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Climate Change and Human Health: An Exploratory Study on Rising Temperatures and Changing Dietary Habits in Europe with a Particular Focus on Italian Cuisine

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Abstract

Climate change is increasingly recognized as a major determinant of human health, influencing both environmental conditions and lifestyle-related risk factors. Within this context, dietary patterns play a pivotal role because they affect chronic disease outcomes while also shaping the environmental footprint of food systems. This study provides a descriptive comparison between temperature trends, dietary habits, and diabetes prevalence across four European macro-regions (Northern, Southern, Western, and Eastern Europe) through a One Health perspective, with a specific focus on Italy following the recent UNESCO recognition of Italian cuisine as Intangible Cultural Heritage. The analysis combines climate data derived from the ERA5 reanalysis, diabetes prevalence data from the International Diabetes Federation, and food consumption indicators from FAOSTAT. Regional dietary patterns were assessed against the Planetary Health Diet (PHD) framework to evaluate their alignment with sustainable nutrition principles. Results indicate that Southern Europe shows the closest adherence to PHD recommendations, while Western Europe exhibits the largest deviation. Across Europe, dietary patterns remain characterized by excessive consumption of animal-derived products and insufficient intake of legumes and nuts. At the same time, Southern Europe shows both the most pronounced warming and the greatest increase in diabetes prevalence, whereas in the other macro-areas this pattern is not replicated. Italy presents a comparatively more balanced dietary profile and lower diabetes prevalence than the Southern European average, although important gaps remain with respect to sustainable dietary targets. These findings motivate further investigation of climate, health, and food systems. Promoting dietary transitions inspired by sustainable and culturally rooted food practices may contribute simultaneously to reducing environmental pressures and improving population health. The study emphasizes the relevance of integrating environmental sustainability and social sustainability dimensions, including cultural heritage, food traditions, and public well-being, within future strategies addressing climate change adaptation and chronic disease prevention.

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1. Introduction

The impacts of global warming and the associated extreme events have a great relevance in Europe, where changes in climate-influencing factors have already been observed, as highlighted by Working Group I to the Sixth Assessment Report (WGI AR6) of the IPCC: rises in average temperatures and extreme heatwaves [1]. In South-Eastern Europe, and in mountainous areas, as detailed in the Working Group II (WGII) Fifth Assessment Report (AR5) [2] and in the Intergovernmental Panel on Climate Change (IPCC) Special Report on the 1.5°C target, the combined effects on tourism, agriculture, forestry, energy, health and infrastructure make this area particularly vulnerable.

Among the sectors that contribute to climate change, the food system accounts for 21–37% of global greenhouse gas (GHG) emissions [3]. In Europe, a shift towards a more sustainable diet could lead to a decrease of 40% in ammonia emissions and up to a 40% reduction in non-CO_2 GHG emissions [3]. The definition of a sustainable diet has been debated in the literature [4], although Poore and Nemecek [5] and other authors have shown that animal-based diets have a larger impact than plant-based ones [6]. In recent years, the EAT-Lancet Commission has proposed the Planetary Health Diet (PHD), designed to promote human well-being and environmental protection [7] simultaneously. The diet takes into account the macronutrients needed for optimal health outcomes, and its adoption would limit the environmental impacts within the planetary boundaries defined by Rockström et al. [8]. The Planetary Health Diet is a flexitarian dietary pattern consisting predominantly of plant-based foods (fruits, vegetables, legumes, whole grains, nuts, and unsaturated oils), while limiting animal products and processed foods. It is designed to be adaptable across different cultures and to reduce the incidence of various pathologies, such as diabetes.

Climate change severely impacts health incidence, in particular diabetes incidence. In the US, diabetes incidence increases with higher outdoor temperatures [9]. The primary physiological mechanisms proposed to explain this correlation include: dehydration, when reduced renal blood flow alters glucose excretion, leading to higher blood glucose retention; physical stress, meaning that heat stress triggers the release of cortisol, which elevates blood glucose levels; vasodilation, which refers to increased blood flow to the skin, accelerating the absorption of subcutaneous (injectable) insulin. In this framework, Italy represents an informative case study for several scientific reasons. It is one of the European countries most exposed to increasing temperatures and heatwaves associated with climate change [10], while also being historically linked to the Mediterranean dietary pattern. Moreover, Italy has experienced substantial dietary transitions in recent decades, including increased consumption of animal-based products compared with traditional Mediterranean dietary habits. The UNESCO recognition of Italian cuisine as 'Italian Cuisine: Sustainability and Bio-cultural Diversity' (10 December 2025) adds a cultural perspective on this study. No specific culinary dish was recognised, but the entire cultural system of Italian cuisine, understood as the sum of practices, knowledge, rituals, skills, and forms of social interaction [11,12]. However, such recognition should not be interpreted as scientific evidence of nutritional superiority or direct health benefits. Rather, it offers a useful framework for discussing how culturally rooted food systems may influence dietary behaviours and sustainability transitions. It also acknowledges the social, cultural, educational, and sustainability-related dimensions of Italian culinary practices, including intergenerational knowledge transfer,

biodiversity conservation, food waste reduction, and community cohesion. This can serve as a model of a highly significant cultural and geographical context within which dietary habits are evolving to align with those of other European countries. In fact, traditional Italian cuisine, how mentioned above, constitutes a key expression of the Mediterranean Diet (MD), recognised by UNESCO on 16 November 2010, as an intangible cultural heritage for reasons not only culinary, but also cultural and transnational (which concern Italy, Spain, Greece, Morocco, and, subsequently, Cyprus, Croatia, and Portugal) [13–17]. The MD is recognised worldwide as a healthy and sustainable dietary pattern, rich in plant-based foods (grains, fruits, vegetables, legumes, nuts, seeds, and olive oil), with moderate consumption of fish, eggs, poultry, and dairy products, and low consumption of red meat [18], which coincides with the PHD recommendations [7]. Furthermore, it has been shown that ideal adherence to the MD results in greenhouse gas emissions of approximately 2.3 kg of CO_2 equivalent per person per day, in line with global climate goals [7,19,20]. In their study Castaldi et al., [19] analyse actual CO_2 emissions in the seven Mediterranean countries examined (Cyprus, Croatia, Greece, Italy, Portugal, Spain, and Malta); the emissions associated with their diets are nearly double those of the ideal Mediterranean diet (4.46 kg CO_2eq per person per day). In the other EU countries (21 countries) they analysed, emissions are similar (4.03 kg CO_2eq per person per day), showing that current dietary patterns deviate from sustainability standards in both the seven Mediterranean countries and the rest of the EU [19]. This aspect is primarily due to excessive meat consumption, which accounts for 60% of the daily emissions surplus (1.8 kg CO_2eq per person per day) and tripled from approximately 68 g to 235 g per person per day between 1960 and 2017. Excess animal protein (especially red meat) accounts for 70% of total excess emissions compared to the ideal MD diet. Food policies should encourage the consumption of plant-based foods and reduce meat and animal products [21]. Indeed, the adoption of the MD is in line with the European "Farm to Fork" strategy and the European Green Deal for decarbonization by 2050 [19]. In summary, the MD is defined primarily as a nutritional model and a lifestyle based on specific foods and health benefits. The MD safeguards a healthy lifestyle shared by many people of the Mediterranean basin, whose mission is to protect, promote, and highlight the MD, not only as a model for personal well-being [13,14], but also as a key element in achieving the sustainable development goals of the 2030 Agenda. Although numerous studies have separately investigated the relationships between climate change, dietary patterns, and non-communicable diseases [9,22–25], few studies have explored these dimensions simultaneously at the European scale. Limited attention has been given to the combined assessment of temperature trends, dietary transitions, and diabetes prevalence across different European regions, despite their potential interactions within a One Health framework. Furthermore, comparative analyses examining how deviations from sustainable dietary models may interact with climate-related stressors at this spatial scale remain scarce. Tackling this gap is important for understanding the interconnected environmental and public health challenges emerging in Europe under climate change.

This study addresses the following research questions:

- RQ1: How do the four macro-areas relate to trends over time in rising temperatures and the increasing prevalence of diabetes?
- RQ2: To what extent do current regional dietary patterns diverge from the recommendations of the Planetary Health Diet?
- RQ3: How do regional differences in the prevalence of diabetes relate to the combined analysis of climate and dietary indicators?

