8 %), as well as high weekly consumption of pulses (53.8 %), and medium fish and seafood consumption (43.8 %). These results mirror, but in some respects also diverge from, national dietary patterns reported in the 2017 Turkey Nutrition and Health Survey (Republic of Turkey Ministry of Health Director of Public Health, 2019). According to the survey, Turkish adults consume an average of 22.25 g of fibre per day, with a combined daily intake of 415 g of fresh fruits and vegetables. Dairy product consumption is about 1.35 servings per day, including approximately 34.5 mL of milk, 112.7 g of yoghurt, and 39 g of cheese. These figures suggest a moderate intake of fruits, vegetables, and dairy products. However, some components of the Mediterranean diet—such as fish (13.2 g), olive oil (5.2 g), and legumes (18.6 g)—are included in the daily diet at lower amounts. This pattern points to variation in how closely individuals follow Mediterranean dietary principles.

About processed meat, Portugal and Croatia show a high use of these products on the dishes, which aligns with the data available. At a national level, 6.3 % of the Portuguese population consumes more than 50g of processed meat a day and 22.5 % more than 100g a day (Lopes et al., 2017). Similarly, in Croatia, approximately 40g is the daily average consumption of processed meat products (sausages, meat specialities, processed, cured meat, etc.) (European Food Safety Authority, 2011). For example, Bologna-type sausage and Frankfurter sausage are consumed by 46 % and 13 % of the population, respectively. Preference toward red meat, sources of salt (fast food), is expected to differ according to gender. Among Croatian university students, males preferred red meat and fast food, while females preferred (i.e. higher consumption frequency was reported) low-fat dairy products and whole grain products (Colić Barić et al., 2003).

According to the study Çakmak et al., beef, butter, garlic, tomatoes, lemons, parsley, oil, eggs, potatoes, green peppers, carrots, chickens, dill, black pepper, kashar cheese and olive oil were some of the main products used for cooking the main dishes in Turkish cuisine. These ingredients, which are part of the Mediterranean food pattern, show that Turkish cuisine is consistent with the Mediterranean diet (Çakmak and Sarıışık, 2019).

Regarding the consumption of sweet desserts instead of fresh fruit, Turkey shows an excessive offer, which could be related to taste preference, taste pairing and also cultural role symbolising hospitality and tradition (Bezirgan, 2024). In Turkey, desserts are an integral part of social and cultural life, prepared and served on special occasions and often offered to guests as a sign of hospitality and respect. The predominance of desserts reflects a historical emphasis on sweet flavours, which are well combined with spices, nuts and fruits. This preference for desserts can be linked to the Ottoman Empire's culinary traditions, with desserts having a main role in palace kitchens and festive occasions. This cultural tradition is visible in national consumption data, with an average daily sugar intake—including sugar, sweets, honey, molasses, and jams—reaching 30.6 g (Republic of Turkey Ministry of Health Director of Public Health, 2019). The frequent consumption on daily meals and special occasions may contribute significantly to this data, indicating a strong societal attachment to sweetness as both a culinary and cultural staple.

As stated before, the Mediterranean Diet is a food pattern well-known for its health benefits. However, there is a lack of structured interventions, reported in the literature, assessing the compliance of HEI menus with the MD. This study aims to fill this gap and by comparing our findings with other studies, within or outside the MD domain, we can better understand how they might align and what new insights our data provides, ultimately contributing to more comprehensive research in this area.

Several studies have used the 14-item Mediterranean Diet Assessment Tool (MEDAS) to assess MD compliance for individuals. Martínez-González MA et al. applied it to a sample of PREDIMED trial participants and reported a mean score of 8.6 ± 2.0, indicating moderate adherence to the MD. The total score is classified in a range of ≤5 points to ≥10 and it was also observed that more men than women scored ≥10 points, which means they have high adherence to MD (Martínez-González et al., 2012).

Vidal-Peracho C. et al. observed similar results in Spanish students with a mean score of 8.77 ± 1.82 points, being higher in non-diabetic subjects (9.06 ± 1.78) rather than in diabetic (8.54 ± 1.81) (Vidal-Peracho et al., 2017). These results align with other authors who studied Spanish high-cardiovascular risk subjects with type 2 diabetes and non-diabetics (Ortega-Azorín et al., 2012).

