PLAN'EAT

Ref. Ares(2023)5955853 - 01/09/2023

Dietary patterns mapping of the nine pre-selected target groups

Deliverable D1.2

This project has received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreement n° 101061023 (PLANEAT). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

DELIVERABLE PLAN'EAT – D1.2

Dietary patterns mapping of the nine pre-selected target groups

Start date of project	01/09/2022
Duration of project	48 months
Deliverable n° & name	D1.2 – Dietary Patterns mapping of the nine pre-selected target groups
Version	Final
Work Package n°	1
Due date of the deliverable	M12 – 31/08/2023 submitted 01/09/2023
Participant responsible	Council for Agricultural Research and Economics (CREA)
Main authors	Laura Rossi, Federica Grant, Vittoria Aureli, Olimpiu Stanciu, Sara Magnanego
Website	https://planeat-project.eu/

Nature of the deliverable		
R	Document, report (excluding the periodic and final reports)	X
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, etc.	
DATA	Data sets, microdata, etc.	
DMP	Data management plan	
ETHICS	Deliverables related to ethics issues.	
SECURITY	Deliverables related to security issues	
OTHER	Software, technical diagram, algorithms, models, etc.	

Dissemination level		
PU	Public	X
SEN	Sensitive, limited under the conditions of the Grant Agreement	
CI	Classified, EU RESTRICTED, CONFIDENTIAL or SECRET under the Commission Decision No2015/444	

Quality Procedure			
Date	**Version**	**Reviewers**	**Comments**
15/08/2023	V1	Olivia Riemer (TMG)	General and language revisions
29/08/2023	V1	Eileen Gibney (UCD)	General and language revisions

Once approved this deliverable will have the following DOI: 10.5281/zenodo.8214431

Contents

List of Tables

List of Figures

Project abstract

The EU food system is under considerable pressure to change due to its negative climate, environmental and health impacts. Food system transition will require many changes including changing dietary habits of millions of Europeans. PLAN'EAT aims to advance the scientific understanding of factors influencing dietary behaviour and the health, environmental and socio-economic impacts of dietary patterns, and deliver solutions for food systems transition through a transdisciplinary and multi-level approach.

PLAN'EAT will co-create data and interventions in a pan-EU network of 9 Living Labs (LLs) and a Policy Lab. These LLs will focus on a broad range of population groups, varying by age, culture, health, and socio-economic status. PLAN'EAT entails four steps that will all feed into each other:

(1) A snapshot of European dietary patterns and food environments will be provided by respectively basing on existing data from 11 EU countries and by involving local population groups in LLs.
(2) Factors and drivers influencing dietary behaviour at macro- (food system), meso- (food environment) and micro- (individual) levels will be deeply investigated.
(3) A True Cost Accounting database and methodology will be developed and applied, for the first time, on dietary patterns, providing integrated insights into the diverse impacts of current and future diets, including possible synergies and trade-offs.
(4) A solution package will be co-developed with food chain actors, consumers, and policymakers, including:
    - a Food System Dashboard, setting out context-specific food policy recommendations;
    - interventions targeting Farm to Fork actors, supporting farmers, food industries, retailers and food services to create suitable food environments;
    - personalised advisory tools to empower consumers; and
    - improved dietary advice and communication strategies to target populations at large.

PLAN'EAT will aim to enable >58500 European consumers to shift to healthier and more sustainable dietary patterns by 2032, reducing premature mortality by 20% and greenhouse gas emissions from local food supply chains by 23% in 39 EU areas.

Executive summary

The dietary pattern mapping of PLAN'EAT covers eleven countries (Belgium, France, Germany, Greece, Hungary, Ireland, Italy, Poland, Spain, Sweden, and The Netherlands) and nine target groups (children in France, Poland, and Sweden; adolescents in France, Germany, and Poland, young adults in Hungary and Ireland, the elderly in Spain and Greece, and people with diabetic and low socio-economic status in Italy) in Europe. The main objectives of the PLAN'EAT dietary pattern mapping exercise were related to the provision for a baseline for future project activities. This involves analyzing the similarities and differences of national dietary patterns, comparing current food consumption with current recommended food-based guidelines, and identifying foods that need to be promoted or discouraged. In addition, regional, and inter-country differences among the same target groups were considered. With the purpose of having a synthetic indicator able to evaluate the healthiness and the environmental impact of food consumption patterns the World Index for Sustainability and Health (WISH) was used. The main results of the PLAN'EAT dietary pattern mapping were that Italy, Spain, and Greece had better WISH than other countries showing a South-Western European gradient of adherence to planetary diet recommendations. Overall, females had a better dietary pattern than males with respect to health and environmental protection characteristics. Among population groups, the elderly in South European countries had the highest WISH, indicating that they were the population group with the healthiest and environmentally friendliest eating patterns. Children had better dietary patterns than adolescents and young adults in the countries analysed. The present EU dietary pattern mapping should be considered as one step of several further elaborations including the application of other diet quality indexes to provide a fine-tuning of the mapping.

1. Introduction

Knowing the specific food patterns of different population groups in Europe is important to identify who is at risk of under or over-consumption of specific foods and nutrients. Previous studies have examined dietary patterns across EU populations to determine possible geographical nuances in terms of food intake (Bamia et al., 2005) (Baxter et al., 2006).

Various methods can be used to identify and understand differences in dietary patterns across countries. Understanding what those differences are and what is driving them will help inform policy either as a wider EU level if possible, or within individuals member states.

1.1 Dietary pattern across Europe

Numerous European projects have previously addressed the issue of defining EU dietary patterns through diverse methodologies. Table 1 presents a compilation of these EU projects along with their main outcomes.

Table 1: Dietary patterns identification in EU projects				
Project name	**Countries covered**	**Target Group and Methodology**	**Dietary patterns (DPs) identified**	**Reference**
Food4Me	7 European countries: Ireland, UK, Spain, Greece, Germany, Netherlands, Poland	Adults. Web-based, randomized control trial, food frequency questionnaire.	2 main DPs were identified: • The "Prudent" diet was characterized by high consumption of plant-based foods. • "Western/processed" diet was high in energy-dense or processed foods.	(Woolhead et al., 2015)
HELENA	10 European cities: Athens and Heraklion in Greece, Dortmund in Germany, Ghent in Belgium, Lille in France, Pecs in Hungary, Rome in Italy, Stockholm in Sweden, Vienna in Austria, Zaragoza in Spain	Adolescents. Healthy eating determinants questionnaire; 24-hour recall questionnaire.	3 positive (in line with recommendations) DPs and 2 negative DPs were identified: • Positive DPs: ○ "Plant-based" "Mediterranean" and "healthy breakfast" DPs are characterized by high fruit consumption, low availability of soft drinks, higher perception of the benefits of healthy eating, and higher awareness of what is a healthy diet. • Negative DPs: ○ "Confectionary and sweetened beverage" DP, is correlated with consumption of cheese, sauces, confectionary non-chocolate, chocolate, butter and animal fats, coffee, tea, sweetened beverages, beer, wine, and other alcoholic and limited consumption of milk. ○ "Animal-based food and processed food" DP is characterized by high consumption of meat, cakes, pies and biscuit, chocolate, and sweetened beverages and limited consumption of sugar, honey, jam and syrup, butter and animal fats, coffee, and tea.	(González-Gil et al., 2019)
EPIC Study	10 Western European countries (Denmark, France, Germany, Greece, Italy, Norway, Spain, Sweden, The Netherlands and the UK). Non representative sample (practical and logistics sampling procedure)	Adult and elderly (35–74 years); 24-hour dietary recall measurements	DPs' characteristics of EPIC participating countries: • Italy and Greece: mainly plant based foods (except potatoes) and a low consumption of animal and processed foods. • France and Spain: heterogeneous dietary patterns, with a relatively high consumption of both plant foods and animal products. • Nordic countries (The Netherlands, Germany, and the UK) high consumption of potatoes and animal, processed and sweetened/refined foods; fruit and vegetables consumption is similar to, or below, the overall EPIC means, and is low for legumes and vegetable oils.	(Slimani et al., 2009)
DAFNE	10 European countries: Belgium, France, Finland, Germany, Greece, Italy, Norway, Portugal, Spain and the United Kingdom	Households. Standardized data collected through the national household budget survey	• Mediterranean DP: high vegetable and pulse consumption, high availability of unprocessed red meat. • Central and Northern European DP: high consumption of meat products, high availability of beverages (alcoholic and non-alcoholic).	(Naska et al., 2006)

Mapping of dietary patterns relies on food consumption data, the collection of which is often a costly and timely exercise. According to Mertens and Peñalvo (Mertens and Peñalvo, 2023) routine dietary surveys, following the same methodology of participant selection and diet collection, allow for food consumption estimates over time and hereby provide an evidence to investigate changes in food consumption and, when

repeated at regular intervals, to establish trends in such changes that might be related to the (rapidly changing) food environment and food and nutrition policies in place. In line with this statement, the European Food Safety Authority (EFSA) initiated the European Union Menu Project in 2014 (European Food Safety Authority, 2014), with the objective of producing a standardized collection of accurate, harmonized, and detailed individual-level food consumption data. The EFSA's Food Consumption dataset has the advantage of being consistent and reliable in terms of consumers' dietary estimates. Furthermore, the harmonization of methodology across countries enables cross-country and subregional comparisons of the diet.

Once data is collected and available it can be used for multiple purposes including assessment of health and sustainability. To assess whether a population follows a healthy diet, various diet quality indices are available, including the Healthy Eating Index (HEI), the Diet Quality Index (DQI), the Healthy Diet Indicator (HDI), the Mediterranean Diet Score (MDS) (Gil, 2015), etc., with the majority of them developed for a specific country or region (Trijsburg et al., 2019). The combination of examining the healthiness of a dietary pattern alongside its impact on the environment is a relatively new topic that needs to be taken into account in the framework of a project such as PLAN'EAT which has the ambition to better understand how environmental, social, cultural and individual factors affect people's food choices. Some indices combining the healthiness and environmental impact of the diet in one score are available (Seconda et al., 2019) (Van Dooren et al., 2017). However such indices have difficulties in terms of interpretation relying on information from life-cycle assessment databases (Jones et al., 2016). Therefore, for the present mapping, a relatively simple index using only data on food consumed measuring both the healthiness and environmental impact of the diet was identified.

For the PLAN'EAT dietary pattern mapping the World Index for Sustainability and Health - WISH, developed by Trijsburg et al (Trijsburg et al., 2020) was considered as the most appropriate. The WISH index is based on global recommendations for a healthy diet for the general healthy population within environmental sustainability targets.

1.2 Dietary mapping in the framework of PLAN'EAT activities

Dietary intake mapping of the PLAN'EAT countries and each Living Lab's (LL) target population group provided a profile in terms of quantity, variety, and combination of different foods within country specific diets. Such data was then used within the WISH index to examine current diets with respect to the recommendations in terms of the health or environmental impact of current food choices. In addition, data on nutrition-related health problems and socioeconomic aspects of dietary patterns were provided at the country level and specifically for each LL target group. The data set that has been generated allowed to identification of the common foods and food groups within each dietary pattern and across countries, as well as the biggest food/food group contributors in terms of environmental impact. These key inputs will be used for the development of personalized decision trees and web-based tools for personalized and localized guidelines that will be produced in the framework of PLAN'EAT WP4 activities.

This mapping exercise relied on existing national food intake and food composition databases acquired for the present work. The mapping presented in this deliverable is the step-in building/developing an appropriate dataset that would permit the identification of differences across dietary patterns in different countries and population groups.

The mapping exercise and the dataset that are going to be produced will be used for various purposes. The dataset could be used to develop indexes to carry out a pre- and post-comparative assessment based on the criteria of adherence to nutritional and environmental dietary recommendations and the consensual definition of a healthy diet (e.g., portion of fruits and vegetables per day, quantity of milk, etc.) which may be the subject of specific publications during PLAN'EAT project activities.

The findings from the mapping exercise will be used in work package 4 of the PLAN'EAT project to develop a tool which can be used to provide individuals with sustainable and healthy dietary plans. Based on the mapping it will create a framework for the development of food-based dietary guidelines, for specific local contexts, dietary patterns, and population groups. These localized guidelines will empower citizens to make informed and accessible choices as a win-win for their health and the environment, by adjusting to their local food environments, culture, age, health, and socio-economic status.

The dietary patterns of PLAN'EAT participating countries and the specific population groups mapped will be evaluated in terms of environmental, socioeconomic, and health impacts through True Cost Accounting (TCA) methodology. The dietary mapping databases need to be linked to population groups with a breakdown by age, gender, living area, socio-economic status (SES), and health status. The TCA will gather relevant data collected and generated during the project: dietary patterns and food environments mapping, dietary behavior studies, and impacts of food choices. The data will be used to estimate the health, socio-economic, and environmental impacts of three dominant European dietary patterns. These patterns will be chosen based on synergies and overlaps observed in the mapping of the nine population groups and of the eleven countries. The approach would permit the evaluation of the impacts of dietary patterns and their variation across population groups, and socio-cultural-geographical-economic contexts.

1.3 The nine population group targets and areas considered.

To adopt a participatory and multi-actor approach, PLAN'EAT is implementing most of its activities in 9 LLs, which each targets a specific population group (Table 2). The population groups have been selected for their potential for behavioural change, low representativeness in existing studies and statistics, ability to influence other population groups, foreseen impact of interventions, and epidemiological needs. Vulnerability of the study subjects and gender are also considered.

Table 2: Living Labs target groups

Living Lab (LL)	Target group	Setting
France (Auvergne)	Healthy children and adolescents, middle and high socioeconomic status (SES), urban and rural (6-15 years)	School
Germany (Bayern)	Obese and overweight children and adolescents from a cohort in Germany (10-18 years)	Clinical
Greece (Attica)	Elderly people, NCDs, all SES (> 60 years)	Free-living population
Hungary (Budapest)	Healthy young adults, low SES (single parents) (20 – 30 years)	Citizen community
Ireland (Dublin)	Healthy young adults – University students, all SES (18-30 years)	University Campus
Italy (Bologna – Pilastro)	Diabetic adults from low SES (low income/ rural/ immigrants), (18-70 years).	Clinical
Poland (Kracow)	Healthy children and adolescents, low SES (1-16 years)	School, kindergarten, and household
Spain (Catalonia)	Healthy adults from middle age to elderly, low SES, (40-85 years)	Citizen community
Sweden	Healthy toddlers, middle and high SES (<6 years)	Pre-school and household

The dietary mapping of PLAN'EAT is carried out not only on the LLs target groups but also on the entire national population within the country where the LLs are performed. Hence, PLAN'EAT dietary pattern mapping covers both the countries and the LLs target groups, when data were available for both. This approach recognizes that while national-level data is more widely available and representative, it might not accurately reflect the nuances of specific population groups.
It was deemed efficient to incorporate Belgium into the analysis, where the Policy LL will be performed as well as to add the Netherlands to the analysis, a participating country in PLAN'EAT but in which no LL will be performed. At the end of the mapping exercise, eleven national populations (in Belgium, France, Germany, Greece, Hungary, Ireland, Italy, Poland, Spain, Sweden, and The Netherlands) and nine target groups (Children in France, Poland, and Sweden, Adolescents in France, Germany, and Poland, Young Adults in Hungary and Ireland, the Elderly in Spain and Greece, and Diabetic low socio-economic status in Italy) were covered.

1.4 The scope of PLAN'EAT dietary patterns mapping and analysis

The main goals of the PLAN'EAT dietary pattern mapping are to:

- provide a baseline for LL activities, by mapping the dietary patterns of each of LLs 9 target groups in each of the areas considered and in the 11 PLAN'EAT countries.
- analyze the differences and peculiarities of local and/or national dietary patterns - with regard to age, gender, socio-economic status (SES), critical foods, culture, region, and country - and their strengths and weaknesses.

Specifically, the PLAN'EAT dietary pattern mapping will:

- provide a comparison between food consumption and recommendations using diet quality indexes applicable in different countries overcoming the issue that each country has its own recommendations.
- develop diet quality indexes that include environmental protection aspects as well as health protection aspects.
- identify foods that need to be promoted and foods that need to be discouraged as well as behaviors in line with recommendations and behaviors to be corrected.
- provide regional and sub-regional differences and differences among the same target groups belonging to different countries.

1.5 Methodology

The PLAN'EAT dietary pattern mapping was based on secondary data collection for the eleven PLAN'EAT countries. The secondary data mainly consisted of country-level food consumption data estimated from individual-level national dietary surveys that were obtained from the Comprehensive European Food Consumption Database, that has been developed and maintained since 2011 by EFSA (European Food Safety Authority, 2011). The summary statistics of their food consumption data, reported in grams/day (population mean intakes) and classified according to the fifth level of the "Exposure Hierarchy" of the comprehensive food classification and description system FoodEx2 (EFSA, 2015), were retrieved, and aggregated for infant (1-2 years), children (3-9 years), adolescent (10–17 years), adult (18–64 years), and elderly (65–74 years) populations' groups, stratified by sex.

The data collection methodologies of the surveys used in the present analysis were reported in Table 3.

Table 3: Data collection methodologies of the food consumption national surveys.

Country	Date	Name	Classes of ages	Sample size	Dietary assessment methodology	Additional data collected	Source
Belgium	2014	Second Belgian general national food consumption survey (BNFCS2014)	3-65 years	3.200 individuals (1.000 children, 1.000 adolescents, 1.200 adults)	24-hour dietary recall (Adolescents and adults); Two non-consecutive one-day food diaries (children); Food Propensity Questionnaire	Socio-demographic characteristics, physical activity (questionnaire and accelerometer), sedentary behaviour, and food safety. Weight and height measured	(Scientific Institute of Public Health, Belgium, Bel, S. De Ridder, K. 2018.)
France	2014-2015	The French national dietary survey (INCA3)	Adults (18–79 years); children (0–17 years)	4114 individuals (2121 adults, 1993 children)	Three non-consecutive 24 h recalls (15–79 years); records (0–14 years old); Food Frequency	Food supplement use, eating habits, physical activity and sedentary behaviours, health status, and sociodemographic characteristics	(Dubuisson et al., 2019)

					Questionnaire	(questionnaires). Height and weight measured.	
Germany	2007	Second German National Nutrition Survey (NVS II)	14–80 years	15.371 individuals (1.124 adolescents; 10.276 adults; 3971 elderly)	DISHES (Diet Interview Software for Health Examination Studies)	Sociodemographic, education, occupation, household structure and income, nutritional behaviour, health aspects (e.g., smoking), use of dietary supplements, food purchase, leisure time activities, and sleeping behaviour. Weight and height measured.	(Heuer et al., 2015)
Greece	2014	The EFSA-funded collection of dietary and related data in the general population aged 10-74 years in Greece	Adult and elderly (18-74 years); adolescents (10-17 years)	780 individuals (276 adolescents; 261 adults up to 64 years; 261 elderly 65-74 years.	24-hour dietary recalls and Food Propensity Questionnaire.	Gender, date, country of birth, nationality, educational attainment, employment and current occupation, composition of the household, and physical activity were also administered. Weight and height measured.	(Tricopolu et al., 2018)
Hungary	2018-2020	Hungarian national food consumption survey	Adolescents (10-17 years), adults (18-64 years), and elderly (65-74 years).	1585 individuals (528 adolescents, 529 adults, 528 elderly).	Recall of two non-consecutive days, with at least 10 days distance between the two and the Food Propensity Questionnaire.	Socio-demographic information, food supplements, food allergy and intolerance, and physical activity. Weight and height measured.	(National Food Chain Safety Office, Hungary et al., 2020)
Ireland	2008-2010	National Adult Nutrition Survey (NANS)	18-90 years adults (18-64 years), elderly (65-74 years).	1500 individuals (1274 adults, 226 elderly)	Food diary with a four-day semi-weighed food record.	Social and demographic variables, employment status, attitudes to food and health, supplement use, alcohol consumption, smoking, and habitual physical activity levels. Weight and height measured.	https://www.iuna.net/
Italy	2018	Italian national dietary survey on the adult population from 10 up to	10-74 years	1203 individuals (288 adolescents, 757 adults, 158 elderly).	Two 24-hour dietary recall interviews with an interval of at	Socio-demographic characteristics, physical activity questionnaire,	(Turrini et al., 2022)

		74 years old			least 15 days and a Food Propensity Questionnaire	food supplements consumption. Weight and height measured.	
Poland	2000	Household Food Consumption and Anthropometric Survey	1-96 years	4.200 individuals (488 children; 666 adolescents; 2.593 adults; 453 elderly)	24-hour recall	Assessment carried out in a sub-sample of households participating in the countrywide, representative household budget survey (HBS)	(Szponar et al., 2001)
Spain	2013	Spanish National dietary survey in adults, elderly and pregnant women (ENALIA2)	Adults (18 – 64 years old), elderly (65 to 74 years old), and pregnant women	1033 individuals (636 adults; 264 elderly; 133 pregnant women)	Two 24-hour dietary recall interviews with an interval of at least 15 days and a Food Propensity Questionnaire	Socio-demographic information; Health status; Physical activity; food supplement consumption; Weight and height measured	(Suarez et al., 2016)
Sweden	2010 2003	Swedish National Dietary Survey - Riksmaten adults 2010-11 Riksmaten children 2003: dietary habits and nutrient intake in Swedish school children in grade 2 and 5.	18-80 years 4-6 years	1797 individuals (1430 adults; 367 elderly) 590 children	web-based food diary	Health status; smoking habits; typology of the diet; use of fats and salt; dietary behaviors. Weight and height measured	(Riksmaten adults 2010-2011 - Survey.) (Riksmaten children 2003)
The Netherlands	2012-2016	Dutch National Food Consumption Survey 2012-2016 (DNFCS)	1-79 years	4.313 individuals (1466 children; 769 adolescents;1039 adults; 1039 elderly)	Two 24-hour dietary recall interviews with an interval of at least 15 days; Diary (Children and elderly)	Socio-demographic characteristics, physical activity, smoking, and use of alcoholic beverages, special diets, and eating habits, breakfast, dietary supplements, use of salt. Weight and height measured in children, and self-reported in adults and the elderly.	(van Rossum et al., 2020)

Whilst comprehensive, the EFSA database did not cover all the specific population groups of the 9 LLs. Specific requests were made to relevant national authorities to obtain additional datasets related to specific population groups not included or fully represented in the EFSA data sets. For Hungary data collected in 2015 covering infants and toddlers (0-3 years) were included harmonizing the food categories with EFSA data sets (Erdélyi-Sipos et al., 2019). For Ireland the following population groups were added: adolescents (13-15 years) from the National Teens' Food Survey II (NTFS II) - 2019-2020, children (5-8 years) from the National Children's Food Survey II (2017-2018) and toddlers (1-3 years) from the National Pre-School Nutrition Survey (2010-2011). These data were part of surveys carried out by the Irish Universities Nutrition Alliance (IUNA) aimed to gather Ireland's national databases of dietary intake and health status

through national nutrition surveys of the population from age 1 to 90 years (https://www.iuna.net/surveyreports).