We analysed the energy supply of the population across four major European regions (Northern Europe, Southern Europe, Western Europe, Eastern Europe) during the period 2014–2023. For each region, we assessed changes in the incidence and temperature trends

of diabetes, as well as assessing the degree to which current energy supply deviates from the recommendations of the PHD. Given the observational nature of the study, we do not seek to establish causal relationships. Rather, we explore the hypothesis that regions experiencing greater dietary deviation from sustainability-oriented dietary models and increasing temperature trends may also exhibit less favourable diabetes outcomes. It should be noted that differences in diabetes prevalence among European countries may be influenced by multiple factors beyond dietary habits, including population age structure, socioeconomic conditions, healthcare access, physical activity levels, genetic predisposition, obesity prevalence, and diagnostic practices. Therefore, any observed associations between dietary patterns, temperature trends, and diabetes indicators should be interpreted with caution. The objective is not to establish causality, but rather to identify patterns and generate evidence that may support future interdisciplinary research on the interconnected challenges of climate change, nutrition, and health. This paper is structured as follows. Section 2 (Materials and Methods), including Research Design, Temperature in Europe, Dietary Habits in Europe, and Diabetes in Europe, describes the database and methodologies adopted for the analyses. Section 3 (Results), comprising Temperature Patterns, Dietary Habits Comparison, Diabetes Prevalence, and the Italian Case Study, presents the statistical outcomes. Section 4 (Discussion) critically examines the findings, highlighting limitations and future research perspectives. Finally, Section 5 presents the main conclusions of the study.

2. Materials and Methods

2.1. Research Design

To understand the effects of climate change on human health, the study focuses on the established relationship [22,24] between rising temperatures and the prevalence of diabetes mellitus. A site-specific analysis was carried out to describe the co-occurrence of the prevalence of the disease and changes in dietary habits across Europe, to ensure that key factors were not overlooked in the analysis. A particular focus was placed on Italian cuisine, due to its UNESCO's recent recognition. The aim is therefore to assess, across the four main European regions and specifically in Italy, the association of food supply and increasing temperatures with the prevalence of diabetes mellitus.

2.2. Temperature in Europe

The ERA5 dataset (the fifth-generation ECMWF reanalysis) was employed, to analyse temperatures in the four European macro-areas. The parameter expressed in kelvins (K), known as the "temperature at 2 m", was used. This refers to the air temperature at a height of 2 m above the surface of the land, sea or inland waters, calculated by interpolation between the lowest level of the model and the Earth's surface, taking atmospheric conditions into account [26]. Using data from "2m Temperature", an area-weighted average was calculated for each region of Europe (Eastern, Western, Southern and Northern) on an annual basis for the period 2014–2024. Concerning Italy, the data provided on the ISTAT (Italian National Institute of Statistics) portal are available from 1971 to 2021 and have been analysed to obtain a trend of yearly mean temperature of regional main cities [27].

2.3. Dietary Habits in Europe

We used FAOSTAT (https://www.fao.org/faostat/en/#data/FBS accessed on: 21 September 2026) data to analyse changes in the dietary habits of the four European macro-areas (more details on the countries included in each partition can be found in Table A1). Data range from 2010 to 2023, a 14-year-period that enables us to analyse the daily average kcal per capita of food available in 62 countries. The food available is based on the

food balance account, which includes the national supply of each food item for a specific reference period. The per capita quantity is obtained by dividing the total food available for human consumption by the country population. We used the daily food supply per kcal/capita to account only for the food available for human consumption (FAOSTAT differentiates between food exported, used for livestock, for seed, losses during storage and transportation and put to manufacture for food and non-food uses). Our analyses do not take into account food waste, which represented 19% of food at the consumer level in 2022 [28]. This overestimates our analyses, since the actual food intake might be lower than the supply available for human consumption. We consider this a study limitation, which could be overcome by future studies. We excluded the following categories: infant food; beverages (beer, alcoholic beverages, wine, tea, coffee, fermented beverages); rape or mustard seed; coconuts (including copra); olives; oil crops; cottonseed; sunflower or sesame seed; cocoa; pepper; pimento; cloves; spices; fish liver or body oil; sugar beet or cane; and a miscellaneous category. The final dataset used to conduct our analyses is complete for the countries specified in Table A1 for all 14 years. Nevertheless, some countries have no available data for some of the items (see Table A2 in Appendix A). The largest share of non-available data is composed of whole grains, which represents 30.55% of the total non-available data. It is followed by unsaturated plant oil (31.82%), tubers and starchy roots (25.47%), and coconut and palm oil (10.25%). Less than 2% of the non-available data is represented cumulatively by legumes (0.59%), milk and butter (0.26%), and fish and seafood (0.55%). Considering only the included items in our analyses, only 8.27% of the data is not available. To compare the energy intake of each macro area with the PHD recommendations, we classified the food items into the following categories: whole grains, tubers and starchy roots, vegetables, fruits, tree nuts and peanuts, legumes, milk and butter, poultry meat, fish and seafood, eggs, meat, unsaturated plant oil, coconut and palm oil, sugar and sweeteners. As authors reported in their recommendations, food should be mostly whole and potentially unprocessed or minimally processed [7]. The kcal supply of each food item was summed within each food category c:

$$k_{a,c,t} = \sum_{i \in c} k_{a,i,t} \tag{1}$$

where $k_{a,i,t}$ is the kcal supply of item i in area a in year t. Then, for each area a and category c, we computed the mean food supply across the 14 years as follows:

$$\bar{k}_{a,c} = \frac{1}{|T_{a,c}|} \sum_{t \in T_{a,c}} k_{a,c,t}, \tag{2}$$

where $k_{a,c,t}$ is the food supply (kcal/capita/day) of food category c in year t of area a and $T_{a,c} \subseteq \{2010, \ldots, 2023\}$ is the set of years with an available observation. Averaging allowed us to handle missing data in the dataset. We computed the ratio of each food category to the total kcal supply $\bar{k}_a$, calculated by summing the food categories for each area: $\sum_{c \in K} \bar{k}_{a,c}$, where K is the set of food categories. We computed the ratio as follows:

$$r_{a,c} = \frac{\bar{k}_{a,c}}{\bar{k}_a}, \tag{3}$$

which estimates how much each food category weighs on the daily average energy intake per capita. The same ratio was computed for the PHD, $r_c^{\mathrm{PHD}} = k_c^{\mathrm{PHD}} / \sum_{c' \in K} k_{c'}^{\mathrm{PHD}}$. Since the shares are normalised, signed differences would sum to zero across categories. Therefore,

the distance between each regional diet and the PHD was calculated as the absolute difference between each category ratio and the PHD ratio:

$$d_{a,c} = \left| r_{a,c} - r_c^{\mathrm{PHD}} \right|, \tag{4}$$

and the total distance of area a from the PHD resulted in $D_a = \sum_{c \in K} d_{a,c}$.

2.4. Diabetes in Europe

Diabetes mellitus represents a public health emergency in Europe. Type 2 diabetes accounts for the majority of these cases, driven primarily by demographic ageing, rapid urbanisation, and unhealthy lifestyle changes. Type 2 diabetes is characterised by insulin resistance combined with a progressive decline in insulin secretion. This metabolic impairment leads to chronic hyperglycaemia and alterations in carbohydrate, lipid and protein metabolism, and also a lot of secondary medical complications. Data employed to produce the plot related to diabetes in Europe are provided by the International Diabetes Federation (IDF), which is an umbrella organisation of 264 national diabetes associations in 163 countries and territories [29]. Data were collected for the countries in the four macro-areas, after which we computed the share of people with diabetes on the total population in each region for the years 2011 and 2024. As regards Italy, the data provided on the ISTAT portal are available from 1980 onwards and have been averaged at the national level [30].

3. Results

3.1. Temperature Patterns

A plot has been generated showing the trends for the four macro-areas, based on the average temperature calculated for each region (Eastern, Western, Southern and Northern Europe) annually for the period 2014–2024 (Figure 1). Figure 1 shows the trends of the average annual temperature by macro-area. The positive slope (angular coefficient) indicates that the annual average temperature has risen over time. In particular, southern Europe appears to be clearly affected by this increase

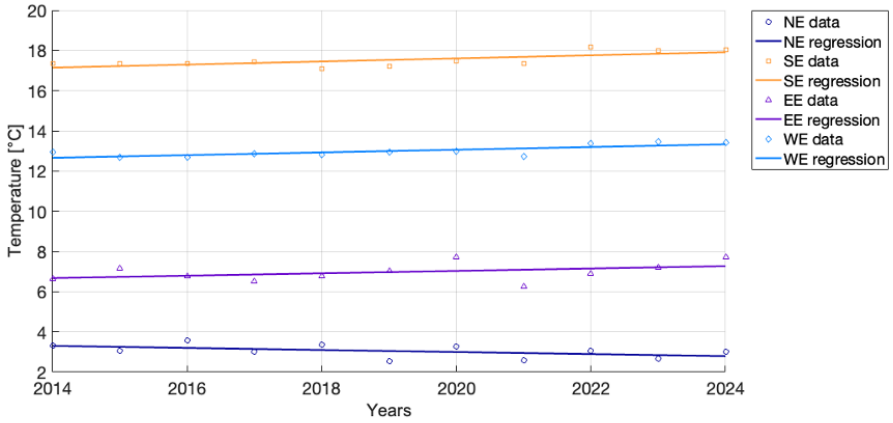


Figure 1. Comparison between temperature patterns in the four macro-areas. The plot shows the trends of the average annual temperature by macro-area (indicated by symbols of different shapes and colours depending on the macro-region in question).