Vagenas-Radd S. et al. developed the MediCul score to assess MD adherence in a Western population, finding a mean score of 55.2 out of 100.0 points and only 4 % achieved a high adherence score to the MD (≥10) using the MEDAS tool (Radd-Vagenas et al., 2018).

Figueiredo L et al. found a mean score of 3.88 ± 1.49 on a scale that ranges from 0 to 9 points using the Mediterranean Diet Score (MDS). Only 13.2 % of the sample scored ≥6 points, which means the majority has a low MD adherence. This study also calculated the carbon footprint and found an average of 8146 ± 3081 CO2eqKg−1, which is considered to be high (Figueiredo et al., 2024).

Studies focusing on children showed similar results. Roccaldo R et al. used the KIDMED score and found that only 5 % of the children exhibited high adherence to the MD, 62.2 % an average adherence and 32.8 % a poor adherence. This highlights a concerningly reduced consumption of fruit, vegetables and pulses (Roccaldo et al., 2014).

Lotti S et al. show a more positive perspective. Applying their web-based version of Medi-Lite score with a score range from 0 (low adherence) to 18 (high adherence), in a sample of Italian adults, showed a mean score of 12 ± 2.5, suggesting a good level of adherence. About half of the sample reported optimal consumption of fruit, vegetables and pulses. However, 64.8 % still consume meat and its products, as well as dairy products with a high frequency (Lotti et al., 2024).

Mandracchia F et al. assessed the MD adherence and other nutritional aspects in restaurants in Spain. Using the Amed score, they discovered that 72.7 % of the restaurants claimed to offer Mediterranean cuisine options. The average score was 5.1 ± 1.6 points out of the 9 obligatory criteria. This means that more efforts are needed to improve the compliance of the food offer with the MD. Interestingly, there was a weak positive relationship between the restaurant owner's perception of menu healthiness and their Amed criteria (Mandracchia et al., 2021).

The different studies show a diverse level of adherence to this food pattern in different contexts and are in line with our results, which also showed very low compliance. There is a clear need for improvement of the menus offered, specifically in HEI cafeterias focusing on reducing meat consumption and promoting the consumption of vegetables and pulses. Further research is needed to understand what the current food offer is in university cafeterias and what are the best strategies to promote and maintain MD adherence in this population.

Concerning the environmental impact of the menus assessed, the carbon footprint returned an average of 1.9 kg CO2-eq for the three countries. In an attempt to classify this result in terms of sustainability, the authors relied on the work of Lukas M. et al. (2016) (Lukas et al., 2016) which presents estimations for environmental indicators on the nutrition field. Considering these values, the diet-associated carbon footprint level obtained suggests that overall, the meals included in the analysis have a low environmental impact. Similarly, the water footprint average is 1785.411 ± 909.3 m^3/ton, which also indicates a low impact.

Studies have observed a weak correlation suggesting that a higher MD adherence is associated with a higher carbon footprint (Figueiredo et al.), which is in line with our results.

Regarding the water footprint, the literature indicates that following MD has a lower impact on water usage due to the higher consumption of vegetables, fruits and lower consumption of meat (Lotti et al., 2024; Gallo et al., 2022; Blas et al., 2016).

Since the composition of the dishes varies every day, carbon and water footprints vary equally, creating a great diversity of values. The low correlation found could be related with this daily great variation of values versus a constant weekly value of the compliance with MD.

In general, the results show a high variability in both metrics across the three countries included. Turkish menus had the highest environmental impact, suggesting that the food production is more water-intensive and this could be explained by the agricultural practices or climatic conditions. In contrast, Portugal has the lowest footprint while Croatia stays in the middle. According to a study in Turkey, the meat dishes made the biggest contribution to the water and carbon footprint whereas olive oil-based pulses meals had a very low contribution and was served less than meat meals. The frequency of the meals in the menu may have an impact on water and carbon footprints, as meat dishes often included as a mandatory component of the first course in cafeteria menus (Madalı et al., 2021).

A high standard deviation is observed in all countries, indicating variations in water usage and carbon emissions. The menu options with the highest carbon and water footprint have beef or poultry as the main protein source, which provides useful information for food services to plan and design more sustainable menus with a lower environmental impact. Regarding this topic, the evidence is vast and reinforces the need to implement and globaly promote more plant-based menus in the food service area (Willett et al., 2019; Guedes et al.; McInnes et al., 2023; Shavit et al., 2024; Hemler and Hu, 2019; Strasburg et al., 2023; Strasburg and Jahno, 2017).