With the purpose of having an over-arching index indicator to evaluate the healthiness and environmental impact of food consumption patterns the World Index for Sustainability and Health (WISH) was used. The WISH index was calculated according to Trijsburg et al. (Trijsburg et al., 2020). The components included in its calculation are reported in Table 4. The healthiness level was based on the supplementary material of the EAT-Lancet recommendations (Willett et al., 2019). The environmental impact was based on the assessment of Clark et al. (Clark et al., 2019) which included the following sustainability indicators: greenhouse gas, land use, eutrophication, acidification, and scarcity of water. The recommended amount of nutrient intake was obtained from the Global Burden of Disease study (Afshin et al., 2019).

The original WISH indicator was revised and adapted to the scope of the present work. The first adaptation concerned the food groups used. The original WISH included 13 food groups and dietary elements; however, two aspects were not taken into consideration that have relevance at the EU level namely alcohol consumption (Berdzuli et al., 2020) and processed meat consumption (De Boer and Aiking, 2022), both considered important either for public health or for sustainability aspects. Hence the WISH used in the present work included 15 food groups and dietary elements that were scored between 0 and 10, where 0 indicates no adherence to the recommended intake (g/day) as reported in Table 4 and 10 indicates complete adherence to the recommended intake (g/day). Scores between 0 and 10 were calculated proportionally based on the range of intakes reported in the last column of Table 4; for example, in the case of a wholegrain intake of 112.5 g/day, the correspondent score is 5.00, because it lies in the middle of 100-125 g/day. For protective and low impacting food groups, whole grains, fruits, vegetables and legumes, no restrictions at the upper ranges were fixed; hence also having an intake above the upper recommended quantity results in the maximum score of 10. For the protective food groups nuts, dairy foods and fish intakes between the recommended intake and the upper level of recommended intake are scored as 10. However, as these food groups pose a medium or high impact on the environment, intakes above the upper recommended intake are assigned a score of 0 given the impact on the environment. For the two neutral healthy groups (eggs, and chicken and other poultry) a medium environmental impact is observed, with higher intakes consequently increasing the burden on the environment. Therefore, an intake between the lower recommended intake (set at 0 g for all 3 food groups) and the recommended intake by EAT-Lancet is scored as 10. An intake between the recommended amount and the upper recommended intake is scored between 10 and an intake exceeding the upper recommended intake is scored as 0. For red meat, saturated oils and added sugars consumption should not exceed the recommended amount, as negative health effects increase from that intake level onwards (Trijsburg et al., 2020).

Table 4: Components included in the World Index for Sustainability and Health (WISH).						
Food Groups/Dietary Elements	**Recommended intake in g/day (Lower and Upper Range of intake)**	**Healthiness**	**Environmental impact**	**10 points**	**0 points**	**Range between 0 and 10**
Whole grains	≥125 (100-150)	Protective	Low	≥125	<100	100-125
Vegetables	300 (200-600)	Protective	Low	≥300	<200	200-300
Fruit	200 (100-330)	Protective	Low	≥200	<100	100-200
Dairy foods	250 (0-500)	Protective	Medium	250-500	>500	0-250
Red meat	14 (0-28)	Limit	High	≤14	>28	28-14
Fish	28 (0-100)	Protective	High	28-100	>100	0-28
Eggs	13 (0-25)	Neutral	Medium	≤13	>25	13-25
Chicken and other poultry	29 (0-58)	Neutral	Medium	≤29	>58	29-58
Legumes	75 (0-100)	Protective	Low	≥75	0	0-75
Nuts	50 (0-75)	Protective	Medium	50-75	>75	0-50
Unsaturated oils	40 (20-80)	Protective	Low	≥40	<20 and >80	20-40
Saturated oils	11.8 (0-11.8)	Limit	High	≤11.8	>11.8	Not applicable
Added sugars	31 (0-31)	Limit	Low	≤31	>31	Not applicable
Alcoholic beverages	0 (0-10)	Avoid	High	0	>0	Not applicable
Processed meat	2 (0-4)	Limit	High	<2	>4	2-4

Another innovative aspect of the use of the WISH index in the present work was its application to selected population groups, meaning the LLs target groups. In this regard, WISH was applied to adolescents, the elderly, and young adults. For children and adolescents, adjustments were made to account for the portion size and frequency of consumption within this age group (Rossi et al., 2022). Moreover, modifications were applied to the food categories (e.g., alcoholic beverages were replaced with sugary beverages in children).

To compute the total WISH score, all dietary components are summed up. A higher score indicates stronger adherence to both health and environmental recommendations, with both aspects carrying equal weight in the total score. In addition to the total WISH score, 4 sub-scores were calculated. Two scores were based on the diet quality concept (the healthy and the less healthy sub-scores) and the other two were based on the environmental sustainability of the food group (the high and low environmental impact sub-scores). The sub-scores give a more refined view of the dietary pattern of a country or region or population group; their calculation was carried out according to the following criteria:

- Healthy sub-score: summing the scores of protective and neutral food groups. A higher "healthy sub-score" means a higher adherence to the recommendations for protective foods and thus a healthier diet.
- Less healthy sub-score: summing the scores of food groups to be limited or avoided. A higher "less healthy sub-score" for limiting foods means a higher adherence to the recommendations for these limiting foods and thus a healthier diet.
- Low environmental impact sub-score: summing the scores of food groups associate with low environmental impact. A higher "low environmental sub-score" means better adherence to the recommendations for foods with low impact on the environment and thus yielding a lower overall negative effect. The "low environmental impact sub-score" is lower when the consumption of products such as whole grains, vegetables, fruits, and legumes is below recommended amounts, leading to a dietary pattern that negatively impacts the environment.
- High environmental impact sub-score: summing the scores of food groups associate with medium and high environmental impact. A higher "high environmental impact sub-score" means a greater adherence to the recommendations to limit the intake of highly impacting foods, resulting in a low impact on the environment. A lower sub-score would mean consumption beyond recommended amounts and so greater negative impacts on the environment.

Under this calculation system, higher scores for the individual food groups components translates to higher total and sub-scores indicating a diet that is both healthier and more environmentally friendly.

To provide the most recent data for country profiling in consideration of the fact that for some countries EFSA data are quite old, data from the Global Nutrition Report (GNR) (https://globalnutritionreport.org/) were also retrieved and further analysed for the purposes of this work. The dietary intake profiling carried out by the GNR was comparable with WISH in consideration that the intake targets recommended by GNR were determined based on the EAT-Lancet recommendations (Willett et al., 2019). This includes minimum recommended intakes of health-promoting food groups (fruits, vegetables, legumes, nuts, and wholegrains) and maximum recommended intakes of food groups with detrimental effects on health and/or environmental impacts (red meat, dairy, and fish). The GNR data evaluating the Country Nutrition Profiles were used in consideration that they bring together the latest data on nutrition at global, regional, and country levels. These data were used to compare different regions or to find out what progress the country has made toward global nutrition targets set by the World Health Assembly.

2. Part 2 – Outcomes and main results

2.1 Description of data sources and data export tool

The large data set collected from EFSA and from other sources was organized as a searchable dataset usable by the PLAN'EAT consortium members to explore the food consumption data (https://planeat-dietarypatterns.dev4u.eu/). An online user-friendly data export tool was created with access limited to consortium members (Figure 1). In the future and after refining, the data export tool can be made usable outside the consortium. The system permitted analysis of data by country, age, food items or food groups (Figure 2). The output of the tool was a table in which it was possible to add or eliminate rows. Simple descriptive statistics (mean, standard deviation, percentiles) were provided. The data were exportable in .xls format for further analysis (Figure 2). The whole database can be downloaded in .cvs format (Figure 3).

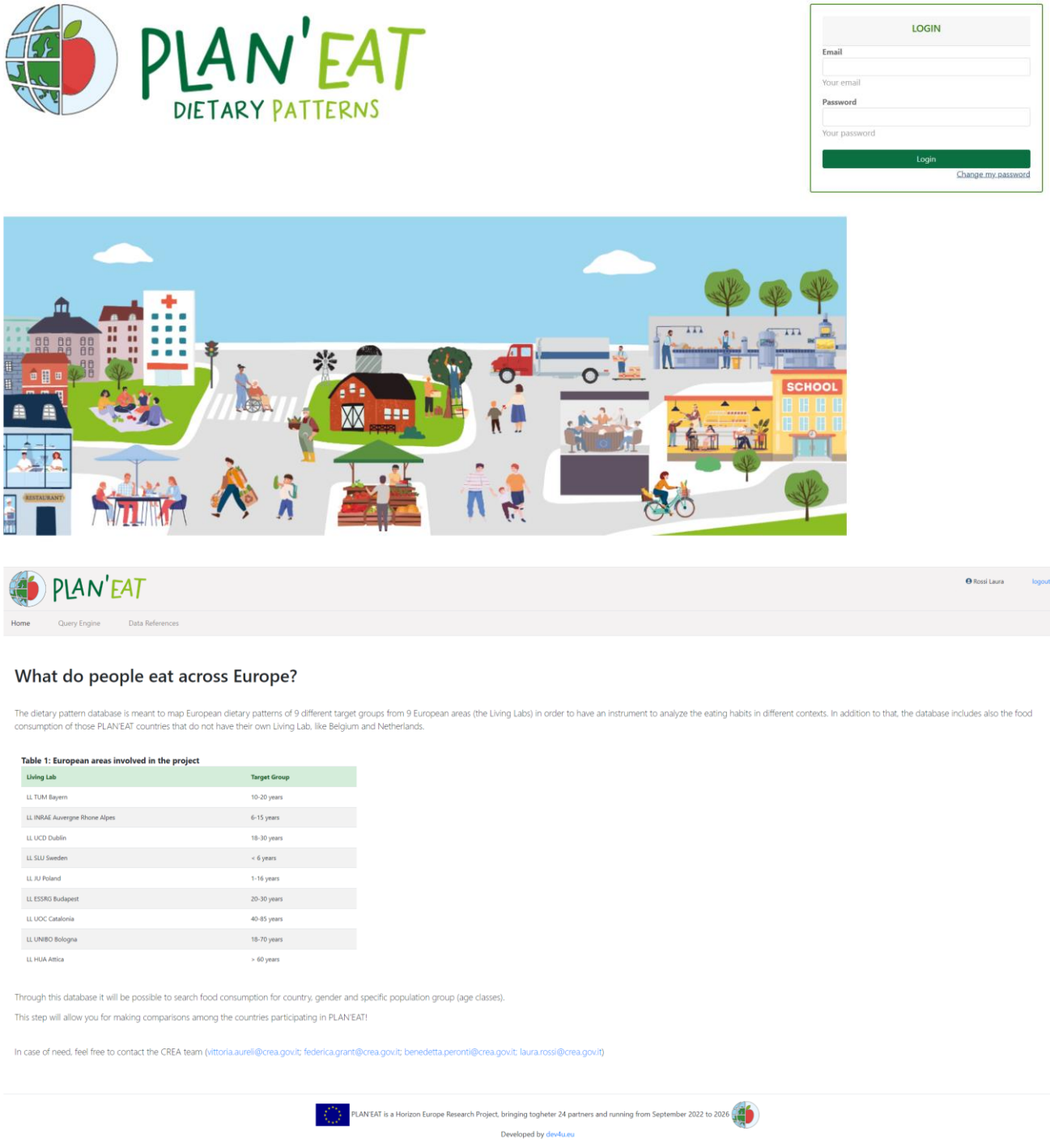
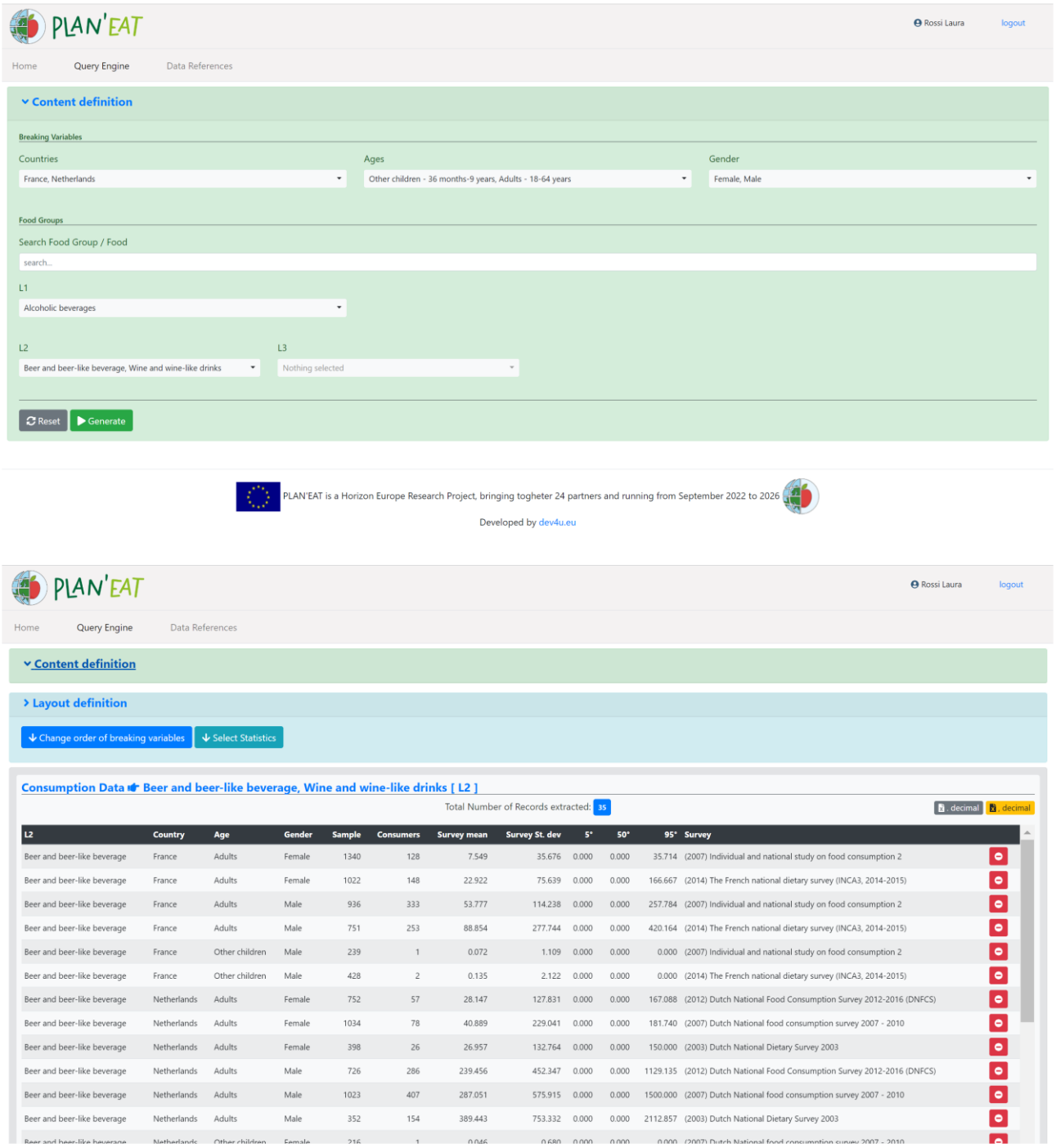


Figure 1 – PLAN'EAT dietary patterns exportation tool: access and content



L2	Country	Age	Gender	Sample	Consumers	Survey mean	Survey St. dev	5°	50°	95°	Survey
Beer and beer-like beverage	France	Adults	Female	1340	128	7.549	35.676	0.000	0.000	35.714	(2007) Individual and national study on food consumption 2
Beer and beer-like beverage	France	Adults	Female	1022	148	22.922	75.639	0.000	0.000	166.667	(2014) The French national dietary survey (INCA3, 2014-2015)
Beer and beer-like beverage	France	Adults	Male	936	333	53.777	114.238	0.000	0.000	257.784	(2007) Individual and national study on food consumption 2
Beer and beer-like beverage	France	Adults	Male	751	253	88.854	277.744	0.000	0.000	420.164	(2014) The French national dietary survey (INCA3, 2014-2015)
Beer and beer-like beverage	France	Other children	Male	239	1	0.072	1.109	0.000	0.000	0.000	(2007) Individual and national study on food consumption 2
Beer and beer-like beverage	France	Other children	Male	428	2	0.135	2.122	0.000	0.000	0.000	(2014) The French national dietary survey (INCA3, 2014-2015)
Beer and beer-like beverage	Netherlands	Adults	Female	752	57	28.147	127.831	0.000	0.000	167.088	(2012) Dutch National Food Consumption Survey 2012-2016 (DNFCS)
Beer and beer-like beverage	Netherlands	Adults	Female	1034	78	40.889	229.041	0.000	0.000	181.740	(2007) Dutch National food consumption survey 2007 - 2010
Beer and beer-like beverage	Netherlands	Adults	Female	398	26	26.957	132.764	0.000	0.000	150.000	(2003) Dutch National Dietary Survey 2003
Beer and beer-like beverage	Netherlands	Adults	Male	726	286	239.456	452.347	0.000	0.000	1129.135	(2012) Dutch National Food Consumption Survey 2012-2016 (DNFCS)
Beer and beer-like beverage	Netherlands	Adults	Male	1023	407	287.051	575.915	0.000	0.000	1500.000	(2007) Dutch National food consumption survey 2007 - 2010
Beer and beer-like beverage	Netherlands	Adults	Male	352	154	389.443	753.332	0.000	0.000	2112.857	(2003) Dutch National Dietary Survey 2003
Beer and beer-like beverage	Netherlands	Other children	Female	216	1	0.046	0.680	0.000	0.000	0.000	(2007) Dutch National food consumption survey 2007 - 2010