The results highlight some marked differences between the areas (Table 1).

As can be seen in the Figure 1 and Table 1, it is clear that temperatures in Northern and Eastern Europe are lower and unlikely to fall within the ranges identified in the literature as potentially stressful for diabetic patients [22,24]. On the other hand, the average increase

in temperatures in Southern Europe over this period is pronounced [31], and it could contribute to episodes of hypoglycaemia.

Table 1. Comparison of average temperatures over the entire period across the four macro-areas.

Macro-Region	Mean Temperature 2014–2024 (°C)
Southern Europe	17.53
Western Europe	12.99
Northern Europe	3.05
Eastern Europe	6.97

3.2. Dietary Habits Comparison

We analysed the FAOSTAT data to compare the daily per capita kcal supply of Europeans to the PHD recommendations. Table A4 shows the specific energy share per category for each macro area and for the whole continent.

Figure 2 shows that, in Europe, the share of dietary energy from plant-based foods, such as legumes and tree nuts, is lower than the recommendations from the PHD (the mean in Europe is 0.8% and 1.3%, compared to the recommended 11.5% for both). On the other hand, the share of animal-sourced foods, such as meat and milk and butter, is respectively 10.8% and 14.3% compared to the recommended ratios of 1.9% and 6.1%. Regarding fats and sugar, the percentage of energy intake for sugar and sweeteners is approximately two and a half times the PHD recommendations (12% compared to the recommended 4.8%). It is worth noticing that the share of whole grains in Europe is perfectly aligned with the PHD recommendations.

Among macro-areas, Eastern Europe records the highest share of energy from whole grains, 34.5% compared to the other areas. Sugar and sweeteners, and milk and butter are the second and third largest components of dietary energy in the region (12.8% and 12.7%, respectively). Meat also plays an important role in the region's kcal supply, representing 9.9% for meat and 3.3% for poultry of the daily 3142.3 kcal per capita. Plant-based proteins are far from the PHD recommendations: legumes are 0.6%, while tree nuts are the lowest on the continent at 0.6%.

The energy supply in Northern Europe is mainly composed of whole grains (29.9%), milk and butter (15.6%) and unsaturated plant oils (11.9%). Animal-based foods are prevalent in Northern and Western Europe, with the highest ratios of total energy supplied by meat and milk, respectively, 10.5% and 12.7% for meat and 15.6% and 17.7% for dairy. Northern Europe also has a higher share of poultry meat on the continent (3.6%). Southern Europe is characterised by having the highest share of unsaturated plant oil (17.4%), the only one that exceeds the PHD recommendations (14.8%). Among the main shares of kcal per capita per day there are whole grains (30.4%); sugar and sweeteners (9.6%); and milk (12%). Animal-based foods exceed the PHD recommendations in Southern Europe, especially meat (10.3% compared to 1.9%) and fish and seafood, which show the highest share on the continent 1.6%.

The composition of dietary energy of Western Europe sees sugar and sweeteners (13%) and milk and butter (17.7%) exceeding the European average (12% and 14.3%). The share of meat in energy is the highest on the continent (12.7%), while poultry is one of the lowest (2.3%), below the mean (2.9%). On the other hand, Western Europe is closer to the PHD for tree nuts (1.9%, the highest share on the continent).

In Figure 3, the sum of the differences in food categories between the regional energy composition and the PHD showed that Southern Europe is closest to the PHD recommendations compared to the other regions (47.3 percentage points (p.p.) difference in total). Western Europe is farthest from the PHD (65.6 p.p.). See Table A5 for the full overview.

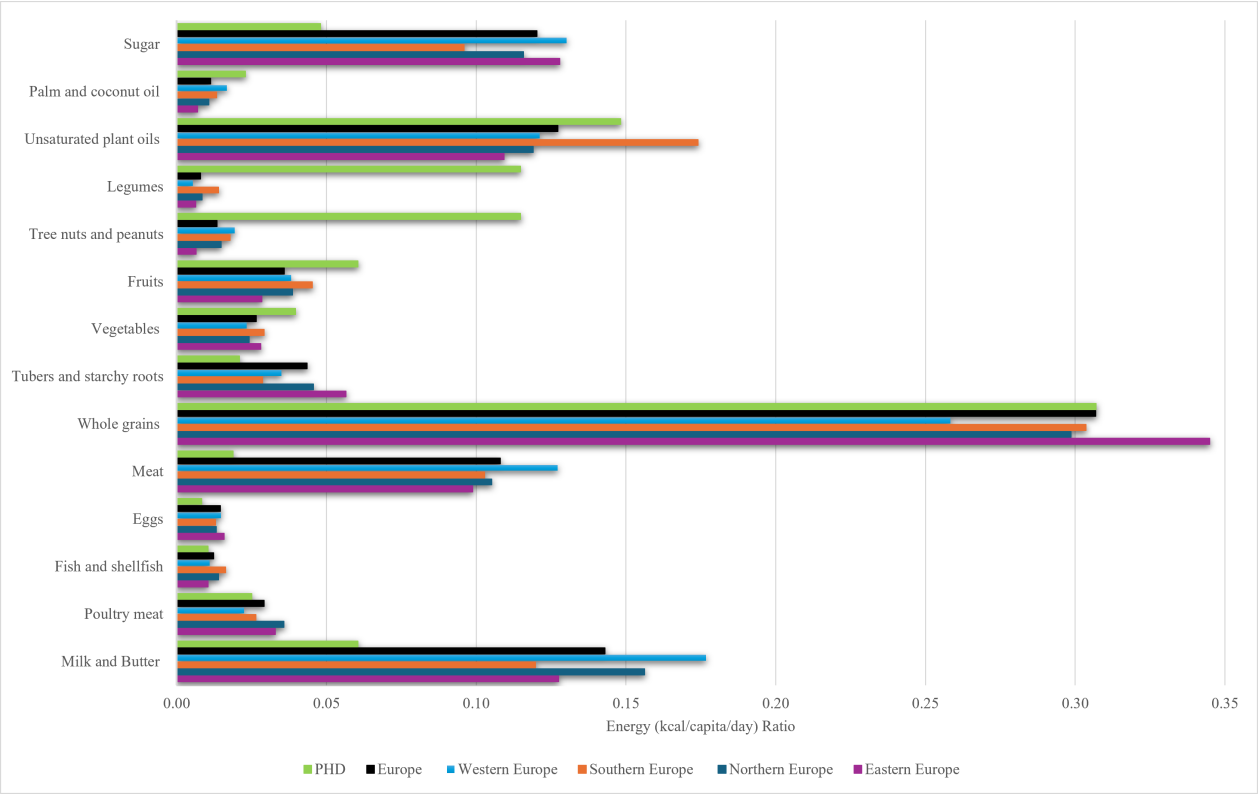


Figure 2. Comparison between the Planetary Health Diet (PHD), Europe, and the four macro-areas. For each area, the bars report the ratio of the daily kcal/capita supply of each food category to the total daily kcal/capita supply. The green bars show the same ratio computed for the PHD.