Our results align with other authors who studied this theme. Strasburg J. V. et al. evaluated the water footprint of the menus in a university cafeteria and concluded that the animal products, namely red meat, had the largest percentage of the water footprint calculated. In contrast, vegetable products had the lowest percentage of water footprint. These authors considered that it is fundamental to plan menus, implement sustainable practices and promote healthier and more sustainable habits (José Strasburg and Dalosto Jahno, 2015).

Similarly, Kilian L. et al. reported that omnivorous menus have a significantly higher water footprint compared to vegetarian menus. Red meat was the major contributor to the high water footprint of the omnivore menus, in contrast to textured soya protein and vegetables associated with the lowest values (Kilian et al., 2021).

Hatjiathanassiadou M. et al. reached the same conclusion, in a university context. The water footprint was higher on the traditional menus than on the vegetarian menus. These authors suggest that there is a need to review the offer of meat and other animal products, concerning not only health but also sustainability. They advocate for educational actions and public policies that use indicators such as the water footprint (Hatjiathanassiadou et al., 2019).

Kiehle J. et al. found a 1.129t CO2 eq/person total value, of which the university's catering/restaurant services contributed 12.87 % to the overall carbon footprint. These authors consider that creating new policies may have a positive impact on the footprint of food services, leading to more sustainable restaurants. A close partnership between the university and service providers is needed for this to become a reality (Kiehle et al., 2022).

Although these studies compare omnivorous vs vegetarian meals, it is important to highlight that most Western omnivorous food patterns are not plant-based, while the MD food pattern, although including animal food products, is mostly based on plant foods (Shively et al., 2019).

This study reveals valuable insights about the adherence of the menus from the different HEIs included and their associated environmental impacts. The consistently low compliance across the three countries emphasises the importance of introducing changes to the menus to improve university food services. The visible variations between countries underscore the importance of tailored interventions that consider culinary traditions, gastronomy practices, food availability and cultural preferences.

The carbon and water footprint calculations provide important data on the environmental impact of the menus provided. The correlations observed suggest that there is a complex relationship between MD adherence and environmental sustainability that requires further investigation.

Our results made the cultural and gastronomic differences of each country evident, encouraging an interesting discussion and making it possible to bring together learnings and practices from each country to improve the menus and enable the sharing of best practices. The authors hope these findings serve as a valuable baseline to develop targeted strategies to enhance the nutritional quality and sustainability of HEI cafeteria menus in all the countries.

5. Limitations and strengths

In terms of limitations of this study, we acknowledge that although the MeDCIn tool was applied by different researchers, including clear instructions, and validation returned a high inter-rater reliability, there is always the possibility of bias due to individual interpretation when evaluating the criteria. The individual perceptions of different researchers about the dishes' composition could lead to different assessments. In addition, many menus do not specify the composition of the dishes and researchers use their own personal and technical knowledge to categorize the menu options. To minimise this bias, menus from each country were evaluated by researchers from the specific country.

The authors consider that including the values of fish and seafood in the calculations is an added value, making the analysis more reliable. It thus stands out from other studies in the area and contributes to further study of this topic.

CRediT authorship contribution statement

B. Neto: Writing – original draft, Investigation. **D. Dikmen:** Writing – review & editing, Supervision, Methodology, Investigation. **L. Ferreira:** Writing – original draft, Investigation. **C. Viegas:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **S. Filipec:** Writing – review & editing. **L. Drobac:** Investigation. **Z. Šatalić:** Writing – review & editing. **A. Rocha:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization.

Funding

Funded through the Project "MEDDIETMENUS4CAMPUS - Promoting stakeholder adherence to Mediterranean Diet on Campus through menu interventions and social marketing strategies", within the scope of the Transnational Cooperation – Partnership for Research and Innovation in the Mediterranean Area (PRIMA) supported by the HORIZON 2020 Program and through national funds through FCT – Foundation for Science and Technology, I.P., under the project PRIMA/0008/2022/FCT and PRIMA/0009/2022/FCT, and through national co-funding in Turkey provided by the Scientific and Technological Research Council of Turkey (TÜBİTAK) under Project No: 123N063. This research was also supported by national funds through FCT - Foundation for Science and Technology within the scope of UID/5748/2025 GreenUPorto - Centro de investigação em Produção Agroalimentar Sustentável.