Figure 2 – PLAN'EAT dietary patterns exportation tool: selection of contents and outputs

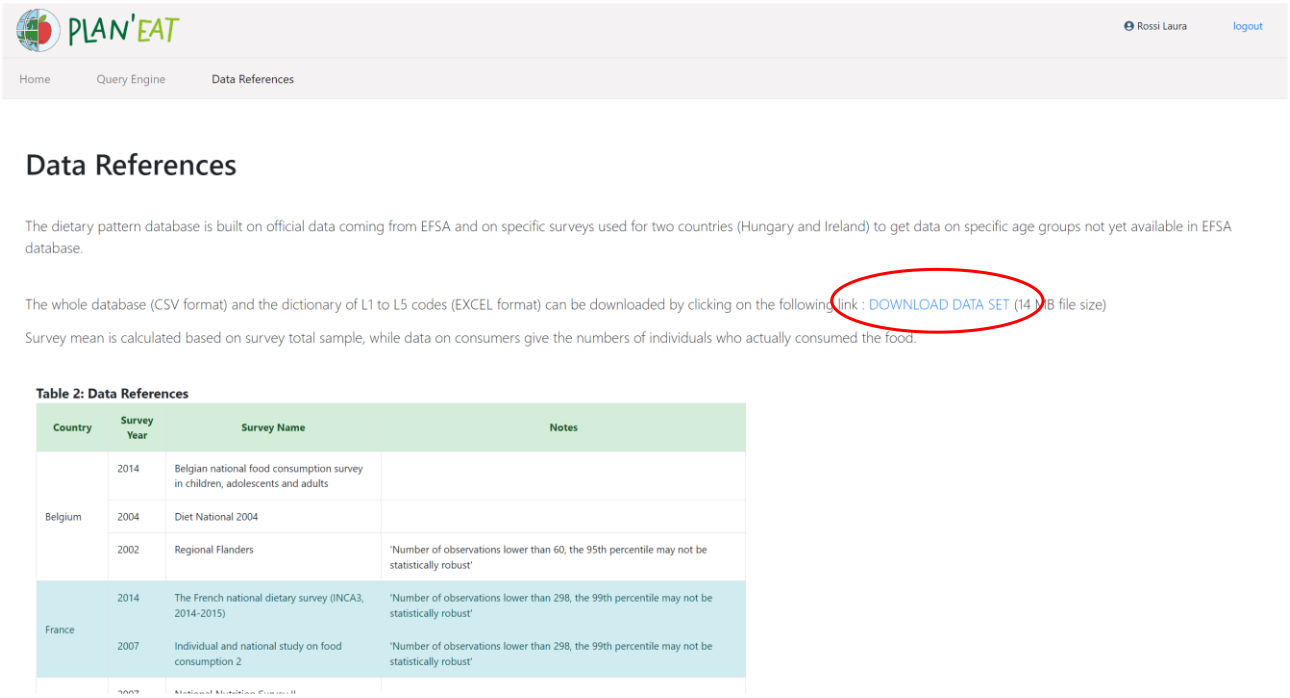


Figure 3 – PLAN'EAT dietary patterns exportation tool: data references and access to the whole data set.

2.2 Analysis of EU dietary patterns: PLAN'EAT countries and the Living Labs's target groups

In the following paragraphs the eleven PLAN'EAT countries and the LLs target groups were mapped in terms of food consumption, nutrition-related health conditions and effects of socioeconomic disparities on dietary patterns.

Countries were assessed analysing the data retrieved from the Global Nutrition Report (GNR) (https://globalnutritionreport.org/). Dietary intake of key foods among adults in relation to the EAT-Lancet targets were reported for each Country compared with sub-regional data (Eastern, Northern, Southern, and Western Europe) and regional data (Europe).

WISH scores were calculated both at country level and LLs target groups on the basis of food consumption data retrieved by the EFSA Food Consumption Database (https://www.efsa.europa.eu/en/data-report/food-consumption-data).

For countries and for LLs target groups the scores for each of the 15 food groups and dietary elements used for WISH calculation was reported and the direction of change in intake to obtain higher WISH score was indicated.

2.2.1 BELGIUM

Country dietary pattern: comparison of sub-regional and regional data

As shown in Figure 4, red meat and dairy consumption in Belgium exceeded the recommendations by ca. 200% and 300% respectively. Plant-based food intake was less than 50% of the recommended intake, with some items such as legumes and nuts being very far from recommended intakes (less than 10%). Belgium's food consumption pattern conformed to Western European and European data except for lower fish consumption (30% less of the recommended intake) and red meat consumption and higher dairy consumption in comparison to the European dietary pattern.

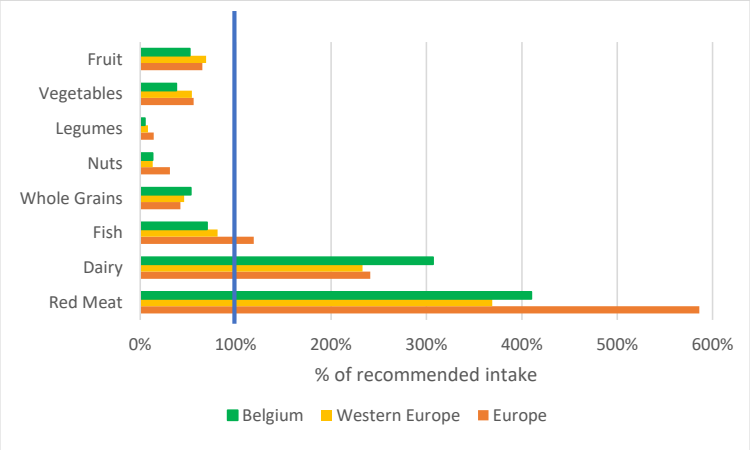


Figure 4 – Food consumption in Belgium, Western Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report datasets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/belgium/).

Healthiness and sustainability of Belgian food consumption: the WISH score

The details of the WISH intake for Belgian food intake, for the whole population and separated by gender were reported in Figure 5. The Belgian average dietary pattern was low, when considered in terms of 'planetary boundaries' receiving only 24% of the maximum theoretical WISH score, corresponding to 35 out of 150. Particularly low levels of the "less-healthy" and "low-environmental impact" sub-scores were found. Females have higher WISH than males both total score and health and environmental sub-scores. Belgium diet resulted in a relatively low environmental impact in consideration of the particularly high level of "high environmental impact sub-score" meaning the adherence that reach the 50% of the theoretical maximum for females, to the recommendations to limit the consumption of environmentally impacting foods.

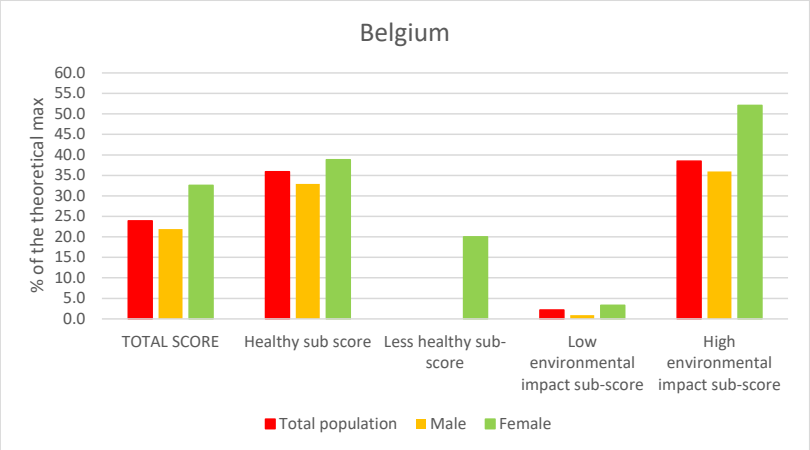


Figure 5 – Total WISH score and sub-score of adults in Belgium (total population, male and female).

Scores for each of the 15 food groups and dietary elements used for WISH calculation in Belgium were reported in Table 5. The highest scores (adequate/near-optimal consumption) were found for some animal food group categories (fish, eggs and at less extent chicken and dairy); other animal food categories are very far from recommendation with their consumption that need to be reduced (zero score). Plant-based foods need to be increased (zero scores or values slightly over zero). Females had better consumption level of fruits (1.5), dairy (6.6), and chicken (10.0) while males have better consumption level of fish (10.0).

Table 5: Scores* of each food group/dietary elements used for WISH calculation of Adults in Belgium.				
Food Groups/Dietary Elements	**Total population**	**Male**	**Female**	**Change for improving WISH**
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	0.8	0	1.5	Increase
Dairy foods	6.6	6.6	6.6	Increase
Red meat	0	0	0	Reduce
Fish	9.9	**10.0**	**10.0**	**Adequate**
Eggs	**10.0**	**10.0**	**10.0**	**Adequate**
Chicken and other poultry	7.4	5.1	9.5	Increase (small)
Legumes	0.5	0.5	0.5	Increase
Nuts	0.7	0.7	0.7	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	0	0	**10.0**	Reduce (in male)
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Dietary patterns and socioeconomic conditions

As reported by Desbouys et al., (Desbouys et al., 2019), disparities in food consumption according to region of residency, country of birth, and occupation, and age were found in the data collected in Belgium in 2014. Adolescents (10-13 years) living in households with low educational levels daily consumed lower amounts of fruits and vegetables and whole grain bread and cereals, and higher amounts of sugar-sweetened beverages than adolescents of the same ages having parents with high educational level. Wide dietary disparities were seen according to the region of residency in all age groups and independently of socio-economic conditions. Flanders is socio-economically more advantaged in comparison to Wallonia and the Brussels-Capital region in terms, for instance, of unemployment rate, poverty, and social exclusion. Walloon inhabitants (mainly French speaking) generally had a less healthy diet than the Flemish (mainly Dutch speakers).

Nutrition-related health conditions

In Belgium in 2014, 29% of the population were overweight and 16% obese. Obesity prevalence in Belgium is lower than the Western European average (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/belgium/). These percentages increased with age; thus, from the age of 35, more than a third of the population was overweight, and more than a fifth suffered from obesity (Bel et al., 2015). The majority of young children (3 to 5 years old) (96%) met the World Health Organization's (WHO) recommendations for physical activity (i.e., 3 hours a day of physical activity at all levels of intensity) (*WHO guidelines on physical activity and sedentary behaviour*, 2020). However, school age children spent half of their day sitting and this proportion increased with age to reach a peak in adolescence. Then, only half of the children aged 6 to 9 (48%) and a third of adolescents aged 10 to 17 (29%) achieved the WHO recommendations specific to their age group, namely one hour a day of intense physical activity from moderate to sustained. The majority (91%) of adults (18 to 64 years old) met the WHO recommendations for physical activity (2 hours and 30 minutes per week of moderate-intensity physical activity) (De Ridder, 2016). Children and adolescents (3 to 17 years old) with obesity practiced less physical activity of moderate to vigorous intensity. Adults (aged 18-64) with obesity reported doing more physical activity while at work than adults with normal weight status. Belgium showed limited progress toward achieving the diet-related

non-communicable disease targets. Diabetes affected 3.3% of adult women and 5.7% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/belgium/).

2.2.2 FRANCE

Country dietary pattern: comparison with sub-regional and regional data

As shown in Figure 6, red meat (375%) and dairy (268%) consumption in France exceeded the recommendations. Fruits and vegetables intake was 75% and 52% of the recommendations respectively. As in other countries, low consumption of legumes and nuts was observed. For fish and fruit, the consumption level in France was closer to the recommendations respect to the regional data and respect to the rest of Europe. However, the high consumption of red meat was lower than in other European countries.

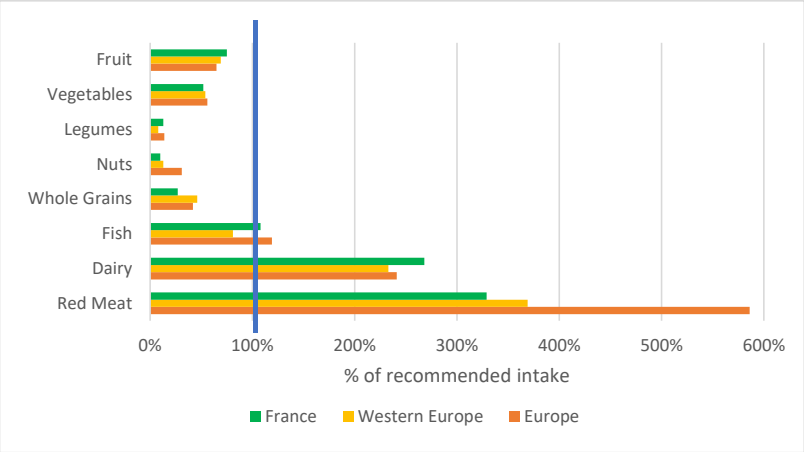


Figure 6 – Food consumption in France, Western Europe and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/france/).

Healthiness and sustainability of France food consumption: the WISH score

Results of the WISH score for the French whole population and separated by gender were reported in Figure 7. Food consumption indicators for France covered 32% of the WISH theoretical maximum corresponding to 48 out of 150. Particularly low levels of the less-healthy sub-scores and low-environmental impact sub-scores were found. Females had better WISH scores than males (51 vs 47) with better values of WISH either for health components or environmental aspects. Particularly high sub-scores were found for the healthy sub-score (40% of the theoretical maximum) and high environmental sub-score (50% of the theoretical maximum) indicating a high consumption of foods protective of health and limited consumption of foods affecting the environment.

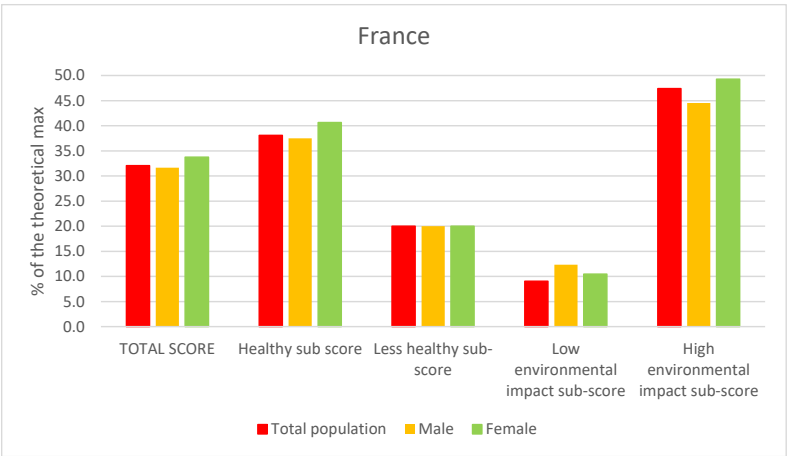


Figure 7 – Total and sub-score WISH for the Adults in France (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in France were reported in Table 6. The highest scores (adequate/near-optimal consumption) were found for some animal food group categories (dairy, fish, eggs, and chicken) and for saturated oils; other animal food categories were overconsumed (zero WISH). Plant-based food consumption was insufficient and need to be increased having score near zero or zero. No relevant differences were found between males and females. Excess of consumption of alcoholic beverages and added sugars was found.

Table 6: Scores* of each food group/dietary elements used for WISH calculation of Adults in France.

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	2.4	2.4	3.7	Increase
Fruit	1.9	1.9	1.8	Increase
Dairy foods	9.3	9.3	9.3	**Adequate**
Red meat	0	0	0	Reduce
Fish	**10.0**	**10.0**	**10.0**	**Adequate**
Eggs	6.7	6.7	7.1	Increase (small)
Chicken and other poultry	6.1	6.1	7.4	Increase (small)
Legumes	1.1	1.1	0.8	Increase
Nuts	0.7	0.7	0.6	Increase
Unsaturated oils	0	0.0	0.0	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

*A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Dietary patterns and socioeconomic conditions

Examining social disparities, in France behaviours closer to recommendations in terms of food consumption (more fruits and fewer sweetened beverages), body weight status (less obesity), and physical activity (more active) were found in individuals with a high level of education, occupation, or socio-professional category. These groups also had more consistent meal timing and are more likely to consume food supplements. Education level had an impact on food consumption, with highly educated individuals (either children or adults) showing a higher consumption of fruits and a lower consumption of sugar-sweetened beverages than subjects with low educational level. Some regional differences were also identified. Adults living in the North-east consumed fewer fruits and vegetables but more potatoes. Consumption of sugar-sweetened beverages was higher in the North (East and West) than in the South (East and West) of France. In terms of the living environment, the large urban areas were characterized by higher consumption of fish, confectionery and chocolate, and fruit juices, while rural areas saw greater consumption of meat, vegetables, and cheese (ANSES, 2017).

Nutrition-related health conditions

Overweight was observed in 34% of adults (18-79 years) with a prevalence of obesity of 17%. Sedentary behavior was widespread in more than 80% of adults. Time spent in front of screens every day (outside of working hours) continued to rise, with an average increase over the last seven years of 1 hour and 20 minutes for adults (https://www.anses.fr/en/content/inca-3-changes-consumption-habits-and-patterns-new-issues-areas-food-safety-and-nutrition). In terms of public health, France showed limited progress

towards achieving the diet-related non-communicable disease (NCD) targets. France's obesity prevalence is lower than the regional average of 25.3% for women and 24.9% for men. Diabetes was estimated to affect 4.6% of adult women and 8.1% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/france/).

LIVING LAB TARGET GROUP IN FRANCE: HEALTHY CHILDREN AND ADOLESCENTS, MIDDLE AND HIGH SES, URBAN AND RURAL (AGE: 6-15)

The LL in France is going to be carried out in the Auvergne Rhone Alpes area, one of the biggest French regions, characterized by (middle) mountainous pedo-climatic conditions, and high levels of animal/grain food production. The specific focus of the LL is the evaluation of the impact of animal and ultra-processed foods, and food diversity, on food system sustainability. Education tools for children/adolescents, with potential extrapolation to university students, are going to be developed. School canteens are involved in the activity as recipients to develop short supply chains for local products.

According to the data collected in the INCA3 survey (2014/2015) analysed in this deliverable, children's and adolescents' dietary pattern in France did not differ from those of f adults. Animal products (dairy products and meat, fish, and eggs) provided about 60% of protein intakes, regardless of age. The contribution of the meat, fish, and eggs category increased with age (34% for children, 38% for adolescents, and 41% for adults), while that of dairy products decreased (respectively 27%, 19%, and 17%). Animal products also accounted for around 40% of fat intake, regardless of age. Dairy products (including milk) consumption were higher in children aged 1 to 10 years (21% *vs* 17% for adults), while the same was true for meat, fish, and eggs in adults (22% *vs* 19% for children). Confectionery and chocolate for children and adolescents were significant contributors to total fat intake. Lastly, plant-based products (cereal products, fruit, and vegetables) represented the 40% of carbohydrate intakes for children and adolescents and 50% for adults. In children and adolescents, dairy products represented one of the major vectors of carbohydrates (https://www.anses.fr/en/system/files/PRES2017DPA04EN.pdf).

Healthiness and sustainability of French children and adolescents' food consumption: the WISH score

The WISH score was calculated for children and adolescents differentiated by sex (Figure 8). Total scores covered 27% of the theoretical maximum (40 out of 150) in children and 32% (48 out of 150) in adolescents with better figures for females (27% in children and 34% adolescents) than males (25% in children and 32% in adolescents) with better values of WISH either for health components or environmental aspects. Overall WISH for adolescents had the same pattern as WISH found in adults even with lower absolute levels. Also in adolescents, the consumption of healthy foods (contributing to the "healthy sub-score") and the limitation of the consumption of environmentally impacting foods (contributing to the "high environmental impact" sub-score) was higher than other sub-scores.