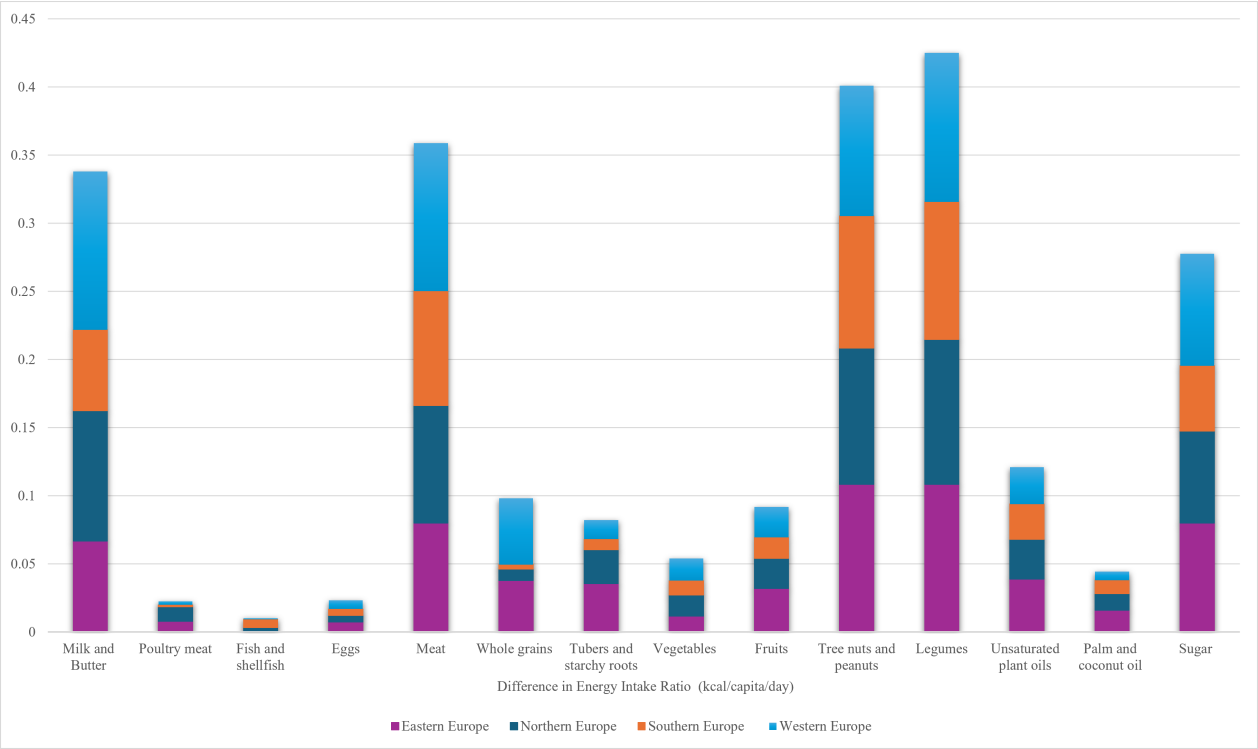


Figure 3. Differences between the Planetary Health Diet (PHD) and each macro-area. The columns report the cumulative absolute difference of the four macro-areas from the PHD for each food category. The column segments represent the difference in the share of energy intake of each macro-area from the PHD.

3.3. Diabetes Prevalence

It is clear that diabetes mellitus is a widespread and increasing chronic disease throughout Europe, according to data provided by the International Diabetes Federation (IDF) (Figure 4 and Table 2). The precision of the prevalence of diabetes in Eastern Europe may be affected by the availability of data in some countries during the reference period, due to sensitive geopolitical situations that may have compromised and influenced the actual transmission of data. In addition to this, it is clear that also other confounding aspects (among others, genetic, individual behaviour, population ageing, obesity, physical activity, socioeconomic status, healthcare accessibility), should be taken into account when exploring diabetes prevalence. However, taking into account the evidence available in the literature [22–25], it is possible, with due caution and without establishing causal links, to analyse the general trends in temperature in relation to the prevalence of diabetes. This exploratory can identify areas of greater sensitivity or exposure warranting attention.

Table 2. Comparison between diabetes prevalence among the four macro-areas.

Macro-Region	2011 Prevalence (%)	2024 Prevalence (%)	Trend
Southern Europe	6.40	9.27	Rapidly increasing (highest level in 2024)
Western Europe	5.31	6.54	Increasing
Northern Europe	4.66	6.19	Increasing
Eastern Europe	7.27	5.97	Decreasing (was the highest in 2011)

As can be seen from Figure 4 and Table 2, the situation that appears to be the most interesting is that of Southern Europe, which is experiencing a rapid rise in prevalence, with the highest level among the regions in 2024.

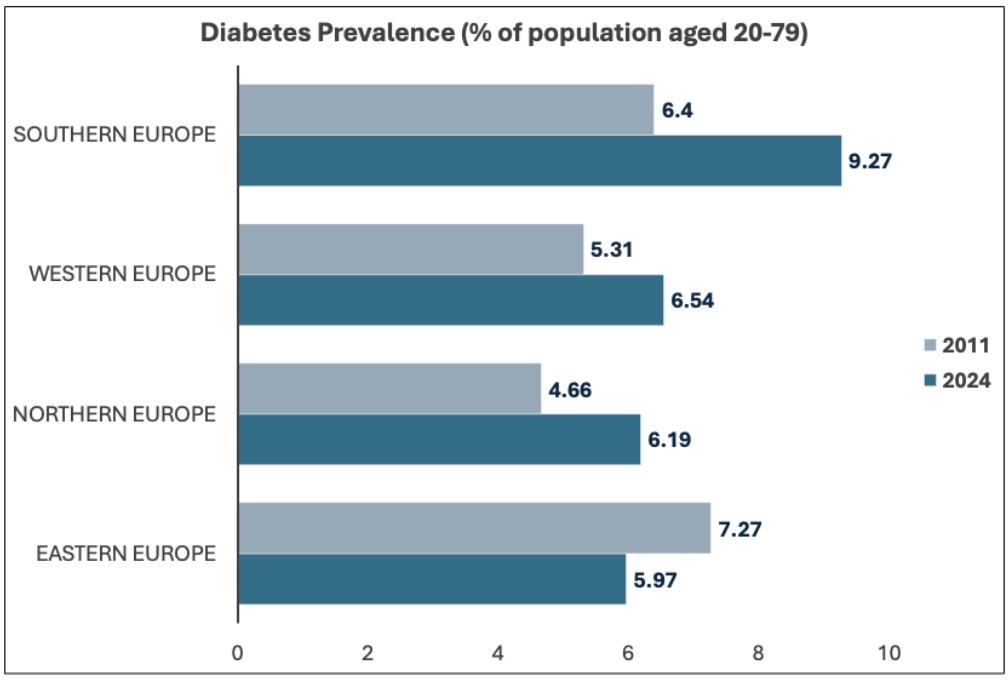


Figure 4. Comparison between diabetes prevalence among the four macro-areas.

3.4. Italian Case Study

At this stage, we focus our analyses on Italy, for the cultural relevance of its cuisine and its climate vulnerability. We analyse data on temperature and prevalence of diabetes mellitus in the country. The results show an increase (Figure 5) in the prevalence of

the chronic disease under investigation and in mean air temperature values ($r = 0.6$; $r^2 = 0.36; m(slope) = 0.658$). Both prevalence and temperature data were taken from the ISTAT portal [27,30], where they have been available since 1980, averaged at the national level and for each year.

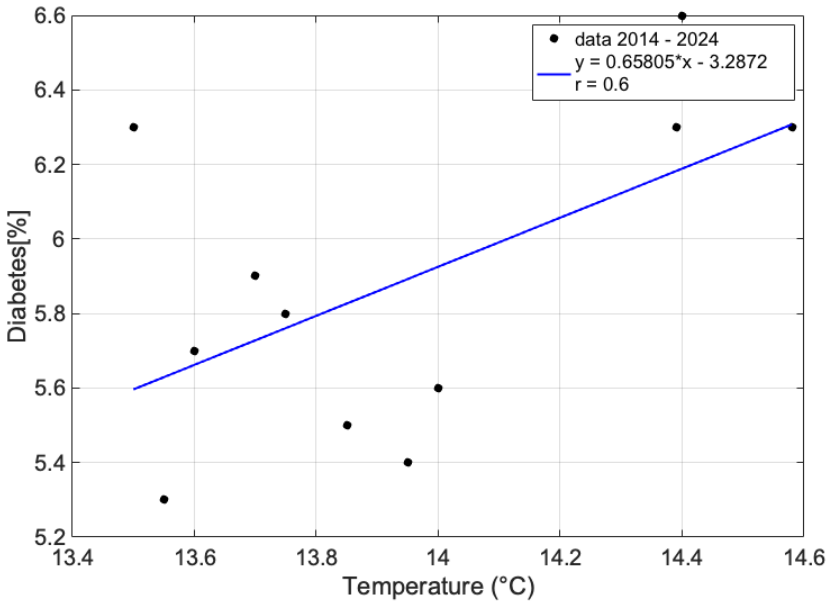


Figure 5. Scatterplot between Temperature and diabetes mellitus prevalence in Italy.