Declaration of competing interest

All authors state they have nothing to declare.

Data availability

Data will be made available on request.

References

Alcorta, A., Porta, A., Tárrega, A., Alvarez, M.D., Vaquero, M.P., 2021. Foods for plant-based diets: challenges and innovations. Foods 10 (2), 293.
Aldaya, M.M., Chapagain, A.K., Hoekstra, A.Y., Mekonnen, M.M., 2012. The water footprint assessment manual [Internet]. Routledge. https://www.taylorfrancis.com/books/9781136538520.
Alves, Débora Vanessa Martins, 2014. Ganho de peso, alteração de hábitos alimentares e prática de atividade física em estudantes que ingressam no ensino superior [Internet]. [Faculdade de Medicina de Lisboa] [citado 22 de maio de 2024]. Tese de Mestrado. Disponível em: https://repositorio.ul.pt/bitstream/10451/23500/1/10894_Tese.pdf.
Andersen, C.J., Murray, K., Gaito, A., Dupree, L., Cintrón-Rivera, L., 2025. Nutritional quality of university dining options varies by location, level of convenience, and accessibility: pilot study perspectives on assessing university food environments. J. Agric. Food Res. 22, 102057.
Antonopoulou, M., Mantzorou, M., Serdari, A., Bonotis, K., Vasios, G., Pavlidou, E., et al., 2020. Evaluating mediterranean diet adherence in university student populations: does this dietary pattern affect students' academic performance and mental health? Health Planning & management, 35 (1), 5–21.
Associação Portuguesa de Nutrição, 2021. Aliança contra a Fome e Má-nutrição em Portugal. Calendários De Produção Nacional [Internet] [citado 23 de agosto de 2024]. Disponível em: https://www.apn.org.pt/documentos/Brochura_Sazonalidade_completo.pdf.
Bach-Faig, A., Berry, E.M., Lairon, D., Reguant, J., Trichopoulou, A., Dernini, S., et al., 2011. Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutr. 14 (12A), 2274–2284.
Bezirgan, M., 2024. Turkish desserts and the place of desserts in Turkish cuisine [Internet]. Livre de Lyon. https://zenodo.org/doi/10.5281/zenodo.11509656.
Blas, A., Garrido, A., Willaarts, B.A., 2016. Evaluating the water footprint of the Mediterranean and American diets. Water. outubro de 8 (10), 448.
Borrego, Rute, Ferreira, Vitor Sérgio, Lavado, Elsa, Melo, Raúl, Rowland, Jussara, Truninger, Monica, 2012. Consumos e Estilos de Vida no Ensino Superior O Caso dos Estudantes da ULisboa/2012 [Internet]. Serviço De Intervenção Nos Comportamentos Aditivos E Dependências (SICAD) [citado 22 de maio de 2024]. Disponível em: https://www.sicad.pt/BK/EstatisticaInvestigacao/EstudosConcluidos/Lists/SICAD_ESTUDOS/Attachments/154/Monografia.pdf.
Çakmak, M., Sarıışık, M., 2019. An investigation on the basic contents of the main dishes of the Turkish cuisine. Rev Anais Bras de Est Tur [Internet] 9 (1, 2 e 3) [citado 26 de setembro de 2024]. https://periodicos.ufjf.br/index.php/abet/article/view/27149.
Cavaleiro, Olga, 2024. Portugal Gastronómico - a Gastronomia Portuguesa E as Cozinhas Regionais, p. 136, 1[a].
Clune, S., Crossin, E., Verghese, K., 2017. Systematic review of greenhouse gas emissions for different fresh food categories. J. Clean. Prod. 140, 766–783.
Colić Barić, I., Šatalić, Z., Lukešić, Ž., 2003. Nutritive value of meals, dietary habits and nutritive status in Croatian university students according to gender. Int. J. Food Sci. Nutr. 54 (6), 473–484.
de Liz Martins, Margarida João R., 2009. Hábitos Alimentares De Estudantes Universitários [Internet]. FCNAUP, Porto. Disponível em: https://repositorio-aberto.up.pt/bitstream/10216/54753/2/132680_09112TCD112.pdf.
Deliens, T., Clarys, P., Van Hecke, L., De Bourdeaudhuij, I., Deforche, B., 2013. Changes in weight and body composition during the first semester at university. A prospective explanatory study. Appetite 65, 111–116.