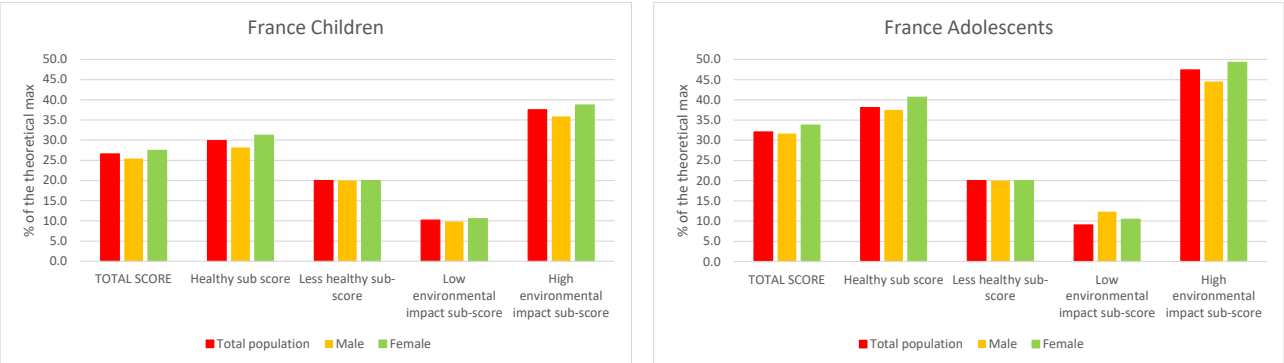


Figure 8 – Total and sub-score WISH of Children (3-10 years) and Adolescents (11-17 years) in France (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in children and adolescents in France were reported in Table 7. In children and adolescents, dairy and saturated fats consumption was adequate. Animal food consumption both in children (7.7 for fish) and adolescents (9.1 for fish, 8.9 for eggs, and 5.0 for chicken) is near to the acceptability. Plant-based foods intake was insufficient and need to

be increased especially in adolescents. Both in children and adolescents, small differences were found between males and females. Alcoholic beverages (in adolescents) and sugary beverages (in children) and added sugars were excessively consumed.

Table 7: Scores* of each food group/dietary elements used for WISH calculation of Children and Adolescent France.

Food Groups/Dietary Elements	Children				Adolescent			
	Total population	Male	Female	Change for improving WISH	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase	0	0	0	Increase
Vegetables	3.2	2.9	3.5	Increase	0	0	0	Increase
Fruit	0	0	0	Increase	0	0	0	Increase
Dairy foods	**10.0**	**10.0**	**10.0**	**Adequate**	**10.0**	**10.0**	**10.0**	**Adequate**
Red meat	0.0	0.0	0	Reduce	0	0	0	Reduce
Fish	7.7	8.0	7.4	Increase	9.1	9.4	8.8	Increase
Eggs	3.8	2.4	5.2	Increase	8.9	7.6	**10.0**	**Adequate**
Chicken and other poultry	0	0	0	Reduce	5.0	3.4	6.3	Reduce
Legumes	2.9	3.0	2.9	Increase	1.0	1.0	0.9	Increase
Nuts	2.3	1.9	2.3	Increase	0.2	0.2	0.1	Increase
Unsaturated oils	0	0	0	Increase	0	0	0	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce	0	0	0	Reduce
Alcoholic/Sugary beverages**	0	0	0	Reduce	0	0	0	Reduce
Processed meat	0	0	0	Reduce	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores.
**In children the food group "alcoholic beverage" was replaced with "sugary beverages".

Dietary patterns and socioeconomic conditions of children and adolescents in France

The INCA3 France dietary assessment showed that disparities in dietary behavior within the population existed according to gender, age, and socio-economic level (level of education or professional category). The disparities by gender appeared in adolescence and become more marked in adulthood. They mainly concerned food consumptions that are more in line with the dietary guidelines for female (favoring poultry, yogurts, fruit compotes, soups, fruit juices, and hot beverages) than for male (favoring other meats, cheeses, dairy-based desserts, and cream desserts, delicatesse, sandwiches and savory pastries, sugar-sweetened beverages, and alcoholic beverages). Compared to adults, adolescents aged 11 to 17 years were more likely to know national dietary guidelines on fruits and vegetables (74% *vs* 59%), dairy products (38% *vs* 22%), and starchy food (10% *vs* 7%). In general, food-based dietary guidelines were better known by women than men. On the other hand, females exhibited higher levels of sedentary behavior compared to males, a trend that persists from childhood through adolescence. Breakfast, and to a lesser extent lunch, was missed by 40% of adolescents aged 15 to 17 years. Breakfast was taken systematically by more than 90% of individuals when they (or their representatives) had a high level of education or professional category. The main sources of information on food for adolescents were firstly the family, then advertising, teachers, and product packaging, while adults relied firstly on the traditional media (radio, television, written press) and then friends and family (ANSES, 2017).

Nutrition-related health conditions of children and adolescents in France

Overweight was observed in 13% of children and adolescents (up to the age of 17) with a prevalence of obesity respectively of 4% (INCA3 2014/2015). Sedentary lifestyle was widespread in half of young adolescents (10-14 years) and two-thirds of adolescents aged 15 to 17 years. Time spent in front of screens

every day continued to rise, with an average increase over the last seven years of 20 minutes for children (https://www.anses.fr/en/content/inca-3-changes-consumption-habits-and-patterns-new-issues-areas-food-safety-and-nutrition). According to the World Health Organisations' Health Behaviour in School-aged Children (HBSC) study in France, family affluence, occurrence of daily breakfast, and physical activity were significantly and negatively associated with overweight; while TV viewing was positively associated with overweight (Dupuy et al., 2011).

2.2.3 GERMANY

Country dietary pattern: comparison with sub-regional and regional data

As shown in Figure 9, in Germany, fruit, vegetables, and whole grains consumption met more than 60% of the minimum target and was comparable with sub-regional and regional data. Legumes and nuts consumption were a lot less than current recommendations and lower than in other Western European and European countries. Similarly, fish consumption was lower than recommended and lower than sub-regional and regional data. Dairy and red meat exceeded the maximum target. However, overall animal-based food consumption was in line with sub-regional and regional data except for red meat which in Germany was consumed less frequently than in other European countries.

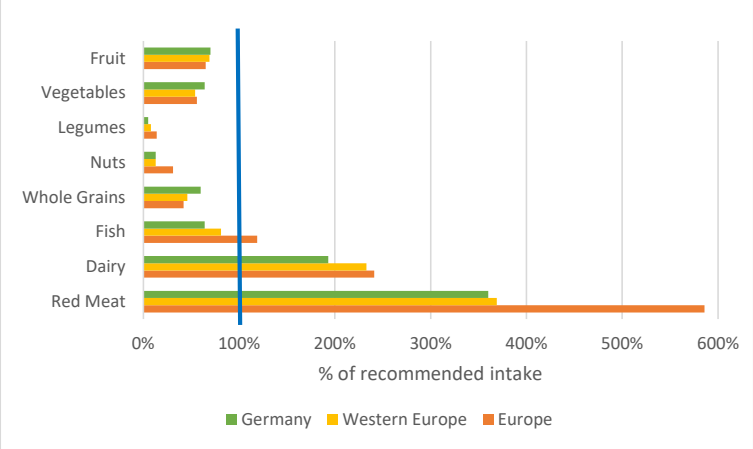


Figure 9 – Food consumption in German, Western Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/germany/).

Healthiness and sustainability of German food consumption: the WISH score

Results of the WISH score for the whole population and separated by gender were reported in Figure 10. German dietary pattern was far from the planetary boundaries, meeting only 20% of the WISH theoretical maximum score, reaching 39 out of 150. Particularly low levels of the less-healthy sub-scores and low-environmental impact sub-scores were found. Females had better WISH scores than males (41 versus 37) with better values of WISH either for health components or environmental aspects.

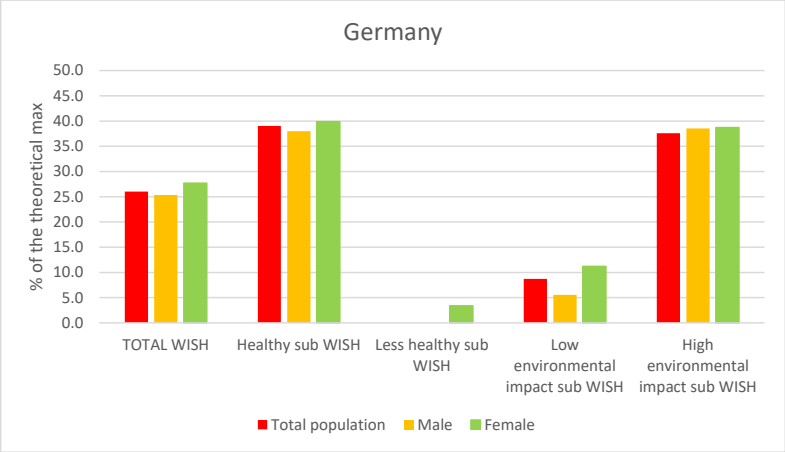


Figure 10 – Total and sub-score WISH among adults in Germany (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in Germany were reported in Table 8. The highest scores (adequate/near-optimal consumption) were found for animal food group categories (dairy, eggs, and chicken). Plant-based foods were insufficiently consumed and need to be increased (score zero or near zero). Fruit was the only plant food that had a certain level of consumption having a score of 4.6, higher for females (6.1) than males (2.6). Alcoholic beverages and added sugars were overconsumed.

Table 8: Scores* of each food group/dietary elements used for WISH calculation of Adults in Germany

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	4.6	2.6	6.1	Increase
Dairy foods	7.4	7.4	7.4	Increase (small)
Red meat	0	0	1.7	Reduce
Fish	5.5	6.3	5.0	Increase
Eggs	**10.0**	**10.0**	**10.0**	**Adequate**
Chicken and other poultry	**10.0**	**10.0**	**10.0**	**Adequate**
Legumes	0.7	0.7	0.6	Increase
Nuts	0.9	1.0	0.8	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	0	0	0	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Dietary patterns and socioeconomic conditions

Examining differences in food consumption with regard to socio-economic status, people with higher socio-economic status consumed more vegetables, fruit, fish, water, coffee/tea, and wine, while those with lower socio-economic status consumed more meat and meat products, soft drinks, and beer. Older consumers showed a lower consumption of meat, fruit juice/nectars, soft drinks, and spirits as well as a higher consumption of fish, vegetables, fruit, and herbal/fruit tea than adolescents and younger adults. In general,

the food consumption of women, the elderly, and the higher socio-economic status group tend to be closer to the official dietary guidelines in Germany (Heuer et al., 2015).

Nutrition-related health conditions

In terms of public health, Germany was characterized by limited progress toward achieving diet-related non-communicable disease targets. 22.4% of adult (aged 18 years and over) women and 26.9% of adult men were living with obesity. Germany's obesity prevalence was lower than the regional (Western Europe) average of 25.3% for women but was higher than the regional average of 24.9% for men. A slow but significant reduction of diabetes prevalence was reported; diabetes affected 4.0% of adult women and 6.3% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/germany/).

LIVING LAB TARGET GROUP IN GERMANY: OBESE AND OVERWEIGHT CHILDREN AND ADOLESCENTS FROM A COHORT IN GERMANY (AGE: 10-18)

The LL in Germany targets obese and overweight children and adolescents recruited from various primary and secondary care hospitals as well as from private practitioners from all over Germany. All socioeconomic statuses are represented, including multiple ethnic backgrounds. The specific focus of the LL is to address the obesity pandemic. In terms of dietary behaviour, the actions aimed to decrease meat consumption inducing a shift towards plant-based diets. The changing of dietary habits will be achieved in an intervention period of 6 weeks in the hospital setting. In Germany, in developmental ages, the prevalence of overweight is 15.4% while the prevalence of obesity is 5.9%. There are no differences between girls and boys. Overweight and obesity prevalence increases with age. Overweight and obesity data in adolescents were reported in the second wave of the German Health Interview and Examination Survey for Children and Adolescents (Robert Koch-Institut, 2018) which provides nationwide measurements on the height and weight of children and adolescents aged 3 to 17 years together with food consumption data that were duly analysed for the purpose of the present work.

Healthiness and sustainability of German adolescents' food consumption: the WISH score

WISH index for German adolescents was reported in Figure 11 showing a limited coverage of the recommendations (32 out of 150) and confirming the findings that females had a better feeding pattern than males (39 versus 33). Females scored higher than males on both health and environmental aspects.

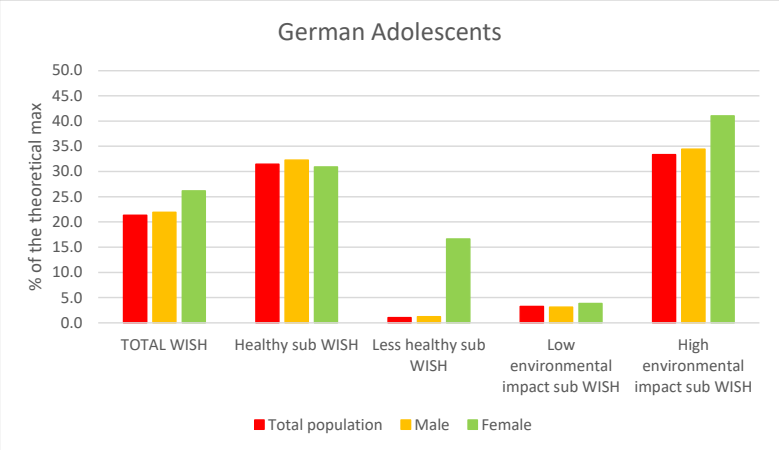


Figure 11 – Total and sub-score WISH of Adolescents in Germany (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in German adolescents were reported in Table 9. The highest scores were found for some animal food group categories (dairy, eggs, and chicken) indicating adequate/optimal consumption level; other animal food categories were excessively consumed (zero score). Plant-based food were insufficiently consumed (zero or near zero score). Alcoholic beverages and added sugars needed to be reduced. Females had better consumption level of red meat and saturated oils than male.

Table 9: Scores* of each food group/dietary elements used for WISH calculation of Adolescents in Germany				
Food Groups/Dietary Elements	**Total population**	**Male**	**Female**	**Change for improving WISH**
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	0	0	0	Increase
Dairy foods	7.5	8.4	6.6	Increase (small)
Red meat	0	0	5.8	Reduce
Fish	2.1	2.5	1.7	Increase
Eggs	**10.0**	**10.0**	**10.0**	**Adequate**
Chicken and other poultry	**10.0**	**10.0**	**10.0**	**Adequate**
Legumes	0.5	0.6	0.4	Increase
Nuts	1.1	1.4	0.9	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	0.0	0.0	**10.0**	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

*A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Dietary patterns and socio-economic conditions of Adolescents in Germany

Children and adolescents with low socioeconomic status were more likely to be overweight and obese than those with high socioeconomic status. Overweight and obesity prevalence stayed stable over time from 2003-2006 (KiGGS baseline study) to 2014-2017 KiGGS, which showed no further increase in overweight and obesity prevalence overall and in all age groups (Robert Koch-Institut, 2018). Three dietary patterns among boys and two among girls were identified. Among boys, high adherence to the 'Western' pattern was associated with higher age, lower socioeconomic status, and lower physical activity levels. High adherence to the 'healthy' pattern among boys, was associated with higher socioeconomic status, and higher physical activity. Among boys, high adherence to the 'traditional' pattern was associated with higher age. Among girls, high adherence to the 'traditional and Western' pattern was associated with lower age, lower socioeconomic status, and more hours of watching TV per day. No significant associations between dietary patterns and overweight were found (Richter et al., 2012).

Nutrition-related health conditions of adolescents in Germany

According to the World Health Organisation's Health Behaviour in School-aged Children (HBSC) in Germany (2017/2018) only 10.0% of girls and 16.9% of boys meet the World Health Organization's (WHO) physical activity recommendations (*WHO guidelines on physical activity and sedentary behaviour*, 2020). Across all HBSC cycles (previous years), this is the lowest figure so far. This is a relevant point to consider addressing the issue of obesity in developmental ages. Concerning dietary habits, 50.6% of girls and 59.0% of boys reported having breakfast every morning. Data for daily fruit, vegetable, and soft drink consumption emphasized the need to promote a healthy diet among adolescents in consideration of the low consumption of these food groups. In terms of gender differences, girls' intake of fruit and vegetables was higher, and they consumed fewer soft drinks, yet boys were more physically active and had breakfast more regularly. For the majority of indicators of dietary habits and physical activity, considerable inequalities relating to family affluence were observed (Bucksch et al., 2020).

2.2.4 GREECE

Country profile

As shown in Figure 12, fruits and vegetables consumption in Greece was far from the minimum recommended intake and also lower than the regional and sub-regional data. This was an unexpected result considering that Greece is a country largely characterized by Mediterranean Diet. The consumption of nuts and legumes, although below the recommended amount, was in line with sub-regional consumption, with nuts covering 30% of the recommendation and legumes 14% of recommended intake. Fish consumption was in line with the recommendation and the European trend, and lower than the sub-regional data. Consumption of red meat and dairy products far exceed the recommended intake, with red meat intake higher than sub-regional consumption.

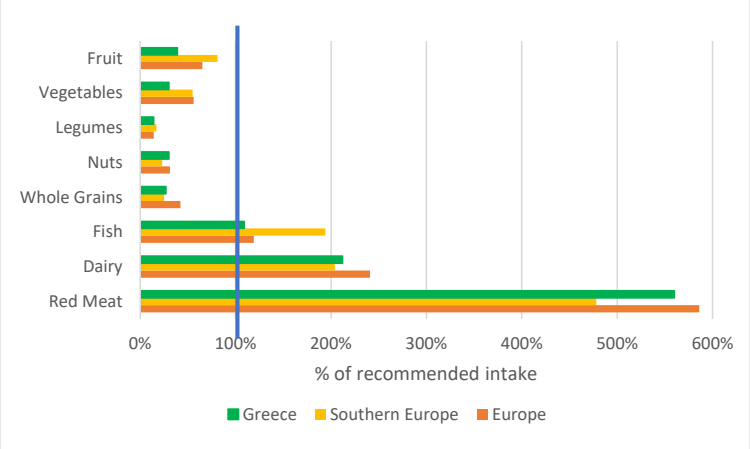


Figure 12 – Food consumption in Greece, Southern Europe and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/southern-europe/Greece/).

Healthiness and sustainability of Greek food consumption: the WISH score

The WISH of adults in Greece was reported in Figure 13 showing coverage of the recommendations corresponding to 38% of the theoretical maximum with a score of 57 out of 150. No differences were observed between the two sexes. Particularly high was the "high environmental impact sub score" meaning that in Greece there was a limiting consumption of foods with high environmental impact.

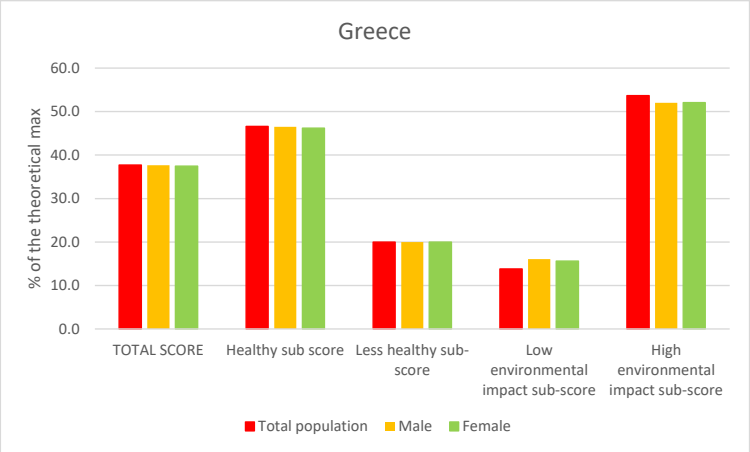


Figure 13 – Total and sub-score WISH of the adults in Greece (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in Greece were reported in Table 10. The highest scores were found for some animal food group categories (fish, eggs, and chicken) suggesting adequate/near-optimal consumption of these goods; other animal food categories were very far

from recommendation having a WISH corresponding to zero, indicating an overconsumption of these food groups. The scores for fats reflected the Mediterranean pattern with saturated fat consumption corresponding to the recommendation and unsaturated oils near to the recommended intake. Plant-based foods were insufficiently consumed (zero or near zero score); only fruit group in females was consumed even at a level that should be further increased (4.9). Alcoholic beverages and added sugars were excessively consumed.