At the same time, we carried out the analysis of dietary habits. In Figure 6, we can see that Italy exceeds the PHD recommendations for animal-sourced foods and fats and sugar. Regarding the first main category, Italy's distance to the PHD is 6.3 p.p. for milk and butter, and 8.2 p.p. for meat and, to a smaller extent, eggs, fish and shellfish, both at 0.4 p.p. Looking at fats and sugar and unsaturated plant oils, Italy differs from the PHD by 4.7 p.p. and 2.3 p.p., respectively. Italy should increase plant-based food intake to be closer to PHD levels. Legumes show the largest gap from the PHD, with Italy's share 10 p.p. below the recommendations. Tree nuts are also far from the recommendations (9.8 p.p. below the PHD). A smaller difference is shown for vegetables and fruits, showing a difference of 1.6 and 1.4 p.p. In the specific case of Italy, therefore, we have 46 p.p. difference in total, which means we are fairly close, given the macro-area values.

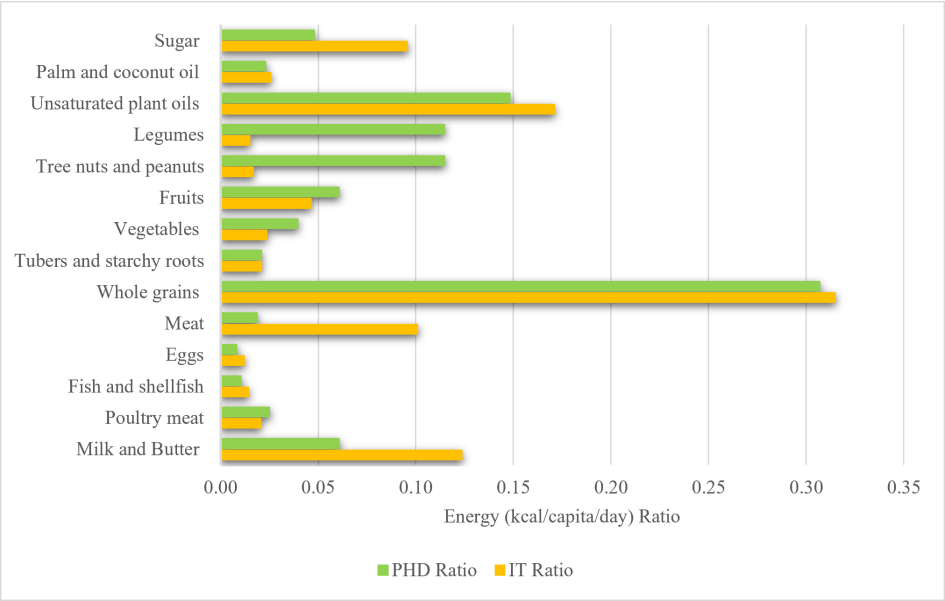


Figure 6. Comparison between the Planetary Health Diet (PHD) and Italy. The bars report the ratio of the daily kcal/capita supply of each food category to the Italian total daily kcal/capita supply. The green bars show the same ratio computed for the PHD.

These findings show that although the deviation of Italian dietary habits from PHD is generally less pronounced than the European trend, the prevalence of diabetes mellitus continues to rise, as does the temperature (Table 3). This once again highlights, as has already been documented in the literature, even if being limited to type 1 diabetes and relating specifically to episodes of hypoglycaemia [22,24], the association between atmospheric conditions and chronic diseases, and encourages the study of the influence of a wide range of factors, from individual habits to environmental characteristics, on the progression of diabetes.

Table 3. Mean temperature, diabetes mellitus prevalence and deviation from PHD in Italy.

Mean Temperature 2014–2024 (°C)	2024 Prevalence (%)	Deviation from the PHD (p.p.)
13.9	6.3	46

4. Discussion

The results presented above suggest that diabetes prevalence, dietary composition, and temperature trends do not always move in the same direction across the four European macro-regions. This apparent inconsistency is itself informative. Southern and Western Europe show the highest and most rapidly increasing average temperatures, consistent with the well-documented Mediterranean warming hot-spot [1,2]; in contrast, Northern and Eastern Europe remain well below the thresholds identified in the literature as potentially destabilizing for glycaemic control [22,24]. Temperature and diabetes trends are, however, not aligned everywhere: Eastern Europe shows a warming trend but a decreasing prevalence (although data availability and reporting issues in the region may have affected this estimate), whereas Northern Europe shows a slightly negative temperature slope alongside an increasing prevalence. These cases show that regional temperature trends alone cannot account for the observed differences in prevalence.

Southern Europe is the macro-area closest to the PHD recommendations (47.3 p.p. total deviation, versus 65.6 p.p. for Western Europe), but it also records the highest and fastest-growing prevalence of diabetes. This apparent paradox indicates that dietary composition,

as measured in terms of food supply, does not explain the regional pattern by itself. Indeed, the FAOSTAT dataset used reports food availability rather than actual intake, so the PHD distance reflects the food supply and not individual dietary behaviour. However, this result is compatible with a role for thermal exposure, in line with physiological mechanisms such as dehydration, cortisol-mediated stress response, and accelerated insulin absorption [9]. Given the ecological design, the small number of time points, and the absence of covariate adjustment, this should be read as an exploratory association rather than as evidence that temperature exerts an independent or dominant effect. Several unmeasured factors may contribute to the Southern European pattern, including population ageing, obesity, physical activity, socioeconomic conditions, genetic predisposition, and differences in diagnostic coverage and healthcare access [22,24], as well as possible differences in how the IDF estimates were produced for 2011 and 2024.

The Italian case study shows a positive association between mean annual temperature and diabetes prevalence over 2014–2024 ($r = 0.6$, $r^2 = 0.36$, $n = 11$; slope = 0.658 percentage points per °C; Figure 5). This is a moderate correlation based on only eleven annual observations, and both series show an upward trend. Shared temporal trends can produce a correlation without any direct link, so this result should be considered descriptive and not statistically robust. Italy shows both a lower PHD deviation (46 vs. 47.3 p.p.; the difference is minimal) and a lower mean temperature than the Southern European average, together with a diabetes prevalence below the regional mean. This is compatible with the hypothesis, which will be assessed in future studies, that dietary quality and thermal exposure act as at least partially independent risk modulators, but it does not demonstrate it. We also stress that the UNESCO recognition [17] is a cultural and sustainability framework: here it serves as the context that motivated the Italian case study, and our results neither confirm nor refute any health benefit attached to it. At the same time, Italy's own distance from the PHD – particularly the marked shortfall in legumes and tree nuts, and the excess of meat, dairy, and added sugars – shows that even a comparatively favourable position within Europe leaves considerable room for improvement, and that the symbolic value of the UNESCO inscription should not be mistaken for an already-achieved nutritional target.

Limitations and Future Perspectives

Several methodological limitations of the present study should be acknowledged, as they also define concrete directions for future work.

First, the analysis is ecological in nature: all three data sources (temperature, dietary supply, diabetes prevalence) are aggregated at the macro-regional or national level, and no individual-level data linking exposure, diet, and disease status were available. As with any ecological design, this raises the risk of the ecological fallacy, i.e., associations observed at the aggregate level may not hold or may even reverse at the individual level. Future studies should aim to replicate this analysis using individual-level or cohort data, allowing dietary intake, thermal exposure, and diabetes status to be linked within the same subjects.

Second, the index was computed to measure the difference between the energy share of each food category for each macro-area and the PHD. This index measures energy composition, without accounting for over-consumption. Furthermore, we acknowledge that food supply does not correspond to food intake, since it does not account for household food waste and variation in intake across individuals. Similar studies on adherence of regional or national diets to the PHD have used indices, such as the EAT-Lancet diet score by Knuppel et al. [32] However, these studies are based on survey data, which measure actual food intake [33–36]; hence, our supply data do not provide the level of granularity required. Moreover, the FAOSTAT classification does not distinguish between whole and refined cereals, so the "whole grains" category effectively includes all cereal products, and

the close match with the PHD share for this category should be interpreted with caution. The deviation index is also an unweighted sum of absolute differences, so categories with large PHD shares (legumes and tree nuts) contribute substantially to the total and are similar across regions; the ranking between regions is therefore driven mainly by dairy, meat and added sugars.