European Food Safety Authority, 2011. Use of the EFSA comprehensive European food consumption database in exposure assessment. EFS2 [Internet] 9 (3) [citado 26 de setembro de 2024]. https://data.europa.eu/doi/10.2903/j.efsa.2011.2097.
Fernandes, Levi Gonçalves Reina Amaral, 2011. Diferenças nos Hábitos Alimentares e Imagem Corporal entre os alunos do 1º e 6º ano de Medicina da Universidade da Beira Interior [Internet]. UNIVERSIDADE DA BEIRA INTERIOR Ciências da Saúde. https://ubibliorum.ubi.pt/bitstream/10400.6/921/1/Disserta%c3%a7%c3%a3o%20final%20Levi.pdf.
Figueiredo, L., Lima, J.P.M., Rocha, A., 2024. Adherence to the mediterranean food pattern and carbon footprint of food intake by employees of a university setting in Portugal. Nutrients 16 (5), 635.
Fonseca, L.B., Pereira, L.P., Rodrigues, P.R.M., Andrade, A.C.D.S., Muraro, A.P., Gorgulho, B.M., et al., 2021. Food consumption on campus is associated with meal eating patterns among college students. Br. J. Nutr. 126 (1), 53–65.
Gallo, I., Landro, N., La Grassa, R., Turconi, A., 2022. Food recommendations for reducing water footprint. Sustainability 14 (7), 3833.
García-Meseguer, María José, Cervera Burriel, Faustino, García, Cruz Vico, Serrano-Urrea, Ramón, 2014. Adherence to Mediterranean diet in a Spanish university population. Disponível em. https://pubmed.ncbi.nlm.nih.gov/24681406/.
Gephart, J.A., Pace, M.L., D' Odorico, P., 2014. Corrigendum: freshwater savings from marine protein consumption (2014 Environ. Res. Lett. 9 014005). Environ. Res. Lett. 9 (6), 069501.
Gotsis, E., Anagnostis, P., Mariolis, A., Vlachou, A., Katsiki, N., Karagiannis, A., 2015. Health benefits of the mediterranean Diet: an update of research over the last 5 years. Angiology 66 (4), 304–318.
Graça, J., Truninger, M., Junqueira, L., Schmidt, L., 2019. Consumption orientations may support (or hinder) transitions to more plant-based diets. Appetite 140, 19–26.
Guedes D, Brazão V, Roque L, Campos L, Godinho C, Truninger M, et al. Promoting plant-based eating in meat-centric meal contexts: a field study. Public Health Nutr. 26(11): 2619–2627.
Hatjiathanassiadou, Maria, Gomes de Souza, Sthephany Rayanne, Pereira Nogueira, Josimara, Oliveira, Luciana de Medeiros, Strasburg, Virgílio José, Moura Rolim, Priscilla, et al., 2019. Environmental impacts of university restaurant menus: a case study in Brazil [citado 29 de maio de 2024]; Disponível em: https://www.mdpi.com/2071-1050/11/19/5157.
Hemler, E.C., Hu, F.B., 2019. Plant-based diets for personal, population, and planetary health. Adv. Nutr. 10 (Suppl. l_4), S275–S283.
How much fish do we consume? First global seafood consumption footprint published - european Commission [Internet] [citado 23 de agosto de 2024]. Disponível em: https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/how-much-fish-do-we-consume-first-global-seafood-consumption-footprint-published-2018-09-27_en.
Iannotti, L.L., Lutter, C.K., Bunn, D.A., Stewart, C.P., 2014. Eggs: the uncracked potential for improving maternal and young child nutrition among the world's poor. Nutr. Rev. 72 (6), 355–368.
ISO 14040:2006 environmental management — life cycle assessment — principles and framework [Internet]. Disponível em: https://www.iso.org/obp/ui#iso:std:iso:14040:ed-2:v1:en.
José Strasburg, Virgílio, Dalosto Jahno, Vanusca, 2015. Sustentabilidade de cardápio: avaliação da pegada hídrica nas refeições de um restaurante universitário [citado 29 de maio de 2024]; Disponível em: https://www.ambi-agua.net/seer/index.php/ambi-agua/article/view/1664.
Joyce, A., Goddek, S., Kotzen, B., Wuertz, S., 2019. Aquaponics: closing the cycle on limited water, land and nutrient resources. In: Em: Goddek, S., Joyce, A., Kotzen, B., Burnell, G.M. (Eds.), Aquaponics Food Production Systems [Internet]. Springer