Table 10: Scores* of each food group/dietary elements used for WISH calculation of Adults in Greece

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	1.5	0	4.9	Increase
Dairy foods	8.1	8.4	7.9	Increase (small)
Red meat	0	0	0	Reduce
Fish	**10.0**	**10.0**	8.7	**Adequate**
Eggs	9.3	7.5	**10.0**	**Adequate**
Chicken and other poultry	9.8	**10.0**	9.1	**Adequate**
Legumes	0.9	1.2	0.6	Increase
Nuts	1.1	0.9	1.2	Increase
Unsaturated oils	5.9	7.9	3.9	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

*A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Dietary patterns and socioeconomic conditions

In Greece the age and individuals' educational level were related to healthier nutritional habits. Older individuals consumed more bread, meat, oils and fats, fruits, and vegetables while the youngest consume more milk, cheese, eggs, and sugar, drink more alcohol, and smoke more tobacco. Elderly people had different concerns about their health status and tended to have better dietary behavior. Discrepancies were observed related to educational level; more educated people have healthier nutrition, as they consumed less meat, bread, oils, and fats, with less occurrence of smoking and less alcohol consumption (Kostakis et al., 2020). In Greece, the discrepancies in the dietary pattern related to socio-economic conditions were reported in other population groups. Adolescents of low socioeconomic status reported significantly lower adherence to the Mediterranean Diet, higher consumption of soft drinks, most frequent breakfast skipping, fewer meals per day consumed with parents, lower physical activity levels, and more TV viewing hours compared to adolescents of higher socio-economic status (Costarelli et al., 2013). According to Kosti et al. (2021) over the past decade, the financial crisis has affected the household income of Greek people with an impact on food purchases and the quality of the diet. Parents who reported that the financial crisis had affected food expenditure consumed less fruit and pulses and more nutrient-poor/energy-dense food on a weekly basis than unaffected parents. Their children showed a decreased weekly consumption of vegetables and increased weekly consumption of nutrient-poor/energy-dense foods.

Nutrition-related health conditions

In terms of public health, Greece showed limited progress toward achieving the diet-related non-communicable disease targets. Overweight and obesity regularly increased in the last 20 years reaching the

level of 69.8% in males and 57.3% in females. Obesity was present in 27.5% of adult (aged 18 years and over) women and 27.1% of adult men. Greece's obesity prevalence was higher than the regional average of 25.3% for women and 24.9% for men. At the same time, diabetes was estimated to affect 6.3% of adult women and 7.9% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/southern-europe/greece/). Insufficient physical activity was reported by 37.7% of the adults with the highest prevalence in females (41.1%) than males (33.9%). In children the prevalence of insufficient physical activity was alarming (80%) (https://data.worldobesity.org/country/greece-80/#data_drivers).

LIVING LAB TARGET GROUP IN GREECE: ELDERLY PEOPLE, NCDS, ALL SES (AGE: > 60)

The LL in Greece targets free-living elderly (not hospitalized or institutionalized) with certain risk factors for NCDs, such as dyslipidemia, hypertension, (pre)diabetes, and obesity. The area of activity is an urban-metropolitan region with 4.5 million inhabitants in which primary care promoting healthy and active living for the elderly is at a very premature stage. Greece, like other South European countries, was claimed as one of the privileged areas of development of the Mediterranean diet principle. Even though, many countries in the Mediterranean basin were drifting away from the Mediterranean dietary pattern (Vilarnau et al., 2019). The elderly represents a group of the population still maintaining a dietary profile with traditional elements. According to (Martimianaki et al., 2022), in Greece, 39.7% of participants over 65 years old are included in the high category of the Mediterranean Diet score while among the under 65 years this proportion corresponds to 25.5%.

Healthiness and sustainability of Greek Elderly people food consumption: the WISH score

The WISH index for Greek Elderly was reported in Figure 14 reaching 30% of the theoretical maximum with a score of 44 out of 150. Females had a better dietary pattern both for healthy and environmental sub-indicators. Particularly high was the “high environmental impact sub score” meaning that in the Greek Elderly, there was a limiting consumption of foods with high environmental impact. The elderly had WHISH scores and sub-scores globally lower than adults (total WISH 44 covering 30% of the theoretical maximum vs 57 corresponding to 38% of the theoretical maximum).

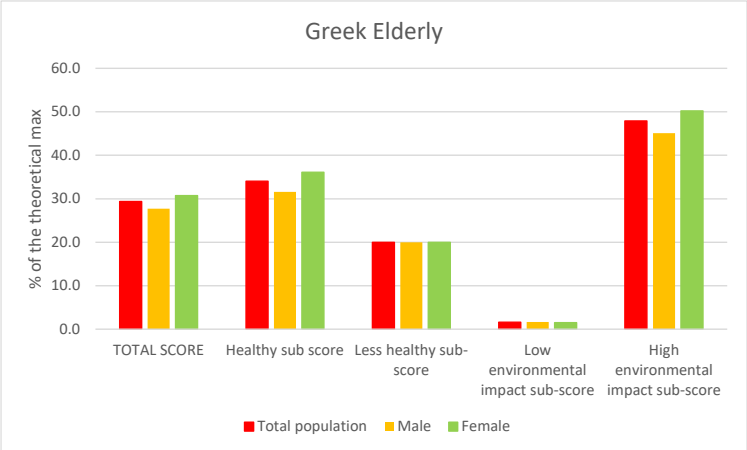


Figure 14 – Total and sub-score WISH of Elderly people in Greece (whole population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in the Greek Elderly were reported in Table 11 showing a pattern very similar to adults. The highest scores (adequate/near-optimal consumption) were found for some animal food group categories (9.9 for fish, 8.9 for eggs, and 5.0 for chicken); other animal food categories largely exceed the recommendation having a WISH corresponding to zero. Adequate consumption of saturated fat and insufficient consumption of unsaturated oils was found. Plant-based foods were insufficiently consumed having zero or near zero scores and resulting worse with respect to adults. Reduction of intake of alcoholic beverages and added sugar was needed. No relevant differences were observed in elderly males and females.

Table 11: Scores* of each food group/dietary elements used for WISH calculation of Elderly in Greece				
Food Groups/Dietary Elements	**Total population**	**Male**	**Female**	**Change for improving WISH**
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	0	0	0	Increase
Dairy foods	**10.0**	**10.0**	**10.0**	**Adequate**
Red meat	0	0	0	Reduce
Fish	9.1	9.4	8.8	**Adequate**
Eggs	8.9	7.6	**10.0**	**Adequate**
Chicken and other poultry	5.0	3.4	6.3	Increase
Legumes	1.0	1.0	0.9	Increase
Nuts	0.2	0.2	0.1	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Dietary patterns and socioeconomic conditions of Elderly in Greece

Few data at the national level were available on the disparities of dietary patterns among the Greek elderly. A large but geographically limited study (Katsarou et al., 2010) with a non-representative cohort showed that older Greek people of higher socioeconomic status seemed to follow a relatively healthier diet. The elderly in the lowest socioeconomic status group were more likely to live alone and to have higher BMI and lower physical activity levels than those in the highest socioeconomic status group. Elderly people in the highest socioeconomic status group seemed to adhere more closely to the traditional Mediterranean diet than the other socioeconomic status categories. Adherence to the Mediterranean diet was positively associated with years of school and financial status. People in the highest socioeconomic status group consumed more quantities of fish and vegetables than those in the lowest socioeconomic status group. No other significant differences were observed between social classes concerning the specific eating habits of the participants (Katsarou et al., 2010).

Nutrition-related health conditions of Elderly in Greece

Prevalence of overweight and obesity in the Greek elderly was widespread; overweight is present in 56.5% of males and 48.8% of females aged 65-75 years and in 57.2% of males and 45% of females aged >75 years. Obesity was present in 20.6% of elderly males and 23.9% of females; results are lower for people aged >75 years (14.6% in males and 21.4% in females) (https://data.worldobesity.org/country/greece-80/#data_population-breakdowns). According to the Hellenic Statistical Authority, the majority of the elderly (91.5% of 65-75 years and 97.4% of >75 years) did not perform any physical activity (sports, fitness) or recreational physical activities (Hellenic Statistical Authority, 2014).

2.2.5 HUNGARY

Country profile

As shown in Figure 15, red meat consumption in Hungary, despite exceeding recommendations, had the lowest surplus among the ten PLAN'EAT countries, with consumption largely below that of Eastern Europe and Europe. A similar trend was observed for dairy, although with less marked differences. Plant-based

food intakes were lower than the recommended intake and also lower than sub-regional and regional consumption. Only legumes, which reached 16% of recommended intake, showed consumption levels slightly higher than that in Eastern Europe and Europe.

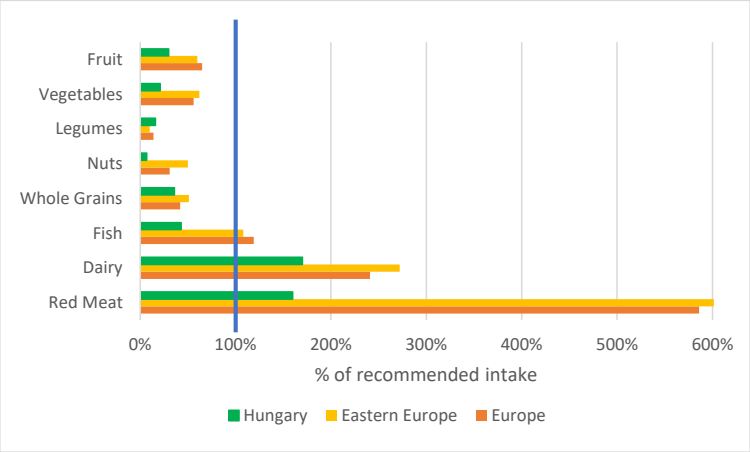


Figure 15 –Food consumption in Hungary, Eastern Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/eastern-europe/hungary/).

Healthiness and sustainability of Hungarian food consumption: the WISH score

The WISH index for Hungarian Adults was reported in Figure 16 reaching 16% of the theoretical maximum with a score of 24 out of 150. Females had a better dietary pattern than males (24.4% vs 17.3%) both for healthy and environmental sub-indicators. Particularly high was the "high environmental impact sub score" meaning that in Hungarian females had a limited consumption of foods with high environmental impact. Hungarian females had also a high "less healthy sub-score" indicating a limited consumption of unhealthy foods. This sub-score was zero for males, indicating that Hungarian men consume large amount of unhealthy food.

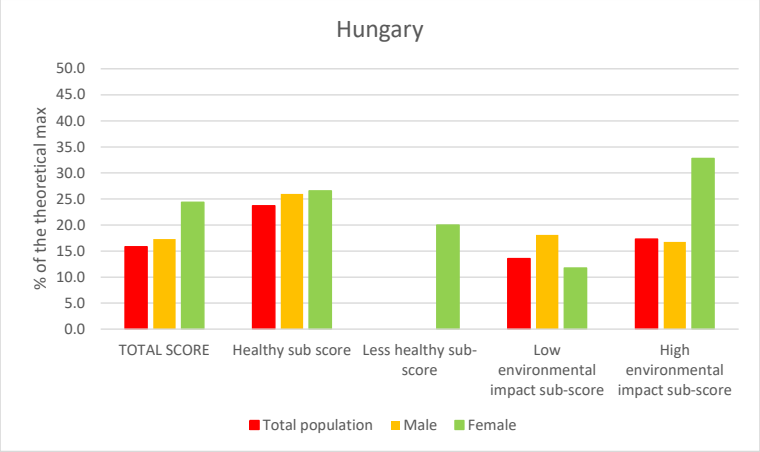


Figure 16 – Total and sub-score WISH of the Adults in Hungary (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in Hungary were reported in Table 12. Hungarian food groups consumption failed to reach the adequacy for all the categories except for dairy. Among animal food group fish, chicken needed to be increased. The score for saturated fat corresponds to the recommendation (adequate consumption) only in female. Too little consumption of plant-based foods was found with only fruits and vegetables have scores higher than zero. Differences in males and females were observed with males having better consumption level of vegetables (3,5 vs 1,4)

and females having a better consumption level of fruit (4,0 vs 3,0). High consumption of alcoholic beverages and added sugar was found.

Table 12: Scores* of each food group/dietary elements used for WISH calculation of Adults in Hungary

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	3.5	1.4	Increase
Fruit	4.5	3.0	4.0	Increase
Dairy foods	**10.0**	9.2	8.8	**Adequate**
Red meat	0	0	0	Reduce
Fish	3.5	4.1	4.1	Increase
Eggs	0	1.0	4.6	Increase
Chicken and other poultry	2.9	0.0	0.9	Increase
Legumes	2.2	1.7	1.6	Increase
Nuts	1.2	1.2	1.2	Increase
Unsaturated oils	3.8	0	0	Increase
Saturated oils	0	0	**10.0**	Reduce (for male)
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Dietary patterns and socioeconomic conditions

According to (Bakucs et al., 2014) the period between 1990-2007 was characterized by relevant socio-economic changes with dietary intakes that varied considerably across different socio-economic groups. There was more consumption of red and white meat in 2007, but a shift from animal to vegetable fats was also observed. The proportion of vegetables in total consumption was massively reduced by 2007; however, the quantity of fruit consumption remained stable. In this scenario, however, some socioeconomic groups managed to shift their food consumption towards healthier intake patterns. In households with high educational levels, there was a higher consumption of vegetable fats and fruits, suggesting more health-conscious eating habits. Income was significantly positively associated with all food categories meaning that more affluent households had more possibility for buying foods. Recent data to assess the current dietary pattern in Hungary were not available.

Nutrition-related health conditions

In terms of public health, Hungary showed limited progress toward achieving the diet-related non-communicable disease targets. 26.8% of adult (aged 18 years and over) women and 31.3% of adult men were living with obesity. Hungary's obesity prevalence was higher than the regional average of 25.3% for women and 24.9% for men. At the same time, diabetes was estimated to affect 7.3% of adult women and 10.0% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/eastern-europe/hungary/). According to Bácsné Bába et al. (2020), 63.39% of the adult Hungarian population had a high level of physical activity, 24.78% performed a moderate activity, and only 11.73% of the nationally representative sample belonged to the category of low physical activity. The dominant forms of their physical activity were linked to work and housework.

LIVING LAB TARGET GROUP IN HUNGARY: HEALTHY YOUNG ADULTS, LOW SES (SINGLE PARENTS) (AGE: 20 – 30)

The LL in Hungary targets healthy young adults (20-30) of low socioeconomic level having limited access to healthy foods. The area of activity is Budapest representing the Hungarian principal political, cultural, commercial, industrial, and transportation center. The objective of the activity is to create communities, able to increase the consumption of legumes and reduce meat consumption. Few data are available on this age group in Hungary. According to Csabai et al. (2022) among individuals aged 19 to 25 years, a higher percentage opted for a more stringent meat-free diet, with a significant proportion being vegetarians (4%) and flexitarian (12%), compared to other age groups.

Healthiness and sustainability of Hungarian Healthy Young Adults' food consumption: the WISH score

WISH for Young Adults in Hungary was reported in Figure 17 reaching 15% of the theoretical maximum with a score of 23 out of 150. Females had a slightly better dietary pattern both for healthy and environmental sub-indicators indicating a high consumption of healthy protective foods (healthy sub-WISH) and a limited consumption of high environmental impacting foods (high environmental impact indicator). The total and sub-score WISH for Hungarian Young Adults was worse than for adults in particular for females (16.6% vs 24.4%) and, to a less extent for males (16.9% vs 17.3%). Sub-scores particularly low in young adults were the "less healthy sub score and the "high environmental impact sub score" indicating a lower level of adherence to the recommendation to limit unhealthy foods and food impacting on the environment.

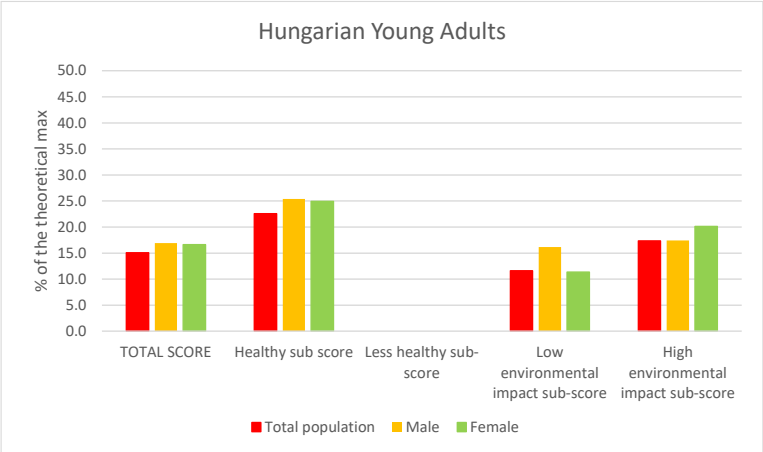


Figure 17 – Total and sub-score WISH of Healthy Young Adults in Hungary (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in Hungarian Young Adults were reported in Table 13. The consumption pattern of Hungarian Young Adults was very similar to those observed in the general adult population. The adequacy of consumption was found only for dairy and the need of increase the consumption was found for animal foods (fish, eggs, chicken) and for all plant-based groups. The consumption of unsaturated oils was better for males (3.4) than females having zero score corresponding to insufficient amount. Females had better consumption levels of fruits and eggs while males had better consumption levels of unsaturated oils and vegetables. High consumption of alcoholic beverages and added sugar was found.

Table 13: Scores* of each food group/dietary elements used for WISH calculation of Young Adults in Hungary				
Food Groups/Dietary Elements	**Total population**	**Male**	**Female**	**Change for improving WISH**
Whole grains	0	0	0	Increase
Vegetables	0	1.8	0	Increase
Fruit	4.3	3.1	5.4	Increase
Dairy foods	**10.0**	**10.0**	9.7	**Adequate**
Red meat	0	0	0	Reduce
Fish	4.5	4.6	4.5	Increase
Eggs	0	0	2.9	Increase
Chicken and other poultry	0	0	0	Increase
Legumes	1.4	1.4	1.4	Increase
Nuts	1.1	1.1	1.0	Increase
Unsaturated oils	1.3	3.4	0	Increase
Saturated oils	0	0	0	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

2.2.6 IRELAND

Country profile

As shown in Figure 18, among animal foods, Ireland showed large consumption of dairy, exceeding the recommendations and being higher than regional and subregional data. In addition, red meat consumption was above recommended intakes albeit at a lesser extent than in Europe and Northern Europe. A similar trend was observed for dairy. Plant-based food consumption were well below the recommended intake and lower than sub-regional and regional consumption. Only the consumption of nuts (52% of recommended intake) showed consumption levels higher than that of Northern Europe and Europe.

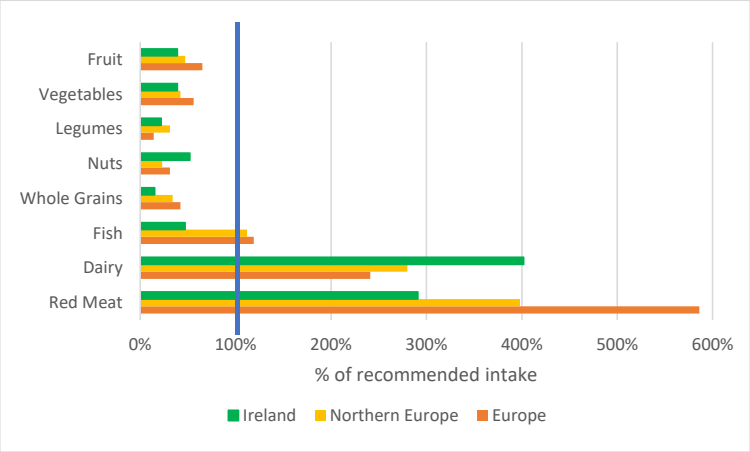


Figure 18 – Food consumption in Ireland, Northern Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/northern-europe/ireland/).

Healthiness and sustainability of Irish food consumption: the WISH score

WISH for Adults in Ireland was reported in Figure 19 with 17% of the theoretical maximum with a score of 26 out of 150. Females had a slightly better dietary pattern than males (18.1% vs 16.2%) both for healthy and environmental sub-indicators indicating a high consumption of healthy protective foods (healthy sub-WISH) and limited consumption of high environmentally impacting foods (high environmental impact indicator).