Third, the temporal windows of the three datasets do not fully coincide (temperature: 2014–2024; diet: 2010–2023; diabetes prevalence: 2011 vs. 2024), and the trend for diabetes is based on only two time points per region rather than a continuous series. This limits the ability to establish temporal precedence, which is a precondition for any causal interpretation. A future extension of this work should use harmonised, continuous annual series for all three variables, enabling time-series or panel-data approaches rather than a comparison of period averages.

Fourth, the macro-regional aggregation itself masks substantial within-region heterogeneity. The Italian case study illustrates how a single country can depart considerably from its macro-regional average, and the same is plausibly true for other countries within each region (e.g., within Eastern or Northern Europe). A country-level, or even sub-national, disaggregation would allow a more granular assessment of the diet–temperature–diabetes relationship and should be prioritised in future analyses.

Fifth, in this study, we did not control for several known confounders of diabetes prevalence, including the age structure of the population and the ageing rate, obesity prevalence, levels of physical activity, socioeconomic status and access to diagnosis and healthcare (which can itself bias the apparent prevalence through differential detection rates between countries with different healthcare systems). No distinction is made between type 1 and type 2 diabetes, which have largely different aetiologies and different expected relationships with diet and temperature. This is particularly relevant because the literature on temperature and glycaemic control cited here mainly concerns short-term outcomes (e.g., hypoglycaemia) in type 1 diabetes, whereas the outcome analysed in this study is prevalence, which is largely driven by type 2 diabetes. The two outcomes are therefore related but not equivalent. Future work should adopt multivariate statistical models (e.g., mixed-effects or panel regression) capable of adjusting for these covariates, rather than relying on the descriptive visual comparison of trends presented here.

Finally, the UNESCO recognition of Italian cuisine is very recent (December 2025), therefore, there are currently no behavioral or health outcome data reflecting its impact. The present study can only describe the pre-existing conditions (dietary composition, temperature, diabetes prevalence) that motivated and contextualised the recognition, not its consequences. A natural and valuable future perspective is a longitudinal follow-up study that assesses whether and to what extent increased public attention to Italian dietary heritage translates into measurable dietary changes and downstream health effects in the coming years. Analyses at the individual level on a cohort of approximately 200,000 patients of a Local Health Authority in Central Italy, currently in preparation for publication, will allow these hypotheses to be tested while adjusting for the confounders discussed above. A country-level analysis based on rank correlation (e.g., Spearman) between temperature, PHD deviation and prevalence would also provide a more robust statistical test than the four macro-regional aggregates.

Taken together, these limitations do not undermine the exploratory value of the present analysis, but they indicate that its findings should be interpreted as hypothesis-generating rather than confirmatory, and they outline a clear roadmap – individual-level data, harmonised time series, sub-national disaggregation, confounder adjustment, and longitudinal follow-up – for strengthening the evidence base on the interplay between climate, diet, culture, and chronic disease within a One Health framework.

5. Conclusions

Diabetes is a chronic disease influenced by several parameters: individual behavioural, clinical, physiological and environmental factors. This exploratory study provides a descriptive overview of the relationship between atmospheric parameters, prevalence of diabetes, and dietary habits within a One-Health framework. At the macro-regional level, there is a parallel increase in average temperature and the prevalence of diabete (in Southern Europe, Western Europe), although it is not possible to establish a cause-and-effect relationship based solely on temperature and prevalence. Nevertheless, the differences observed in Northern and Eastern Europe pave the way for assessing the importance of the absolute temperature values, and not just the role of temperature variation. Regarding dietary habits, Southern Europe appears to be more in line with PHD recommendations; nonetheless, the prevalence of diabetes in this area is the highest among the macro-regions, and the three other areas are more or less comparable to each other. Italy shows a lower PHD deviation, a prevalence of diabetes and a mean temperature lower than the average for its relevant macro-region (Southern Europe). This finding on the one hand, highlights the important role of individual habits, on the other hand, it paves the way for a reassessment of environmental stressors in the epidemiology of chronic diseases.

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Conflicts of Interest: Irene Di Giuseppantonio is an employee of San Giovanni Addolorata Hospital, Rome. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Appendix A

Table A1. Classification of European countries into macro-areas, and inclusion in the analysis.

Country	Included
Eastern Europe	
Belarus	✓
Bulgaria	✓
Czechia	✓
Czechoslovakia	×
Hungary	✓

Table A1 continued.

Country	Included
Poland	✓
Republic of Moldova	✓
Romania	✓
Russian Federation	✓
Slovakia	✓
USSR	×
Ukraine	✓
Northern Europe	
Åland Islands	×
Channel Islands	×
Denmark	✓
Estonia	✓
Faroe Islands	×
Finland	✓
Guernsey	×
Iceland	✓
Ireland	✓
Isle of Man	×
Jersey	×
Latvia	✓
Lithuania	✓
Norway	✓
Sark	×
Svalbard and Jan Mayen Islands	×
Sweden	✓
United Kingdom of Great Britain and Northern Ireland	✓
Northern Europe, unspecified (population)	×
Southern Europe	
Albania	✓
Andorra	×
Bosnia and Herzegovina	✓
Croatia	✓
Gibraltar	×
Greece	✓
Holy See	×
Italy	✓
Kosovo	×
Malta	✓
Montenegro	✓
North Macedonia	✓
Portugal	✓
San Marino	×
Serbia	✓
Serbia and Montenegro	×
Slovenia	✓
Spain	✓

Table A1 continued.

Country	Included
Yugoslav SFR	×
Southern Europe, unspecified	×
Western Europe	
Austria	✓
Belgium	✓
Belgium-Luxembourg	×
France	✓
Germany	✓
Liechtenstein	×
Luxembourg	✓
Monaco	×
Netherlands (Kingdom of the)	✓
Switzerland	✓
Western Europe, unspecified (population)	×

Table A2. Country-item combinations with missing years in FAOSTAT food supply (kcal/capita/day), 2010-2023, for items and countries included in the analysis.

Food Category	Item	Country	Missing Years
Whole grains	Maize and products	Czechia	2017, 2022
		Slovakia	2015
		Poland	All years missing
	Barley and products	Iceland	2014–2015
		North Macedonia	2014–2018
	Millet and products	Belarus	2014–2023
		All except Austria, Belarus, Germany, Montenegro, Portugal, Russia, Switzerland, Ukraine	
	Sorghum and products	Iceland	2010–2022
		Montenegro	2010–2019
		Russian Federation, Ukraine	2018
		All except Bosnia and Herzegovina, Iceland, Montenegro, Russia, Spain, Ukraine	
Tubers and starchy roots	Cassava and products	All except Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Estonia, Hungary, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Poland, Moldova, Russia, Serbia, Ukraine	
	Sweet potatoes	Belgium, Germany, Ireland, United Kingdom	All years missing
	Yams	Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Estonia, Greece, Hungary, Lithuania, Poland, Moldova, Serbia	All years missing
	Roots, other	North Macedonia	All years missing

Table A2. *Cont.*

Food Category	Item	Country	Missing Years
Legumes	Beans	Lithuania, Ukraine	2010–2018
Milk and butter	Cream	Montenegro	2014–2017, 2020–2023
Fish and seafood	Aquatic animals, others	Bosnia and Herzegovina	2010, 2011, 2017
		Greece	2011
		Montenegro	2010–2011
		North Macedonia	2015–2019, 2021–2023
		Serbia	2020
		Switzerland	2010–2011
Coconut and palm oil	Palm oil	Spain	2010–2021
		Estonia	2019–2023
		Portugal	2015, 2017
	Palm kernel oil	Austria, Czechia	2010–2017
		Albania	2010–2015
		Estonia	2019–2023
		Finland	2022–2023
		France	2020
		Portugal	2015, 2017
		Lithuania, Russia, Slovakia, Ukraine	All years missing
		Lithuania, Netherlands, Norway, Russia, Slovakia, Slovenia, Ukraine	All years missing
	Coconut oil	Portugal, Russian Federation	2010–2018
		Czechia	2010–2017
		Albania	2010–2015
		Finland	2023
		France	2020
		Italy, Netherlands, Slovakia, Slovenia, Spain, Ukraine	All years missing
Unsaturated plant oil	Groundnut oil	Finland	2023
		Montenegro	2020
		North Macedonia	2021–2023
	Soya bean oil	Finland	2023
	Rice bran oil	Italy	2018–2023
		All except Italy, North Macedonia, Poland	All years missing
	Cottonseed oil	Portugal	2010–2018
		Moldova	2014–2023
		Ireland, Lithuania, Netherlands, Poland, Russia, Slovakia, Slovenia, Ukraine	All years missing
	Maize germ oil	Switzerland	All years missing
	Rape and mustard oil	Bosnia and Herzegovina, Bulgaria, Greece, Lithuania, Netherlands, North Macedonia, Portugal, Romania, Serbia	All years missing
	Sesame seed oil	Bosnia and Herzegovina, Bulgaria, Czechia, Latvia, Netherlands, Moldova, Serbia	All years missing

Note: Food items with no data in some years between 2010 and 2023 are listed by country. For food items where more than 20 countries have no data for any year between 2010 and 2023, we reported only the countries with available data on that food item; this refers to millet, sorghum and cassava and their respective products.