International Publishing, Cham, pp. 19–34 [citado 26 de setembro de 2024]. http://link.springer.com/10.1007/978-3-030-15943-6_2.
Jwaideh, M.A.A., Dalin, C., 2025. The multi-dimensional environmental impact of global crop commodities. Nat. Sustain. 8 (4), 396–410.
Kasparek, D.G., Corwin, S.J., Valois, R.F., Sargent, R.G., Morris, R.L., 2008. Selected health behaviors that influence college freshman weight change. J. Am. Coll. Health 56 (4), 437–444.
Kiehle, Julia, Kopsakangas-Savolainen, Maria, Hilli, Meeri, Pongracz, Eva, 2022. Carbon footprint at institutions of higher education: the case of the university of Oulu [citado 29 de maio de 2024]; Disponível em: https://www.sciencedirect.com/science/article/pii/S0301479722026299?via%3Dihub.
Kilian, Leideliane, Marcia Triches, Rozane, Ruiz, Eliziane Nicolodi Francescato, 2021. Food and sustainability at university restaurants: analysis of water footprint and consumer opinion [citado 29 de maio de 2024]; Disponível em: https://periodicos.unb.br/index.php/sust/article/view/37939.
Krešić, G., Dujmić, E., Lončarić, D., Zrnčić, S., Liović, N., Pleadin, J., 2023. Determinants of white and fatty fish consumption by Croatian and Italian consumers. BFJ 125 (6), 2157–2175.
Lacour, C., Seconda, L., Allès, B., Hercberg, S., Langevin, B., Pointereau, P., et al., 2018. Environmental impacts of plant-based diets: how does organic food consumption contribute to environmental sustainability? Front. Nutr. 5, 8.
Li, X., Braakhuis, A., Li, Z., Roy, R., 2022. How does the university food environment impact student dietary behaviors? A systematic review. Front Nutr. 8 de abril de 9, 840818.
Lopes, Carla, Torres, Duarte, Oliveira, Andreia, Severo, Milton, Alarcão, Violeta, Guiomar, Sofia, et al., 2017. Inquérito Alimentar Nacional e de Atividade Física, IAN-AF 2015-2016 [Internet] [citado 23 de agosto de 2024]. Disponível em: https://ian-af.up.pt/sites/default/files/IAN-AF%20Relat%C3%B3rio%20Resultados_0.pdf.
Lotti, S., Napoletano, A., Tristan Asensi, M., Pagliai, G., Giangrandi, I., Colombini, B., et al., 2024. Assessment of mediterranean diet adherence and comparison with Italian dietary guidelines: a study of over 10,000 adults from 2019 to 2022. Int. J. Food Sci. Nutr. 75 (3), 336–343.
Lukas, M., Rohn, H., Lettenmeier, M., Liedtke, C., Wiesen, K., 2016. The nutritional footprint – integrated methodology using environmental and health indicators to indicate potential for absolute reduction of natural resource use in the field of food and nutrition. J. Clean. Prod. 132, 161–170.
Madalı, B., Karabulut, Ö.F., Öztürk, E.E., Parlak, L., Erdinç, A.Ş., Dikmen, D., 2021. Toplu Beslenme Hizmeti Veren Bir Kuruluşta Sunulan Menünün Sera Gazı Emisyon ve Su Ayakizi Düzeylerinin Mevsimlere Göre Değerlendirilmesi. J. Nutr. Diet. 1–10.
Mandracchia, F., Llauradó, E., Valls, R.M., Tarro, L., Solà, R., 2021. Evaluating mediterranean Diet-Adherent, healthy and allergen-free meals offered in Tarragona Province restaurants (Catalonia, Spain): a cross-sectional study. Nutrients 13 (7), 2464.
Martínez-González, M.A., García-Arellano, A., Toledo, E., Salas-Salvadó, J., Buil-Cosiales, P., Corella, D., et al., 2012. A 14-Item mediterranean diet assessment tool and obesity indexes among high-risk subjects: the PREDIMED trial. In: Peiró, C. (Ed.), PLoS One 7 (8), e43134.