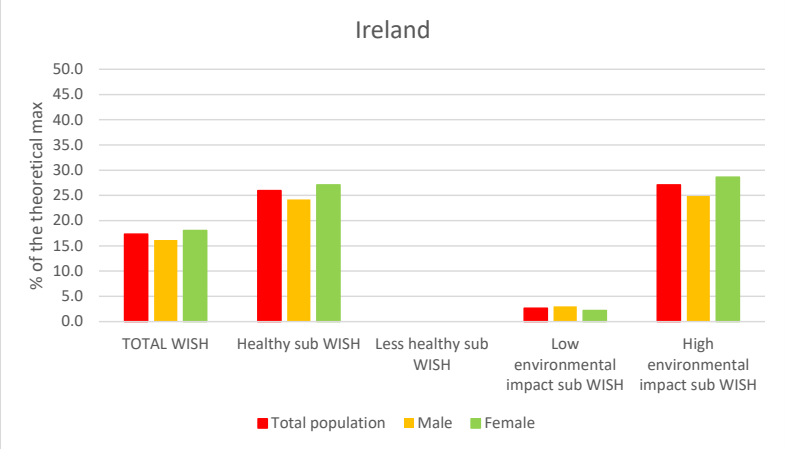


Figure 19 – Total and sub-score WISH of adults in Ireland (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in Ireland were reported in Table 14. The highest scores (adequate/near-optimal consumption) were found for some animal food group categories (10.0 for dairy, 6.1 for fish, and 6.6 for eggs); other animal food categories were overconsumed having a WISH corresponding to zero. Plant-based foods were largely under consumed having zero scores or values slightly over zero (1.6 – legumes; 0.6 – nuts). Alcoholic beverages and added sugar need to be reduced. No relevant differences were observed between the two sexes.

Table 14: Scores* of each food group/dietary elements used for WISH calculation of Adults in Ireland

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	0	0	0	Increase
Dairy foods	**10.0**	**10.0**	9.1	**Adequate**
Red meat	0	0	0	Reduce
Fish	6.1	6.7	5.4	Increase
Eggs	6.6	5.1	8.2	Increase (small)
Chicken and other poultry	1.1	0	2.5	Increase
Legumes	1.6	1.8	1.3	Increase
Nuts	0.6	0.6	0.6	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	0	0	0	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions

In terms of public health, Ireland showed limited progress toward achieving the diet-related non-communicable disease targets. 26.8% of adult (aged 18 years and over) women and 31.3% of adult men were living with obesity. Ireland's obesity prevalence was higher than the regional average of 25.3% for women and 24.9% for men. At the same time, diabetes was estimated to affect 5.6% of adult women and 8.1% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/northern-europe/ireland/). The prevalence of obesity in 18-64-year-old adults had increased significantly from 1990 to 2010, from 8% to 26% in men, and from 13% to 21% in women, with the greatest increase observed in men aged 51-64 years. These results highlighted that obesity remains a major public health problem in Ireland. Overall, the physical activity levels of men and women were similar; however, men were approximately 1.5 times more active than women in occupational and leisure activities, but women were 2.5 times more active in household tasks. The levels of physical activity decreased with increasing age, with over 65-year-olds spending the least amount of time in occupational activities (IUNA, 2011).

Dietary patterns and socioeconomic conditions

In a recent study (Burke et al., 2023) Irish food consumption was analyzed and five distinct dietary patterns ("meat-focused", "dairy/ovo-focused", "vegetable-focused", "seafood-focused", and "potato-focused") were identified. Socio-economic conditions were determinants of the above-mentioned dietary patterns. Females were twice as likely to be associated with the "vegetable-focused" diet. Respondents of Irish ethnicity were more likely to follow the "potato-focused" diet while European/non-Irish white respondents were more likely to be associated with the "vegetable-focused" diet and less likely associated with the "meat-focused" or "potato-focused" diets. Respondents with higher educational levels were more likely to have a "vegetable-focused" diet and less likely to have a "potato-focused" diet and a "meat-focused" diet. In terms of settlement, rural respondents were more likely to be associated with "potato-focused" and "meat-focused" diets, and respondents residing in urban areas were twice as likely to be associated with a "vegetable-focused" diet. Respondents working in the construction and manufacturing, field were twice as likely to be categorized in the "meat-focused" and "seafood-focused" diet groups, while respondents working in "education" were more likely to be categorized in the "vegetable-focused" diet group. "Seafood-focused" diet respondents lived in smaller households than the "dairy/ovo-focused" and "potato-focused" diet groups. Respondents living without children were more likely to follow a "vegetable-focused" diet, while respondents living with children were more likely to follow a "potato-focused" diet.

LIVING LAB TARGET GROUP IN IRELAND: HEALTHY YOUNG ADULTS – UNIVERSITY STUDENTS, ALL SES (AGE: 18-30)

The Ireland LL targets university students (18-30 years) of the University College of Dublin which hosts a large presence of people (> 30,000 students). This age period was chosen in consideration of the fact they represent a moment of dietary transition related to the fact that young adults are gaining more independence from families with an increasing influence of their peers. The focus on the activity of the LL on this population group will be related to aspects such as time, cost, and education as important barriers and enablers to dietary change.

Healthiness and sustainability of Irish Healthy Young Adults' food consumption: the WISH score

WISH of Young Adults in Ireland was reported in Figure 20 reaching only 17% of the theoretical maximum with a score of 26 out of 150. Females had a slightly better dietary pattern both for healthy and environmental sub-indicators indicating a high consumption of healthy protective foods (healthy sub-WISH) and a limited consumption of high environmental impacting foods (high environmental impact indicator). The profile of WISH for Irish young adults was similar to that of adults; the values were slightly lower for males (young 15.8% vs adult 16.1%) and slightly higher for females (young 18.9% vs adults 18.1%).

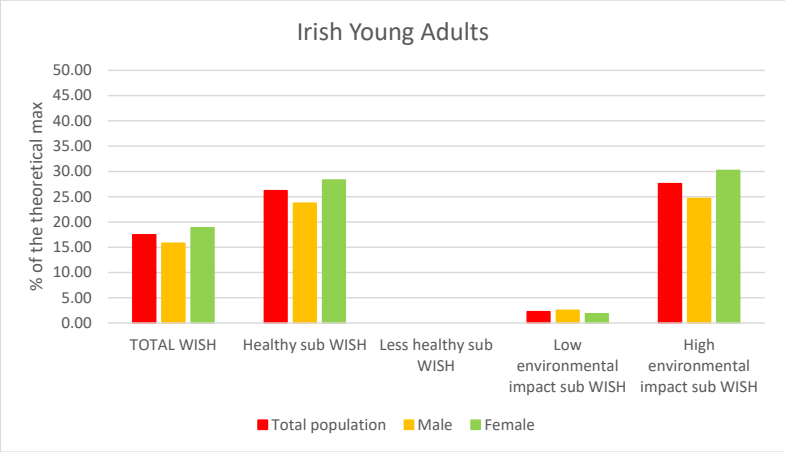


Figure 20 – Total and sub-score WISH of Healthy Young Adults (18-30 years) in Ireland (whole population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in Irish Young Adults were reported in Table 15. Among the animal food groups the highest scores (adequate/near-optimal consumption) was found only for dairy; fish, chicken, and eggs were insufficiently consumed while other animal food categories (red and processed meat) exceeded the recommended intake. Plant-based foods were insufficiently consumed having zero scores or values slightly over zero (1.4, legumes; 0.7, nuts). Females had more adequate consumption of chicken (4.2 vs 1.4) and eggs (6.3 vs 2.7) while males have more adequate consumption of fish (7.4 vs 6.0). Alcoholic beverages and added sugars were too much consumed.

Table 15: Scores* of each food group/dietary elements used for WISH calculation of Healthy Young Adults in Ireland

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	0	0	0	Increase
Dairy foods	**10.0**	**10.0**	**10.0**	**Adequate**
Red meat	0	0	0	Reduce
Fish	6.7	7.4	6.0	Increase
Eggs	4.5	2.7	6.3	Increase
Chicken and other poultry	3.0	1.4	4.2	Increase
Legumes	1.4	1.5	1.1	Increase
Nuts	0.7	0.7	0.7	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	0	0	0	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions in Irish Young Adults

Young adults (18-35 years) in Ireland had a lower prevalence of obesity (13%) than other age groups. About 2% of women aged 18-35 years were underweight. Analyzing the proportion of young adults with increased risk for cardiovascular disease, identified by waist circumference, the age class 18-35 years presented with less risk corresponding to a 15% of incremental risk while the overall prevalence in the adults (18-54 years)

corresponds to 25% of individuals associated with an increased risk (IUNA, 2011). Younger men (18-35 years) were 1.5 times more active in leisure activities than men aged 36-64 years and 2.5 times more active than men over 65 years. Women aged 36-50 years spent the most time in activities of daily living, but their overall activity levels were similar to younger women (18-35 years) and significantly higher than women aged over 65 years (IUNA, 2011).

Dietary patterns and socioeconomic conditions in Irish Young Adults

In the already cited paper of Burke et al. (2023) it was reported that in Ireland the age group 18-25 years is mostly characterized by "meat-focused" (15.5%), "dairy/ovo-focused", (16.1%) "vegetable-focused" (14.6%) dietary patterns. "Seafood-focused" (12.0%), and "potato-focused" (9.7%) dietary patterns are less represented in Irish young adults. In another study investigating the socio-economic disparities in food intakes among young Irish women, it was found that the women of low socio-economic status had lower intakes than the women of high socio-economic status for fruit, vegetables, fish, breakfast cereals, low-fat milk, and whole-meal bread, yogurt, low-fat spread, and fresh meat. They also had higher intakes of butter, processed red meats, white bread, sugar-sweetened beverages, fried potatoes and potato-based snacks, and full-fat milk (McCartney et al., 2013).

2.2.7 ITALY

Country profile

As shown in Figure 21, Italy achieved the recommendation for fruit consumption. Vegetables, and legumes intake were lower than recommended but in line with sub-regional and regional consumption. On the other hand, nuts and whole grain consumption were lower than recommended and lower than Southern Europe and Europe intake. Fish consumption was twice that of the recommend target in line with other Southern Europe countries. Dairy consumption slightly exceeded the maximum target (129%) while red meat consumption largely exceeded recommended intakes.

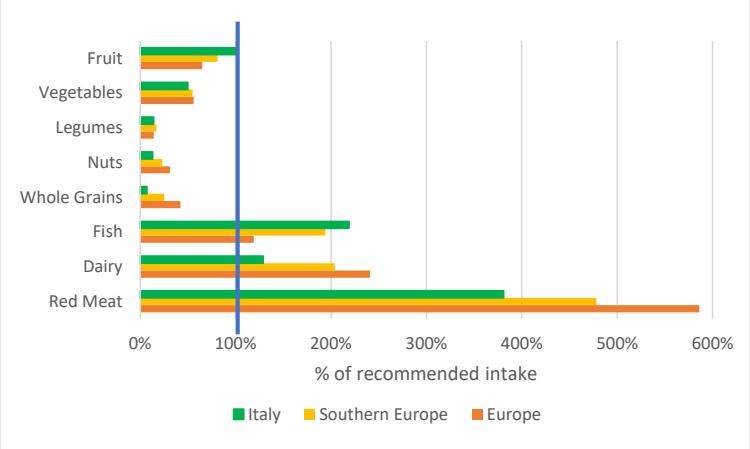


Figure 21 – Food consumption in Italy, Southern Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/southern-europe/italy/).

Healthiness and sustainability of Italy food consumption: the WISH score

WISH for Adults in Italy was reported in Figure 22 reaching 39% of the theoretical maximum with a score of 59 out of 150. The WISH score for Italy showed both a good consumption of healthy and environmentally protective foods and a limited consumption of unhealthy and highly impacting foods. Females had a better dietary pattern than males (39.9% vs 37.9%) both for healthy and environmental sub-indicators.

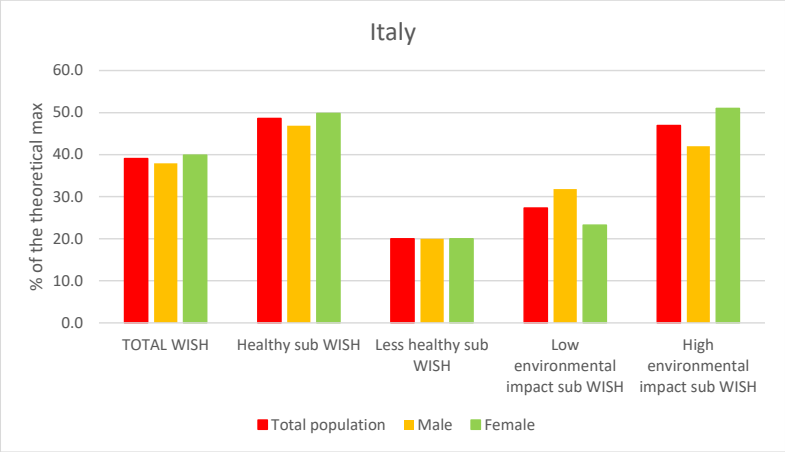


Figure 22 – Total and sub-score WISH of the Adults in Italy (total population, male and female).

Scores of the food groups and dietary elements used for WISH calculation in Italian Adults were reported in Table 16. The highest scores (adequate/near-optimal consumption) were found for some animal food groups (fish, eggs and as a less extent dairy, and chicken); other animal food categories (red and processed meat) were excessively consumed (zero score). Fat consumption was in line with the Mediterranean diet principle with the highest score (adequate/near-optimal intake) for saturated fat and an intermediate score of 4.8 for unsaturated oils. Insufficient consumption of plant-based foods was found; fruit (3.6) and vegetables (6.4) had scores corresponding to suboptimal level of consumption. Reduction of consumption of alcoholic beverages and added sugars was needed. Females had better consumption level of eggs (10.0 vs 6.3) and chicken (8.1 vs 3.5) while males had better consumption level of vegetables (4.4 vs 2.8) and unsaturated oils (6.6 vs 3.3).

Table 16: Scores* of each food group/dietary elements used for WISH calculation of Adults in Italy

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	3.6	4.4	2.8	Increase
Fruit	6.5	6.6	6.3	Increase
Dairy foods	6.5	6.4	6.5	Increase
Red meat	0	0	0	Reduce
Fish	**10.0**	**10.0**	**10.0**	**Adequate**
Eggs	8.4	6.3	**10.0**	**Adequate**
Chicken and other poultry	5.9	3.5	8.2	Increase
Legumes	1.5	1.5	1.5	Increase
Nuts	1.4	1.5	1.2	Increase
Unsaturated oils	4.8	6.6	3.3	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions

In terms of public health, Italy showed limited progress toward achieving the diet-related non-communicable disease (NCD) targets. 21.2% of adult (aged 18 years and over) women and 22.4% of adult

men are living with obesity. Italy's obesity prevalence was lower than the regional average of 25.3% for women and 24.9% for men. Diabetes affected 4.7% of adult women and 7.7% of adult men. (https://globalnutritionreport.org/resources/nutrition-profiles/europe/southern-europe/italy/). According to (Mannocci et al., 2022), Italy has 33% of physical inactivity, with women being more inactive compared to men. The sedentary rate increased with age with almost of elderly people aged 65 and over being sedentary. A geographical gradient was observed with people living in the Center, South, and the Islands being more sedentary than people living in the Northern regions.

Dietary patterns and socio-economic conditions

Adherence to Mediterranean Diet in Italy is a proxy of adherence to nutritional recommendations considering that national Italian dietary guidelines are based on Mediterranean Diet principles. As reported by (Aureli and Rossi, 2022) in Italy several sociodemographic characteristics are significantly associated with the adherence to Mediterranean diet. Females showed higher adherence than males and the youngest respondents showed lower adherence than the elderly. North-eastern regions and Campania (a region in the south) showed the lowest level of Mediterranean Diet adherence than other regions. Living in urban areas was associated with a high level of adherence. Education was strongly associated with adherence to the Mediterranean Diet, with a high proportion of respondents with low adherence in the population group with a low level of education. In terms of family size, living in large families was associated with low adherence compared to respondents living alone or in a family with 2 components.

LIVING LABS TARGET GROUP IN ITALY: DIABETIC ADULTS FROM LOW SES (LOW INCOME/RURAL/IMMIGRANTS), (AGE: 18-70)

The LL in Italy targets diabetic adults of low socioeconomic status in the area of Pilastro in Bologna. Pilastro is a large area (12,000 inhabitants) of high vulnerability with a large prevalence of immigrants from different ethnic groups with low income. In terms of nutrition-related aspects, the target group is characterized by a high prevalence of visceral obesity and diabetes. The LL intends to overcome cultural and economic barriers to healthy diets, combating food poverty and malnutrition, and improving immigrants' adaptation to better lifestyle behavior. The approach of this LLs origins from the evidence that migrants tended to maintain their traditional food habits, even if have negative impacts on health since food habits have many cultural and symbolic implications. Hence a culturally tailored diets for diabetes will be proposed in order to increase the adherence to the therapy considering that strict adherence to traditional food, together with different language and religious beliefs, have been identified as barriers to access to healthcare. In fact, the more distant the recommended diet is from the actual habits of the patients, the more difficult it is to promote a good adherence to nutritional therapy (Piombo et al., 2020). Data to assess the current dietary pattern of diabetic migrants in Italy were not available. However, it is well known that diabetes progression is influenced by food behaviors, and diet control is one of the most critical aspects of disease management (Forouhi et al., 2018).

In the metropolitan area of Bologna, the overall prevalence of diabetes was 6.1% in both Italy-born and immigrant cohorts. Immigrant prevalence was 12.4%, moderately higher than that observed in the total population (12.2%) (Marchesini et al., 2023). Diabetes, represent a crucial area where patients' health is affected by their adherence to care pathways, for which it is reported alarming low levels. In the case of migrants, obstacles to adherence, such as language or organizational barriers, need to be considered in the provision of healthcare services (Listorti et al., 2023). Diabetes, like obesity and other nutrition-related health problems, was more common in socio-economically disadvantaged groups of the population including migrants.(ISTAT, 2017). Large variations in diabetes prevalence by ethnicity was found by (Fedeli et al., 2015) which showed the highest prevalence rates among immigrants from South-East Asia, followed by residents from both North and Sub-Saharan Africa. Citizens from Eastern Europe (the largest immigrant group) showed rates similar to Italians. Most South-Asian patients aged 20-39 years were not insulin-treated, suggesting a very high risk of early-onset type 2 diabetes in this ethnic group. In Italy, hospitalization for diabetes has decreased over time. From 2000 to 2015 it decreased by 66.4%, while the reduction of the total hospital discharges was 26.6%.(ISTAT, 2017). However, the situation for migrants is completely different. In these population groups the risk of avoidable hospitalization for diabetes, which represents a preventable cost for the health care system, increased by 46%, 141%, and 159%, respectively,

for immigrants from Asia, Sub-Saharan Africa, and North Africa. On the other hand, for immigrants from Eastern Europe as well as those from Central and South America the risk of avoidable hospitalization was comparable to Italians (Dalla Zuanna et al., 2020).

2.2.8 POLAND

Country profile

As shown in Figure 23, Poland was the only PLAN'EAT country that reached and in fact exceeded targets for fruit consumption (117%). However, vegetable consumption, lower than recommended, was in line with sub-regional and regional data. Consumption of legumes, nuts, whole grains, and to less extent fish, was very far from recommended and lower than Eastern Europe and Europe. Red meat and dairy largely exceeded the maximum recommended intake with dairy intake comparable with sub-regional and regional data and red meat lower than Eastern Europe and Europe.

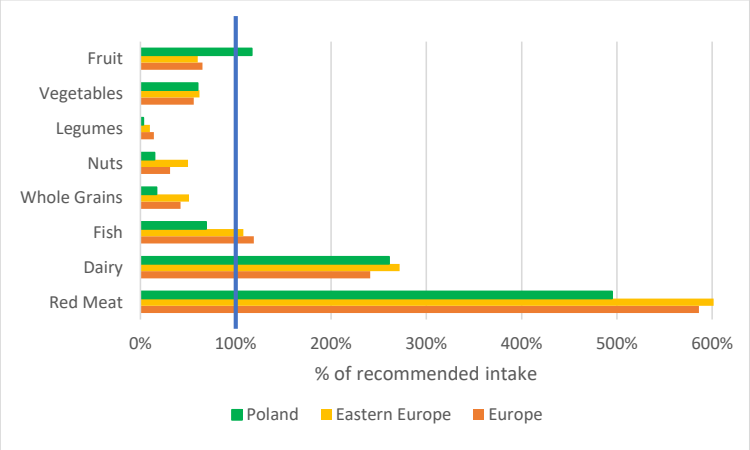


Figure 23 – Food consumption in Poland, Eastern Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/eastern-europe/poland/).