Table A3. FAOSTAT items included in each dietary category.

Category	FAOSTAT Items
Milk and butter	Milk (excl. butter); Butter, Ghee; Cream
Poultry meat	Poultry Meat
Fish and seafood	Freshwater, Demersal, Pelagic, Marine (other) Fish; Crustaceans; Cephalopods; Molluscs, other; Aquatic Animals, other
Eggs	Eggs
Meat	Bovine; Mutton & Goat; Pigmeat; Meat, other; Offals; Animal Fats
Whole grains	Wheat; Rice; Barley; Maize; Rye; Oats; Millet; Sorghum; Cereals, other
Tubers and starchy roots	Potatoes; Sweet potatoes; Cassava; Yams; Roots, other; Plantains
Vegetables	Tomatoes; Onions; Vegetables, other; Aquatic Plants
Fruits	Apples; Bananas; Oranges/Mandarines; Lemons/Limes; Grapefruit; Citrus, other; Grapes (excl. wine); Pineapples; Dates; Fruits, other
Tree nuts and peanuts	Nuts; Groundnuts

Table A3. *Cont.*

Category	FAOSTAT Items
Legumes	Beans; Peas; Pulses, other; Soyabeans
Unsaturated plant oil	Soyabean, Groundnut, Sunflowerseed, Rape/Mustard, Cottonseed, Sesameseed, Olive, Ricebran, Maize Germ, Oilcrops (other) Oils
Coconut and palm oil	Palm Oil; Palmkernel Oil; Coconut Oil*
Sugar and sweeteners	Sugar (Raw Equiv.); Sweeteners, other; Honey
Excluded (Other)	Rape/Mustardseed; Coconuts (Incl. Copra); Olives; Oilcrops, other; Cottonseed; Sunflower/Sesame seed; Cocoa; Coffee; Pepper; Pimento; Cloves; Spices, other; Fish Liver/Body Oil; Misc.; Sugar beet/cane; Infant food, Beverages (beer, alcoholic beverages, wine, tea, fermented beverages)

* Coconut Oil is included for the macro-areas; no record exists for Italy.

Table A4. Dietary energy composition by European macro-area compared with the Planetary Health Diet.

	Macro-Area						
Food Group	**Eastern**	**Northern**	**Southern**	**Western**	**Europe**	**Italy**	**PHD**
Animal-sourced foods							
Milk and butter	12.7	15.6	12.0	17.7	14.3	12.4	6.1
Poultry meat	3.3	3.6	2.6	2.3	2.9	2.0	2.5
Fish and seafood	1.0	1.4	1.6	1.1	1.2	1.4	1.0
Eggs	1.6	1.3	1.3	1.5	1.5	1.2	0.8
Meat	9.9	10.5	10.3	12.7	10.8	10.1	1.9
Plant foods							
Whole grains	34.5	29.9	30.4	25.8	30.7	31.5	30.7
Tubers and starchy roots	5.6	4.6	2.9	3.5	4.3	2.1	2.1
Vegetables	2.8	2.4	2.9	2.3	2.6	2.4	4.0
Fruits	2.8	3.9	4.5	3.8	3.6	4.6	6.1
Tree nuts	0.6	1.5	1.8	1.9	1.3	1.7	11.5
Legumes	0.6	0.9	1.4	0.5	0.8	1.5	11.5
Fats and sugar							
Unsaturated plant oil	10.9	11.9	17.4	12.1	12.7	17.1	14.8
Coconut and palm oil	0.7	1.1	1.3	1.7	1.1	2.6	2.3
Sugar and sweeteners	12.8	11.6	9.6	13.0	12.0	9.6	4.8
Total (kcal/capita/day)	3142.3	3094.4	3245.8	3274.2	3191.1	3467.4	2395.0

Notes: Values are percentages of total dietary energy from the food groups listed. Macro-area figures are FAOSTAT food supply averaged over 2010-2023; food supply measures availability at retail and exceeds actual intake. The Europe column is the unweighted mean of the four macro-areas and is not population-weighted. Italy does not include coconut oil in "Palm and Coconut oil" category due to missing data. Columns may not sum to 100 due to rounding.

Table A5. Differences in dietary energy composition between European macro-area compared and the Planetary Health Diet.

	Difference from PHD (p.p.)					
Food Group	**Eastern Europe**	**Northern Europe**	**Southern Europe**	**Western Europe**	**Europe**	**Italy**
Animal-sourced foods						
Milk and butter	6.7	9.6	5.9	11.6	8.2	6.3
Poultry meat	0.8	1.1	0.1	0.3	0.4	0.5
Fish and seafood	0.0	0.3	0.6	0.1	0.2	0.4
Eggs	0.7	0.5	0.5	0.6	0.6	0.4
Meat	8.0	8.6	8.4	10.8	8.9	8.2

Table A5. *Cont.*

	Difference from PHD (p.p.)					
Food Group	**Eastern Europe**	**Northern Europe**	**Southern Europe**	**Western Europe**	**Europe**	**Italy**
Plant foods						
Whole grains	3.8	0.8	0.3	4.9	0.0	0.8
Tubers and starchy roots	3.6	2.5	0.8	1.4	2.3	0.8
Vegetables	1.2	1.6	1.1	1.6	1.3	1.6
Fruits	3.2	2.2	1.5	2.2	2.5	1.4
Tree nuts	10.8	10.0	9.7	9.5	10.1	9.8
Legumes	10.9	10.6	10.1	10.9	10.7	10.0
Fats and sugar						
Unsaturated plant oil	3.9	2.9	2.6	2.7	2.1	2.3
Coconut and palm oil	1.6	1.2	1.0	0.6	1.2	0.3
Sugar and sweeteners	8.0	6.8	4.8	8.2	7.2	4.7
Total	63.1	58.7	47.3	65.6	55.8	46.7

Notes: Values are absolute differences between each macro-area's share of dietary energy and the corresponding PHD share, in percentage points. Italy is included in the Southern Europe aggregate and is reported separately for comparison. Butter is included with milk, following the energy accounting in Rockström et al. [7]. Macro-area figures are FAOSTAT food supply averaged over 2010-2023; food supply measures availability at retail and exceeds actual intake. Italy does not include coconut oil in "Palm and Coconut oil" category due to missing data.