McInnes, C., Carstairs, S.A., Cecil, J.E., 2023. A qualitative study of young peoples' thoughts and attitudes to follow a more plant-based diet. Front Psychol [Internet] 14 [citado 23 de agosto de 2024]. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2023.1196142/full.
Mekonnen, M.M., Hoekstra, A.Y., 2011. The green, blue and grey water footprint of crops and derived crop products. Hydrol. Earth Syst. Sci. 15 (5), 1577–1600.
Mekonnen, M.M., Hoekstra, A.Y., 2012. A global assessment of the water footprint of farm animal products. Ecosystems 15 (3), 401–415.
Mendez, M.A., Popkin, B.M., Jakszyn, P., Berenguer, A., Tormo, M.J., Sanchéz, M.J., et al., 2006. Adherence to a Mediterranean diet is associated with reduced 3-Year incidence of obesity. J. Nutr. 136 (11), 2934–2938.
Murphy, Adeline, Galli, Alessandro, Madeira, Catarina, Moreno Pires, Sara, 2023. Consumer Attitudes Towards Fish and Seafood in Portugal: Opportunities for Footprint Reduction.
Neto, B., Ferreira, L., Rocha, A., Viegas, C., 2024. Development of a tool to assess the compliance of canteen menus with the mediterranean Diet. Eur. J. Publ. Health 34 (Suppl. ment_3) ckae144.513.
Ortega-Azorín, C., Sorlí, J.V., Asensio, E.M., Coltell, O., Martínez-González, M.Á., Salas-Salvadó, J., et al., 2012. Associations of the FTO rs9939609 and the MC4R rs17782313 polymorphisms with type 2 diabetes are modulated by diet, being higher when adherence to the mediterranean diet pattern is low. Cardiovasc Diabetol. dezembro de 11 (1), 137.
Pfeifer, D., Rešetar, J., Gajdoš Kljusurić, J., Panjkota Krbavčić, I., Vranešić Bender, D., Rodríguez-Pérez, C., et al., 2021. Cooking at home and adherence to the mediterranean diet during the COVID-19 confinement: the experience from the Croatian COVIDiet study. Front. Nutr. 8, 617721.
Radd-Vagenas, S., Fiatarone Singh, M., Daniel, K., Noble, Y., Jain, N., O'Leary, F., et al., 2018. Validity of the mediterranean Diet and culinary index (MediCul) for online assessment of adherence to the 'Traditional' Diet and aspects of cuisine in older adults. Nutrients 10 (12), 1913.
Republic of Turkey Ministry of Health Director of Public Health, 2019. Turkey Nutrition and Health Survey (TNHS) 2017. Tiraj Basım ve Yayın Sanayi Ticaret Ltd. Şti, Ankara, Turkey.
Roccaldo, R., Censi, L., D'Addezio, L., Toti, E., Martone, D., D'Addesa, D., et al., 2014. Adherence to the Mediterranean diet in Italian school children (the ZOOM8 study). Int. J. Food Sci. Nutr. 65 (5), 621–628.
Rondoni, A., Asioli, D., Millan, E., 2020. Consumer behaviour, perceptions, and preferences towards eggs: a review of the literature and discussion of industry implications. Trends Food Sci. Technol. 106, 391–401.
Sakai, Y., Rahayu, Y.Y.S., Araki, T., 2022. Nutritional value of canteen menus and dietary habits and intakes of university students in Indonesia. Nutrients 14 (9), 1911.
Šatalić, Z., Barić, I.C., Keser, I., Marić, B., 2004. Evaluation of diet quality with the mediterranean dietary quality index in university students. Int. J. Food Sci. Nutr. 55 (8), 589–597.
Schwingshackl, L., Hoffmann, G., 2015. Adherence to Mediterranean diet and risk of cancer: an updated systematic review and meta-analysis of observational studies. Cancer Med. 4 (12), 1933–1947.
Sharma, Bishnu, Harker, Michael, Harker, Debra, Reinhard, Karin, 2008. Living away from home and the impact on university students' eating motivation: australia vs. Germany [citado 22 de maio de 2024]; Disponível em: https://research.usc.edu.au/esploro/outputs/99449414702621.