Healthiness and sustainability of Poland food consumption: the WISH score

WISH for Adults in Poland was reported in Figure 24 reaching 16% of the theoretical maximum with a score of 24 out of 150. Healthy sub-WISH and "low environmental impact sub-WISH" were the major contributing to WISH in Poland indicating a certain level of consumption of healthy promoting foods and a certain level of consumption of foods with low environmental impact. In Poland, males had a better dietary pattern than females (26.4 vs 22.9) both for healthy and environmental sub-indicators.

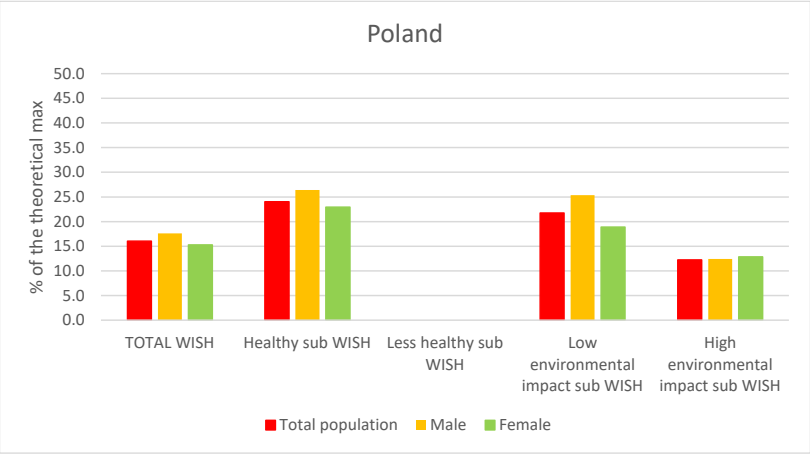


Figure 24 – Total and sub-score WISH for Poland in the adult (whole population, male and female).

Scores of the food groups and dietary elements used for WISH calculation of Adults in Poland were reported in Table 17. Animal food categories were overconsumed having a WISH corresponding to zero or very near zero. Despite the insufficient consumption of wholegrains and vegetables (zero score) other plant-based foods resulted consumed at good level (e.g., fruit, 7.2, legumes, 5.2, and nuts, 10). Overconsumption of alcoholic beverages and added sugars was observed. Male had better consumption level of fruit (8.1 vs 6.5) and legumes (7.1 vs 4.8) than female.

Table 17: Scores* of each food group/dietary elements used for WISH calculation of Adults in Poland

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	7.2	8.1	6.6	Increase (small)
Dairy foods	1.0	1.2	1.6	Increase
Red meat	0	0	0	Reduce
Fish	0	0	0	Reduce
Eggs	0	0	0	Reduce
Chicken and other poultry	0	0	0	Reduce
Legumes	5.8	7.1	4.8	Increase
Nuts	**10.0**	**10.0**	**10.0**	**Adequate**
Unsaturated oils	0	0	0	Increase
Saturated oils	0	0	0	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions

In terms of public health, Poland showed limited progress toward achieving the diet-related non-communicable disease targets. 24.1% of adult (aged 18 years and over) women and 26.4% of adult men were living with obesity. Poland's obesity prevalence was lower than the regional average of 25.3% for women but was higher than the regional average of 24.9% for men. At the same time, diabetes was estimated to affect 7.5% of adult women and 9.5% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/eastern-europe/poland/). Data collected in the period 2003-2005 showed that nearly 35% of Polish adults were not active during their leisure time, while only about 17% were only occasionally engaged in any exercise. Over 42% of children up to 14 years old spent above 3 hours per day in front of a TV or computer monitor. Over 50% of Polish teenagers aged 15–19 years did not participate in any kind of recreational physical activity (Drygas et al., 2008). More recently (2017), Polish sedentary behavior was assessed in a representative sample of adults reporting an average sitting time of 1958,5 min/week. Sedentary was more common in people working at offices than people having physical work typology. Living in urban areas determined an increased time sitting related to transport means (Biernat and Piątkowska, 2023).

Dietary patterns and socio-economic conditions

The dietary habits of total population of Polish adults were below the recommended intakes. In the Polish adult population, a higher socioeconomic status was significantly associated with a better lifestyle (more physical activity and less smoking), a better health status (lower occurrence of overweight and metabolic syndrome in both genders, and lower occurrence of central obesity, hypertension, and diabetes in women), and better dietary habits. Higher socio-economic conditions were positively associated with better dietary

patterns in terms of a lower energy intake and a higher intake of whole meal bread, vegetables, and dairy products in both genders, a lower intake of red meat in men, and a higher intake of fruits, fish, and nuts in women. The consumption of plant fats (oil and margarine) and cereal products was associated with a lower socio-economic status in both genders, while legume intake was found to be associated with a lower socio-economic status only in men (Zujko et al., 2020).

Living Lab target group in Poland: Healthy children and adolescents, low SES (Age: 1-16)

LL in Poland targets healthy children and adolescents with low socioeconomic status. Poland has the highest rate of rising childhood overweight and obesity in the EU and needs prevention programs going beyond individual responsibility (Youth policies in Poland, 2019). Family networks and kindergarten of younger groups (1-3 and 3-6 years) will be particularly assessed in the LL activities focusing on socioeconomic and cultural factors. In terms of global actions on children and adolescents in Poland, the "State Strategy for Youth for 2003-2012" prepared before Poland's accession to the EU remains the only document determining the development and directions of Polish youth policy. Currently, there is no strategy in Poland directly relating to young people (Youth policies in Poland, 2019).

Healthiness and sustainability of Poland Healthy Children and Adolescents food consumption: the WISH score

The WISH score was calculated for children and adolescents differentiated by sex (Figure 25). Total scores reached 20% of the theoretical maximum (31 out 150) in children and 16% (25 out of 150) in adolescents. When considered by sex, better figures were seen for females (21.4%) than males (17.7%). This is a point of difference to the adults in which males showed better values than females. In children no relevant differences among sub-scores were observed except a slightly high "high environmental impact sub-WISH" indicating a certain level of limitation of consumption of environmentally impacting foods. In adolescents, the consumption of healthy foods (contributing to the "healthy sub-score") and the limitation of the consumption of environmentally impacting foods (contributing to the "high environmental impact" sub-score) were higher than other sub-scores.

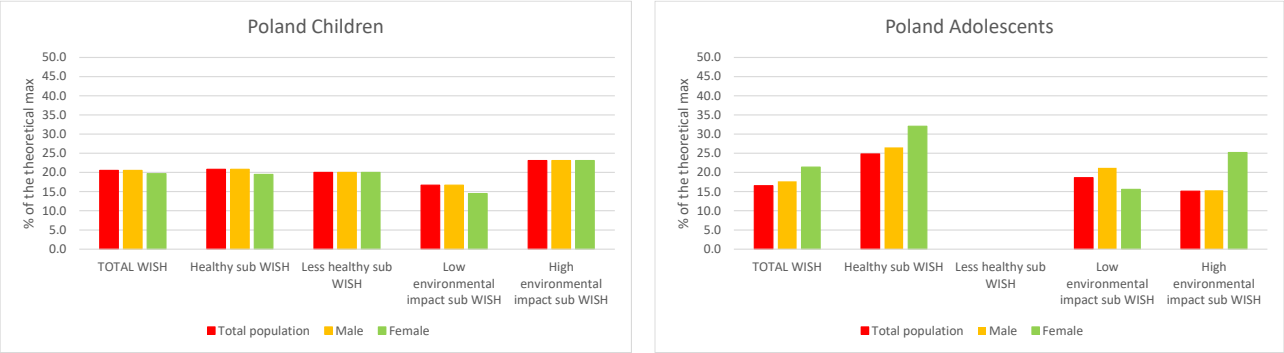


Figure 25 – Total and sub-score WISH for Poland Healthy Children and Adolescents in the whole population, male and female.

Scores of the food categories of WISH in children and adolescents in Poland were reported in Table 18. In children, legumes, saturated fats, and fish consumption showed the maximum scores (adequate consumption). The other animal food groups as well as sugary beverages and added sugars need to be reduced (zero or near zero score). Whole grains, fruit, vegetables, nuts, and unsaturated oils were insufficiently consumed in children. In adolescents, adequacy of consumption was found only for nuts. Excess of consumption of red and processed meat, eggs, chicken, added sugars, alcoholic beverages was observed. The other vegetable foods groups as well as the saturated and unsaturated oils consumption were insufficiently consumed. In adolescents, small differences were found between sexes with males having better consumption of fruits (6.3 vs 5.6) and legumes (6.4 vs 3.7).

Table 18: Scores* of each food group/dietary elements used for WISH calculation of Children and Adolescent Poland.

Food Groups/Dietary Elements	Children				Adolescent			
	Total population	Male	Female	Change for improving WISH	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase	0	0	0	Increase
Vegetables	0	0	0	Increase	0	0	0	Increase
Fruit	0	0	0	Increase	6.0	6.3	5.6	Increase
Dairy foods	0.8	0.8	0.8	Increase	3.6	3.8	3.4	Increase
Red meat	0	0	0	Reduce	0	0	0	Reduce
Fish	**10.0**	**10.0**	**10.0**	**Adequate**	0	0	**10.0**	**Adequate**
Eggs	0	0	0	Reduce	0	0	0	Reduce
Chicken and other poultry	0	0	0	Reduce	0	0	0	Reduce
Legumes	**10.0**	**10.0**	8.7	**Adequate**	5.2	6.4	3.7	Increase
Nuts	0	0	0	Increase	**10.0**	**10.0**	9.3	**Adequate**
Unsaturated oils	0	0	0	Increase	0	0	0	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**	0	0	0	Increase
Added sugars	0	0	0	Reduce	0	0	0	Reduce
Alcoholic/Sugary beverages**	0	0	0	Reduce	0	0	0	Reduce
Processed meat	0	0	0	Reduce	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores.
**In children the food group "alcoholic beverage" was replaced with "sugary beverages".

Nutrition-related health conditions of children and adolescents in Poland

In a paper examining pooled data on children and adolescents' nutritional status in Poland in the period 2005-2015, it was found that the percentage of overweight was around 12-15%, with obesity around 5-11% an observed increased trend especially in children during puberty. On the other hand, underweight affected 3% to 18% of boys, and up to 20% of girls (Malczyk, 2016). More recent data reported a prevalence of 17.1% of weight excess (overweight or obesity) with obesity present in 6.8% of school-age children (6-10 years) and underweight present in 8.2% of the surveyed children (Potempa-Jeziorowska et al., 2022). According to (Zembura et al., 2018), 21.5% of youth (10-17 years) in Poland met the recommended level of ≥60 minutes of moderate-to-vigorous intensity physical activity per day, 47.4% of this age group reported walking to school and 5.5% travel to and from school by bicycle. The sedentary attitude is very common with 49% of students declaring spending ≤2 hours per day watching TV or on the computer.

Dietary patterns and socio-economic conditions children and adolescents in Poland

The diet of children and adolescents in Poland is high glycemic index cereals, sweets, and animal fats, while it is low in fish, fruits, and products containing probiotics (Czarnocinska et al., 2020). Region's affluence influences dietary behaviors in vulnerable population groups such as young females. A higher proportion of subjects' belongings to the 'Fast-food and sweets' dietary pattern was found in the less affluent (North) region when compared to other regions. Higher adherence to the 'Fruit and vegetables' dietary pattern was found in more affluent regions when compared to poorer regions. Higher family socio-economic conditions were associated with higher adherence to the 'Fruit and vegetables' dietary pattern and lower adherence to the 'Traditional Polish' dietary Pattern (Czarnocinska et al., 2020). In a study specifically addressing the issue of fiber intake in adolescents it was found that adolescents with low socio-economic status (low parents' educational level, rural residence, and lower household economic situation) were less likely to adhere to the "High-fiber" dietary pattern meaning a food consumption profile with a high frequency of fruit, fruit or vegetable juices, potatoes, green salad, and vegetables, and a moderate frequency consumption of high-fiber or bran cereals and wholegrain bread (Krusinska et al., 2017).

2.2.9 SPAIN

Country profile

As shown in Figure 26, in Spain, plant-based foods, in particular fruit and vegetables, showed consumption levels low than the minimum recommended intake, and lower than the sub-regional data. On the other hand, legumes and nuts consumption reaching 23% and 31% of the recommended intake respectively were the highest values in the PLAN'EAT countries. Fish and dairy intake exceeded recommended intakes and were higher than in Southern Europe and Europe. Red meat consumption exceeded recommended intakes but was lower than sub-regional and regional averages.

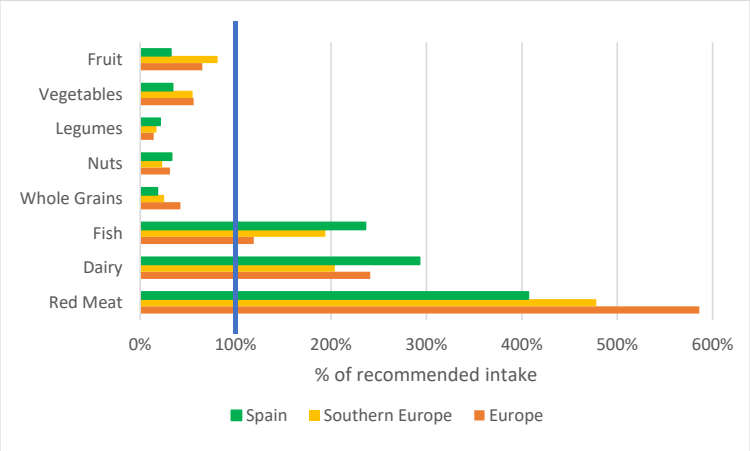


Figure 26 – Food consumption in Spain, Eastern Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/southern-europe/spain/).

Healthiness and sustainability of Spain food consumption: the WISH score

WISH for Adults in Spain was reported in Figure 27 reaching 33% of the theoretical maximum with a score of 50 out of 150. The WISH for Spain showed both a good consumption of healthy and environmentally protective foods and a limited consumption of unhealthy and highly impacting foods. Females had a better dietary pattern than males (35% vs 31%) both for healthy and environmental sub-indicators.

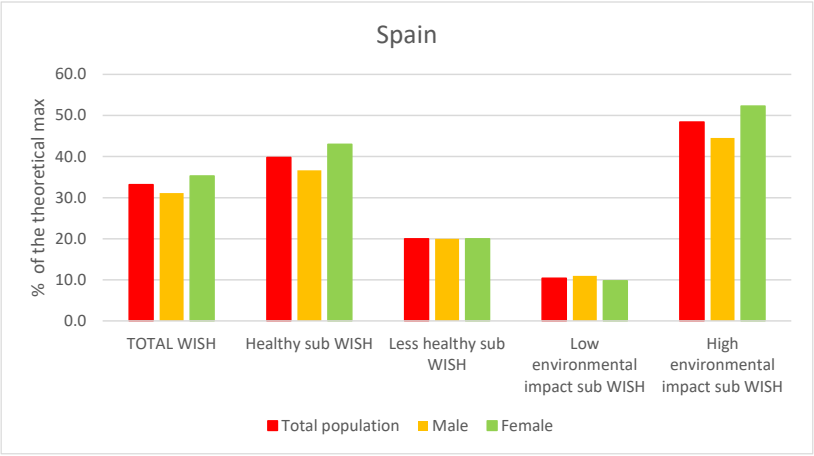


Figure 27 – Total and sub-score WISH in the Adults in Spain (total population, male and female).

Scores of the food categories of the WISH in Spanish Adults were reported in Table 19. The highest scores (adequate/near-optimal consumption) were found for some animal food group categories (fish, eggs, dairy, and chicken); other animal food categories were too much consumed. Fat consumption was in line with the Mediterranean diet principle with a maximum score (adequate consumption) for saturated fat; on the other hand, insufficient consumption of unsaturated oils was found. Plant-based foods consumption was

insufficient except for fruit having a score (5.0) corresponding to a sub optimal level of consumption. Alcoholic beverages and added sugars need to be reduced. Females had better consumption level of eggs (9.0 vs 3.8) and chicken (7.7 vs 5.8) while males had better consumption level of fruits (5.3 vs 4.6).

Table 19: Scores* of each food group/dietary elements used for WISH calculation of Adults in Spain

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	5.0	5.3	4.7	Increase
Dairy foods	**10.0**	**10.0**	**10.0**	**Adequate**
Red meat	0	0	0	Reduce
Fish	**10.0**	**10.0**	**10.0**	**Adequate**
Eggs	6.4	3.8	9.0	Increase
Chicken and other poultry	6.7	5.8	7.7	Increase (small)
Legumes	1.3	1.3	1.2	Increase
Nuts	0.5	0.5	0.4	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions

In terms of public health, Spain showed limited progress toward achieving the diet-related non-communicable disease targets. 24.6% of adult (aged 18 years and over) women and 27.2% of adult men were living with obesity. Spain's obesity prevalence was lower than the regional average of 25.3% for women but was higher than the regional average of 24.9% for men. Diabetes in Spain affected 5.7 of adult women and 9.1% of adult men (https://globalnutritionreport.org/resources/nutrition-profiles/europe/southern-europe/spain/). Statistics on sedentary lifestyle in Spain in 2020, reported that more than one-third of the adults (18-65 years) are sedentary with a higher proportion in females (37%) than males (34%). The sedentary attitude increased with age (https://www.statista.com/statistics/776555/population-with-a-sedentary-lifestyle-in-spain-by-gender-and-age/).

Dietary patterns and socio-economic conditions

As in other Southern European countries adherence to the Mediterranean diet pattern has declined in Spain which tends to adopt a less healthy diet, typical of Western countries (Vilarnau et al., 2019). This shift from the MD appeared to mostly affects socially disadvantaged people and those with other unhealthy lifestyles. Two specific dietary patterns in Spain were identified, “Westernized” rich in red and processed meat, French fries, refined cereals, and sweetened beverages, and poor in fresh fruit, and “Mediterranean” rich in olive oil and plant-based foods. The Westernized pattern was more frequent among the younger, the less educated, current smokers, and those less physically active and more sedentary (León-Muñoz et al., 2012). According to Sandri et al. (Sandri et al., 2023), women with higher education and a medium-high income have better nutrition and healthier lifestyles and a lower BMI, and higher self-perceived health status than women with basic education and a lower income. In addition to that, results indicate that nutrition was influenced by the age of the sample with adult women having better nutrition than younger women, although they are more sedentary and do less sport.

LIVING LAB TARGET GROUP IN SPAIN: HEALTHY ADULTS FROM MIDDLE-AGE TO ELDERLY, LOW SES, (AGE: 40-85)

The LL in Spain targets healthy adults from middle age to elderly of low socioeconomic status living in Cataloni, an agricultural productive region of Spain. The focus will be the assessment of socio-cultural behaviours, as well as perceived health, which is particularly relevant for a healthy population in a Mediterranean context, in which public health is strongly linked to diet. In Spain, the number of people over 65 has doubled in the last 40 years. The population over 65 is around 20%, of which approximately 30% are octogenarians. Several factors influence the elderly quality of life and nutritional status in Spain. On one side this age group has a more traditional dietary pattern with larger adherence to the Mediterranean diet than adults; however, this elderly group are also vulnerable, often presenting with frailty and social conditions that could influence food consumption and dietary patterns (Latorre et al., 2023).

Healthiness and sustainability of Spain Elderly food consumption: the WISH score

The WISH for Spanish Elderly was reported in Figure 28 reaching 40% of the theoretical maximum with a score of 59 out of 150. Females had a slightly better dietary pattern than males (39.3% vs 37.8%) both for healthy and environmental sub-indicators. Particularly high were the "healthy sub-WISH" and the "high environmental impact sub score" meaning that in Spanish Elderly there was high consumption of healthy protective foods and limited consumption of foods with high environmental impact. In Spain, the elderly had WISH scores and sub-scores globally higher than adults (total WISH 59 covering 40% of the theoretical maximum vs 50 corresponding to 33% of the theoretical maximum) either in females (39.3% elderly vs 35.3% adults) or males (37.8% elderly vs 31.1% adults).