References

1. Hoegh Guldberg, O.; Jacob, D.; Taylor, M.; Bindi, M.; Brown, S.; Camilloni, I.A.; Diedhiou, A.; Djalante, R.; Ebi, K.L.; Engelbrecht, F.; et al. Impacts of 1.5°C global warming on natural and human systems. In *Global Warming of 1.5°C.: An IPCC Special Report*; IPCC Secretariat: Geneva, Switzerland, 2018.
2. Kovats, R.; Valentini, R.; Bouwer, L.; Georgopoulou, E.; Jacob, D.; Martin, E.; Rounsevell, M.; Soussana, J. Europe. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability*; Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; IPCC: Geneva, Switzerland, 2014; pp. 1267–1326.
3. Mbow, C.; Rosenzweig, C.; Barioni, L.; Benton, T.; Herrero, M.; Krishnapillai, M.; Liwenga, E.; Pradhan, P.; Rivera-Ferre, M.; Sapkota, T.; et al. Food Security. In *Climate Change and Land: An IPCC Special Report on Climae Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*; Technical report, Intergovernmental Panel on Climate Change; IPCC: Geneva, Switzerland, 2019.
4. Jones, A.D.; Hoey, L.; Blesh, J.; Miller, L.; Green, A.; Shapiro, L.F. A systematic review of the measurement of sustainable diets. *Adv. Nutr.* **2016**, *7*, 641–664.
5. Poore, J.; Nemecek, T. Reducing food's environmental impacts through producers and consumers. *Science* **2018**, *360*, 987–992. Erratum in *Science* **2019**, *363*, eaaw9908.
6. Xu, X.; Sharma, P.; Shu, S.; Lin, T.S.; Ciais, P.; Tubiello, F.N.; Smith, P.; Campbell, N.; Jain, A.K. Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nat. Food* **2021**, *2*, 724–732.
7. Rockström, J.; Thilsted, S.H.; Willett, W.C.; Gordon, L.J.; Herrero, M.; Hicks, C.C.; Mason-D'Croz, D.; Rao, N.; Springmann, M.; Wright, E.C.; et al. The EAT–Lancet Commission on healthy, sustainable, and just food systems. *Lancet* **2025**, *406*, 1625–1700.
8. Rockström, J.; Steffen, W.; Noone, K.; Persson, Å.; Chapin, F.S., III; Lambin, E.; Lenton, T.M.; Scheffer, M.; Folke, C.; Schellnhuber, H.J.; et al. Planetary boundaries: Exploring the safe operating space for humanity. *Ecol. Soc.* **2009**, *14*, 32.
9. Blauw, L.L.; Aziz, N.A.; Tannemaat, M.R.; Blauw, C.A.; de Craen, A.J.; Pijl, H.; Rensen, P.C. Diabetes incidence and glucose intolerance prevalence increase with higher outdoor temperature. *BMJ Open Diabetes Res. Care* **2017**, *5*, e000317.
10. Kannankeril Joseph, V.J.; Conte Keivabu, R.; Muttarak, R.; Zagheni, E.; Mazzuco, S. Harvesting effect and extreme temperature-related mortality in Italy. *Eur. J. Popul.* **2026**, *42*, 3.
11. Capatti, A.; Montanari, M. *Italian Cuisine: A Cultural History*; Columbia University Press: New York, NY, USA, 2003.
12. Montanari, M. *L'identità Italiana in Cucina*; Gius. Laterza & Figli Spa: Rome, Italy, 2012.
13. Keys, A.; Keys, M. *How to Eat Well and Stay Well the Mediterranean Way*; Doubleday: Garden City, NY, USA, 1975.
14. Keys, A.; et al. *Seven Countries*; Harvard University Press: London, UK, 2013; Volume 245.
15. Gerber, M.; Hoffman, R. The Mediterranean diet: Health, science and society. *Br. J. Nutr.* **2015**, *113*, S4–S10.
16. UNESCO. 2010. Available online: https://www.unesco.it/it/iniziative-dellunesco/patrimonio-culturale-immateriale/dieta-mediterranea/ (Accessed: 4 May 2026).

17. UNESCO. 2025. Available online: https://www.unesco.it/it/news/la-cucina-italiana-iscritta-alla-lista-rappresentativa-del-patrimonio-culturale-immateriale-unesco/ (Accessed: 4 May 2026).
18. Davis, C.; Bryan, J.; Hodgson, J.; Murphy, K. Definition of the Mediterranean diet: A literature review. *Nutrients* **2015**, *7*, 9139–9153.
19. Castaldi, S.; Dembska, K.; Antonelli, M.; Petersson, T.; Piccolo, M.; Valentini, R. The positive climate impact of the Mediterranean diet and current divergence of Mediterranean countries towards less climate sustainable food consumption patterns. *Sci. Rep.* **2022**, *12*, 8847.
20. Shukla, P.R.; Skeg, J.; Buendia, E.C.; Masson-Delmotte, V.; Pörtner, H.O.; Roberts, D.; Zhai, P.; Slade, R.; Connors, S.; Van Diemen, S.; et al. *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*; IPCC: Geneva, Switzerland, 2019.
21. Renzella, J.; Townsend, N.; Jewell, J.; Breda, J.; Roberts, N.; Rayner, M.; Wickramasinghe, K. *What national and subnational interventions and policies based on Mediterranean and Nordic diets are recommended or implemented in the WHO European Region, and is there evidence of effectiveness in reducing noncommunicable diseases?*; World Health Organization, Regional Office for Europe: Copenhagen, Denmark, 2018.
22. Mascitelli, A.; Tumini, S.; Chiacchiaretta, P.; Aruffo, E.; Sacrini, L.; Saltarelli, M.A.; Di Carlo, P. Effect of Atmospheric Temperature Variations on Glycemic Patterns of Patients with Type 1 Diabetes: Analysis as a Function of Different Therapeutic Treatments. *Int. J. Environ. Res. Public Health* **2025**, *22*, 1850.
23. Mascitelli, A.; Chiacchiaretta, P.; Staropoli, M.C.; Aruffo, E.; Tumini, S.; Ferretti, A.; Franciotti, R.; Zhang, N.; Di Carlo, P. The VITALITY Project: An analysis of the impact of climate change on diabetic patients in a region of central Italy (Abruzzo, Italy). In Proceedings of the 19th Plinius Conference on Mediterranean Risks, Murcia, Spain, 6–9 October 2026; Plinius19-19, abstract.
24. Chiacchiaretta, P.; Tumini, S.; Mascitelli, A.; Sacrini, L.; Saltarelli, M.A.; Carabotta, M.; Osmelli, J.; Di Carlo, P.; Aruffo, E. The Impact of Atmospheric Temperature Variations on Glycaemic Patterns in Children and Young Adults with Type 1 Diabetes. *Climate* **2024**, *12*, 121.
25. Daultrey, H.E.; Oliver, N.S.; Chakera, A.J.; de la Cruz Libardi, A.; Iwuji, C.C.; Gasparrini, A. The Association Between Ambient Temperature and Hypoglycemia in People Living With Type 1 Diabetes: A Case Time Series Analysis Using Real-Time Continuous Glucose Monitoring. *Diabetes Care* **2026**, *49*, 1323–1329. https://doi.org/10.2337/dc25-2383.
26. Hersbach, H.; Bell, B.; Berrisford, P.; Biavati, G.; Horányi, A.; Muñoz Sabater, J.; Nicolas, J.; Peubey, C.; Radu, R.; Rozum, I.; et al. ERA5 Hourly Data on Single Levels from 1940 to Present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). 2023. Available online: https://doi.org/10.24381/cds.adbb2d47 (accessed on 5 June 2026).
27. ISTAT—Istituto Nazionale di Statistica. Temperatura e precipitazione delle città capoluogo negli anni 1971-2021. In *Report on Long-Term Meteorological and Climatic Trends in Italian Provincial Main Cities*; ISTAT: Rome, Italy, 2023
28. UNEP. *Food Waste Index Report 2024*; Technical report; United Nations Environment Programme Nairobi: Nairobi, Kenya, 2024.
29. IDF. International diabetes federation, 2026.
30. ISTAT—Istituto Nazionale di Statistica. Anni 2000-2016 IL DIABETE IN ITALIA. In *Report on Diabetes in Italy*; ISTAT: Rome, Italy, 2017
31. (C3S), C.C.C.S. *The European State of the Climate 2025 Report*; Technical report; C3S: Bonn, Germany, 2024.
32. Knuppel, A.; Papier, K.; Key, T.J.; Travis, R.C. EAT-Lancet score and major health outcomes: The EPIC-Oxford study. *Lancet* **2019**, *394*, 213–214.
33. Cacau, L.T.; Hanley-Cook, G.T.; Huybrechts, I.; De Henauw, S.; Kersting, M.; Gonzalez-Gross, M.; Gottr, ; F.; Ferrari, M.; Nova, E.; Castillo, M.J.; et al. Relative validity of the Planetary Health Diet Index by comparison with usual nutrient intakes, plasma food consumption biomarkers, and adherence to the Mediterranean diet among European adolescents : The HELENA study. *Eur. J. Nutr.* **2023**, *62*, 2527–2539.
34. Miranda, A.; Murante, A.M.; Manca, F.; Consalez, F.; Jani, A.; DeClerck, F.; Maillot, M.; Verger, E. Assessing sustainable and healthy diets in large-scale surveys: validity and applicability of a dietary index based on a brief food group propensity questionnaire representing the EAT-Lancet planetary health diet. *J. Nutr.* **2025**, *155*, 3084–3096.
35. Miranda, A.R.; Meunier, J.M.; Romagosa Vilarnau, S.; Jani, A.; Verger, E.O. Are European diets healthy and sustainable? Evidence from nine countries using the planetary health diet framework. *Eur. J. Nutr.* **2026**, *65*, 82.
36. Kesse-Guyot, E.; Rebouillat, P.; Brunin, J.; Langevin, B.; Allès, B.; Touvier, M.; Hercberg, S.; Fouillet, H.; Huneau, J.F.; Mariotti, F.; et al. Environmental and nutritional analysis of the EAT-Lancet diet at the individual level: Insights from the NutriNet-Santé study. *J. Clean. Prod.* **2021**, *296*, 126555.

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