Shavit, Yael, Tepper, Sigal, Teodorescu, Kinneret, 2024 [citado 23 de agosto de 2024]. Exploring Culinary Diversity to Enhance Mediterranean Diet Adherence: a Randomized Controlled Trial, 201. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S0195666324004008.
Shively, C.A., Appt, S.E., Vitolins, M.Z., Uberseder, B., Michalson, K.T., Silverstein-Metzler, M.G., et al., 2019. Mediterranean versus Western diet effects on caloric intake, obesity, metabolism, and hepatosteatosis in Nonhuman Primates. Obesity 27 (5), 777–784.
Silva, S.S., Pereira, A.C., Marques, B., Liz Martins, M., 2024. Inadequacy of meals served and food waste in a Portuguese university canteen. Sustainability 16 (10), 4317.
Sogari, G., Velez-Argumedo, C., Gómez, M., Mora, C., 2018. College students and eating habits: a study using an ecological model for healthy behavior. Nutrients 10 (12), 1823.
Stoll-Kleemann, S., O'Riordan, T., 2015. The challenges of changing dietary behavior toward more sustainable consumption. Environment 57, 4–13.
Strasburg, V.J., Jahno, V.D., 2017. Application of eco-efficiency in the assessment of raw materials consumed by university restaurants in Brazil: a case study. J. Clean. Prod. 161, 178–187.
Strasburg, V.J., Prattes, G., Acevedo, B., Suárez, C., 2023. Calidad nutricional e impacto en medio ambiente por los insumos de un comedor universitario en Uruguay. Arch. Latinoam. Nutr. 73 (2), 90–101.
Teixeira, A., Rodrigues, S., Cavadas, A., Neto, B., 2013. Fish and seafood in Portugal - - a review of its availability and consumption [Internet] [citado 23 de agosto de 2024]. Disponível em: https://repositorio-aberto.up.pt/bitstream/10216/70991/2/39791.pdf.
Trichopoulou, A., Naska, A., Orfanos, P., Trichopoulos, D., 2005. Mediterranean diet in relation to body mass index and waist-to-hip ratio: the Greek European prospective investigation into cancer and nutrition study. Am. J. Clin. Nutr. 82 (5), 935–940.
Troell, M., Metian, M., Beveridge, M., Verdegem, M., Deutsch, L., 2014. Comment on 'Water footprint of marine protein consumption—aquaculture's link to agriculture'. Environ. Res. Lett. 9 (10), 109001.
TURKSTAT corporate [Internet] [citado 26 de setembro de 2024]. Disponível em: https://data.tuik.gov.tr/Bulten/Index?p=Fishery-Products-2022-49678&dil=2.
TURKSTAT corporate [Internet] [citado 26 de setembro de 2024]. Disponível em: https://data.tuik.gov.tr/Bulten/Index?p=Consumer-Price-Index-June-2024-53616&dil=2.
Valagão, Maria Manual, 2024. Património Alimentar De Portugal, 140.
Vidal-Peracho, C., Tricás-Moreno, J.M., Lucha-López, A.C., Lucha-López, M.O., Camuñas-Pescador, A.C., Caverni-Muñoz, A., et al., 2017. Adherence to mediterranean diet pattern among Spanish adults attending a medical centre: nondiabetic subjects and type 1 and 2 diabetic patients. J. Diabetes Res. 2017, 1–11.
Widmer, R.J., Flammer, A.J., Lerman, L.O., Lerman, A., 2015. The mediterranean diet, its components, and cardiovascular disease. Am. J. Med. 128 (3), 229–238.
Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., et al., 2019. Food in the Anthropocene: the EAT–lancet commission on healthy diets from sustainable food systems. Lancet 393 (10170), 447–492.
Willett, W., Sacks, F., Trichopoulou, A., Drescher, G., Ferro-Luzzi, A., Helsing, E., et al., 1995. Mediterranean diet pyramid: a cultural model for healthy eating. Am. J. Clin. Nutr. 61 (6), 1402S–1406S.