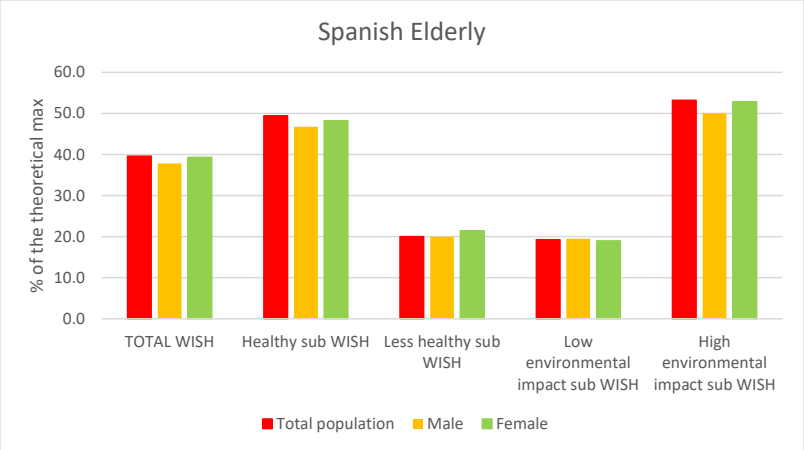


Figure 28 – Total and sub-score WISH of Elderly in Spain (total population, male and female).

Scores of the food categories of the WISH in Spanish Elderly were reported in Table 20. The highest scores (adequate/near-optimal intake) were found for some animal food group categories (fish, eggs, chicken, and dairy); other animal food categories need to be reduced. Adequate consumption of saturated fat was found both in males and females. Among plant-based foods fruits was adequately consumed while other groups were insufficiently consumed. Alcoholic beverages and added sugars were overconsumed. No relevant differences were observed in elderly males and females.

Table 20: Scores* of each food group/dietary elements used for WISH calculation of Elderly in Spain				
Food Groups/Dietary Elements	**Total population**	**Male**	**Female**	**Change for improving WISH**
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	**10.0**	**10.0**	**10.0**	**Adequate**
Dairy foods	**10.0**	**10.0**	**10.0**	**Adequate**
Red meat	0	0	0.7	Reduce
Fish	**10.0**	**10.0**	**10.0**	**Adequate**
Eggs	7.3	5.0	6.2	Increase (small)
Chicken and other poultry	**10.0**	9.5	**10.0**	**Adequate**
Legumes	1.5	1.7	1.4	Increase
Nuts	0.6	0.5	0.7	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions of Elderly in Spain

The prevalence of obesity and abdominal obesity in individuals aged ≥65 years in Spain is high; obesity is higher in women (40.1%) than in men (32.5%) and abdominal obesity is also higher in women (69.9%) than in men (40.7%). Obesity and abdominal Obesity is higher in the South region compared to the East, North-East, and Central regions and showed inverse association with educational level (Pérez-Rodrigo et al., 2022). Sedentary behavior progressively increased after 50 years of age, reaching 33% in males and 39% in females aged 65-74 years, 43% in males and 55% in females aged 75-84 years, and of 60% in males and 79% in females aged >75 years (https://www.statista.com/statistics/776555/population-with-a-sedentary-lifestyle-in-spain-by-gender-and-age/)

Dietary patterns and socio-economic conditions

The assessment of prevailing food patterns in Spanish older adults (55-80 years) was carried out by (Bibiloni et al., 2017) who reported two major dietary food patterns: "Western" and "Mediterranean" existed. The "Western dietary pattern" was positively associated with frequent intakes of whole dairy products, meats (i.e., red meat, viscera, low-fat processed meat, and high-fat processed meat), seafood, potatoes, refined grain bread, rice, pasta, non-extra virgin olive oils, non-olive oils, bakery (i.e., homemade and also commercial bakery), chocolate, sugar, processed meals, sauces, spices, salt, and commercial juices; and negatively associated with low-fat dairy products, white fish, and olives and extra-virgin olive oil. The "Mediterranean dietary pattern" was positively associated with frequent intakes of white and blue-fish, canned fish/seafood, fruit, canned and dried fruit, jam, vegetables, potatoes, nuts, legumes, whole grain bread, rice, olives, and extra-virgin olive oil, honey, and spices. Participants with a higher adherence to the Western Dietary Pattern were more likely to be men, with a primary or secondary-level education. Moreover, women with higher adherence to the Western Dietary Pattern were more likely to have a higher income.

2.2.10 SWEDEN

Country profile:

As shown in Figure 29, in Sweden fruit and vegetable consumption reached 50% of the recommended intake, while legumes, nuts, and whole grains consumption only met one-fifth of the recommended target. Plant-based food consumption in Sweden was similar to regional and sub-regional data. Fish consumption met recommended intakes while dairy and red meat intakes were largely over the recommended intakes. Animal-based food consumption was in line with sub-regional and regional data except for red meat which in Sweden is consumed more than in other Northern European countries.

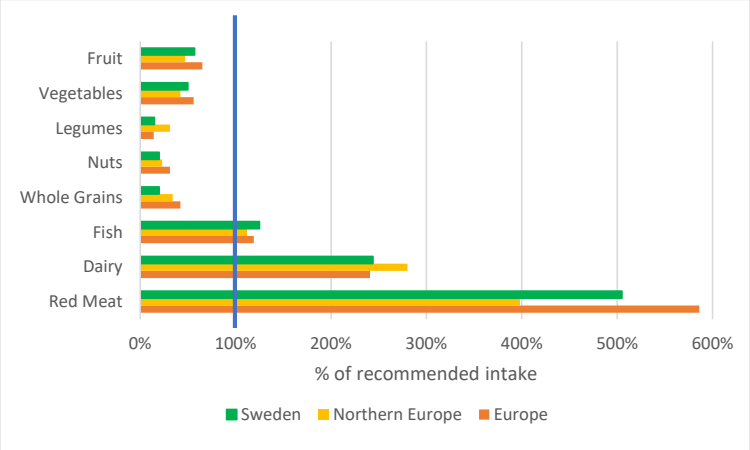


Figure 29 – Food consumption in Sweden, Northern Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report data sets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/northern-europe/sweden/).

Healthiness and sustainability of Sweden food consumption: the WISH score

The WISH of Adults in Sweden was reported in Figure 30 reaching 14% of the theoretical maximum with a score of 21 out of 150. Healthy sub-WISH and "low environmental impact sub-WISH" were the major contributing to WISH in Sweden indicating a certain level of consumption of healthy promoting foods and a certain level of consumption of foods with low environmental impact. In Sweden, females had a better dietary pattern than males (19.7% vs 14.2%) both for healthy and environmental sub-indicators.

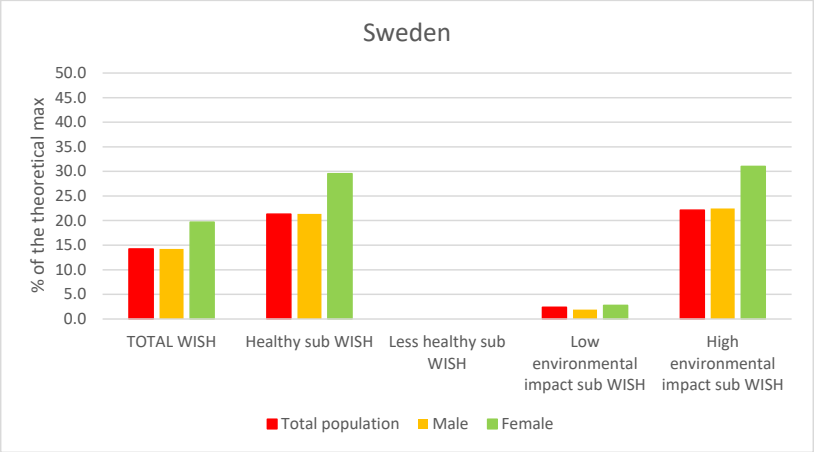


Figure 30 – Total and sub-score WISH of the Adults in Sweden (total population, male and female).

Scores of the food categories of WISH of Adults in Sweden were reported in Table 21. Among the animal food categories, the highest scores (adequate/near-optimal consumption) were found for fish, dairy and eggs (only for females). Excess of consumption of other animal food categories was found. Plant-based foods were insufficiently consumed (zero or near zero scores). Excess of alcoholic beverages and added

sugars intakes was found. Females had better consumption levels of chicken (3.0 vs 0.0) and eggs (10.0 vs 0.0) while males had better consumption levels of fish (9.9 vs 5.5).

Table 21: Scores* of each food group/dietary elements used for WISH calculation of Adults in Sweden

Food Groups/Dietary Elements	Total population	Male	Female	Change for improving WISH
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	0	0	0	Increase
Dairy foods	**10.0**	**10.0**	9.0	**Adequate**
Red meat	0	0	0	Reduce
Fish	7.5	**10.0**	5.5	Increase (small)
Eggs	0.7	0	**10.0**	Increase
Chicken and other poultry	1.5	0	3.0	Increase
Legumes	1.4	1.1	1.7	Increase
Nuts	0.3	0.3	0.3	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	0	0	0	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions

In terms of public health, Sweden showed limited progress toward achieving the diet-related non-communicable disease targets. 19.8% of adult (aged 18 years and over) women and 25.8% of adult men were living with obesity. Sweden's obesity prevalence was lower than the regional average of 25.3% for women but was higher than the regional average of 24.9% for men. Sweden had a prevalence of diabetes of 6.1% in adult men and 4.1% in adult women (https://globalnutritionreport.org/resources/nutrition-profiles/europe/northern-europe/sweden/). The proportion of women and men in Sweden who have reported that they exercise regularly has increased since 1980 and in 2020 was approximately 60% (https://www.folkhalsomyndigheten.se/the-public-health-agency-of-sweden/living-conditions-and-lifestyle/physical-activity/). However, the proportion of women and men in the age group 16–84 years who are physically active for at least 30 minutes per day has been unchanged at approximately 65% over the last decade. The proportion of people with sedentary leisure time has also been relatively unchanged at approximately 13–15 percent during the same period. There were no major differences between the genders. However, sedentary leisure time was affected by age, being more common among older people compared to young people and was twice as common among people with only primary and lower secondary education compared to people with post-secondary education (https://www.folkhalsomyndigheten.se/the-public-health-agency-of-sweden/living-conditions-and-lifestyle/physical-activity/).

Dietary patterns and socio-economic conditions

Three dietary patterns were identified in Sweden (Ax et al., 2016). A healthy pattern, Swedish traditional pattern and a light meal pattern. The “healthy pattern” was characterized by a high intake of vegetables, fruits and berries, fish and seafood, eggs, hot and cold cereals, and vegetable oils, and lower intakes of fast food, refined bread, and soda. The “Swedish traditional pattern” was characterized by the intake of traditional Swedish foods such as potatoes, meat, and processed meat, sauces (including dressings and condiments), non-Keyhole milk products, sweet bakery products, sweet condiments, desserts, and

margarine, and a lower intake of fast food. In women, a third pattern was identified, the "light-meal pattern" characterized by fiber-rich bread, cheese, rice, pasta, and food grain dishes, substitute products for meat and dairy products, soya and oat milk, soya, tofu, and Quorn (a meat substitute product based on mycoprotein) products, margarine, sweets and candies, snacks, tea, with low presence of potatoes and coffee. Among women, the healthy pattern was positively associated with education and income. Men and women with high healthy pattern scores were older, less likely to smoke, and more likely to be physically active in their spare time. On the other hand, the Swedish traditional pattern was associated with lower education and living in rural areas, and older age, in both men and women. In men, the Swedish traditional pattern was also associated with less spare-time physical activity. High light-meal pattern score was associated with younger age, lower BMI, living in urban areas, not smoking, and having higher education (Ax et al., 2016).

Living Lab target group in Sweden: HEALTHY TODDLERS, MIDDLE AND HIGH SES (Age: <6)

The LL in Sweden targets preschool children to be enrolled in pre-school and households with young parents in the framework of the assessment of the living food environment. The focus of the work will be on the ongoing activities of law-enforced public meals. Children under 6 years in Sweden are included in the Swedish Child Health Services which is a free-of-charge healthcare system aimed to improve children's physical, psychological, and social health by promoting health and development, preventing illness, and detecting emerging problems early in the child's life (Wennergren et al., 2023).

Healthiness and sustainability of Sweden's Healthy Toddlers food consumption: the WISH score

The WISH of Children in Sweden was reported in Figure 31 reaching 31% of the theoretical maximum with a score of 46 out of 150. Healthy sub-WISH and "high environmental impact sub-WISH" were the major contributing to WISH in Sweden Children indicating a certain level of consumption of healthy promoting foods and a limited consumption of foods with high environmental impact. In Sweden, female children had a better dietary pattern than male children both for healthy and environmental sub-indicators. In Sweden, children had WISH scores and sub-scores globally higher than adults (total WISH 46 covering 31% of the theoretical maximum vs 21 corresponding to 14% of the theoretical maximum) either in females (30.6% children vs 19.7% adults) or males (26.6% children vs 14.2% adults).

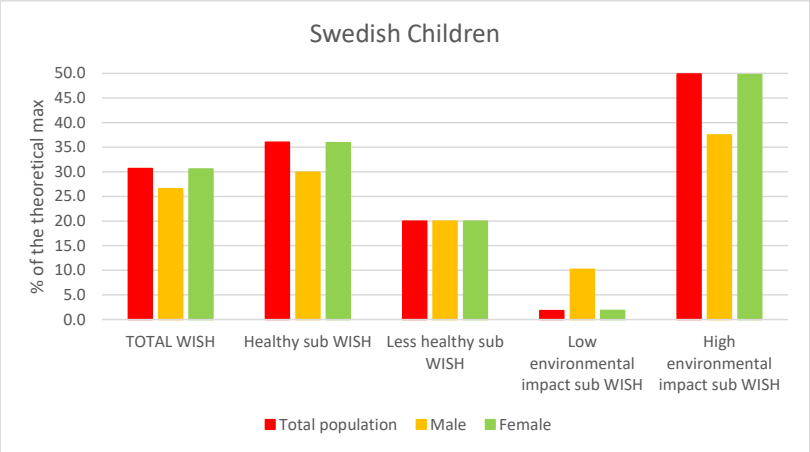


Figure 31 – Total and sub-score WISH of Healthy Children in Sweden (total population, male and female).

Scores of the food categories of the WISH of children in Sweden were reported in Table 22. The highest scores (adequate/near-optimal consumption) were found for some animal food groups (dairy, eggs, and chicken for females and dairy and fish for males). In children (both sexes) saturated oils consumption was adequate while unsaturated oils intake needed to be increased. Plant-based foods consumption was largely insufficient and needed to be increased. Sugary beverages and added sugars should be reduced. Vegetables, legumes, and nuts had a better consumption level in males (3.2 for vegetables, 2.9 for legumes, 2.6 for nuts) than in females (3.2 vs 0.0 for vegetables, 2.9 vs 0.7 for legumes, 2.6 vs 0.9 for nuts). Females have better consumption levels of chicken (10.0 vs 0.0) and eggs (10.0 vs 3.8).

Table 22: Scores* of each food group/dietary elements used for WISH calculation of Children in Sweden				
Food Groups/Dietary Elements	**Total population**	**Male**	**Female**	**Change for improving WISH**
Whole grains	0	0	0	Increase
Vegetables	0	3.2	0	Increase
Fruit	0.3	0	0.4	Increase
Dairy foods	**10.0**	**10.0**	**10.0**	**Adequate**
Red meat	0	0	0	Reduce
Fish	4.1	7.7	3.9	Increase
Eggs	**10.0**	3.8	**10.0**	**Adequate**
Chicken and other poultry	**10.0**	0.0	**10.0**	**Adequate**
Legumes	0.7	2.9	0.7	Increase
Nuts	0.8	2.3	0.9	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	**10.0**	**10.0**	**10.0**	**Adequate**
Added sugars	0	0	0	Reduce
Sugary beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions

Comparative data from Swedish Child Health Services showed that from 2018 to 2020 overweight and obesity increased among Swedish 4-year-olds. In 2020, 13.3% of children was overweight (10.4%) or obese (2.9%). Differences between sexes were observed with 12.0% of the girls and 9.0% of the boys was overweight and 3.1% and 2.6%, respectively, was obese. In 2018, 11.4% of the children had overweight (9.2%) or obesity (2.2%). This meant that the national prevalence had increased by 16.6% from 2018 to 2020. The increase in overweight was of 13.0% while the increase in obesity was of 31.8% (Miregård et al., 2023). The treatment of pediatric obesity has been offered customarily and free of charge for more than 15 years in Sweden. The Swedish Childhood Obesity Treatment Register (BORIS) is a prospective register of children and adolescents undergoing obesity treatment (Hagman et al., 2020). Four-year-old Swedish children engaged in 150 minutes and 102 minutes of screen-time on weekend days and weekdays, with 97% and 86% of children exceeding the 1-hour guideline for screen-time on weekend days and weekdays, respectively. Accelerometer data showed that boys are more active and less sedentary compared with girls and both sexes were more active and less sedentary on weekdays compared with weekend days, while parent-reported data showed that boys engage in more screen-time compared with girls (Berglind and Tynelius, 2018).

Dietary patterns and socioeconomic conditions

In a Swedish urban community of 4-year-olds, 17% were overweight or obese (Garemo et al., 2007). The intake of vegetables, oils, and “junk food” seemed to have increased, while the intake of dairy products, fruit, meat, and fish seemed to be similar to earlier studies. Maternal immigrant status influenced food choices.

2.2.11 THE NETHERLANDS

Country profile:

As shown in Figure 32, whole grains consumption in the Netherlands was the highest (reaching 68% of recommended intakes) among the PLAN’EAT countries and higher than sub-regional and regional averages.

Other plant-based foods consumption ranged between 53% of the target for fruits, to only 5% of the recommended intakes for legumes. Red meat and dairy exceeded the recommended intake with dairy higher than other Western European and European countries and red meat lower than sub-regional and regional data. Fish consumption covered almost half of the recommendation, and its consumption is lower than sub-regional and regional data.

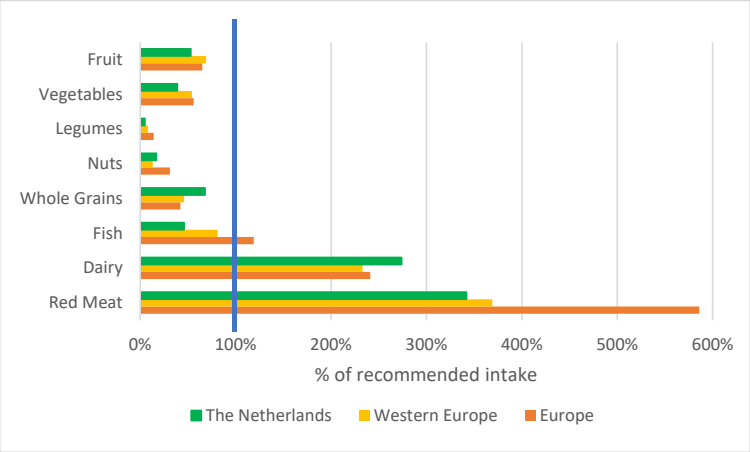


Figure 32 – Food consumption in The Netherlands, Western Europe, and Europe compared against EAT-Lancet minimum target quantity for food groups of health and environmental protection (fruits, vegetables, legumes, nuts, and wholegrains) and maximum acceptable targets for food groups of health and environmental protection (red meat, dairy, and fish). Source: ad hoc elaboration of Global Nutrition Report datasets (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/netherlands/).

Healthiness and sustainability of The Netherlands food consumption: the WISH score

The WISH of Adults in the Netherlands was reported in Figure 33 reaching 26% of the theoretical maximum with a score of 39 out of 150. Healthy sub-WISH and "high environmental impact sub-WISH" were the major contributing to WISH in the Netherlands indicating a certain level of consumption of healthy promoting foods and a limited level of consumption of foods with high environmental impact. In The Netherlands not relevant differences among sexes were found.

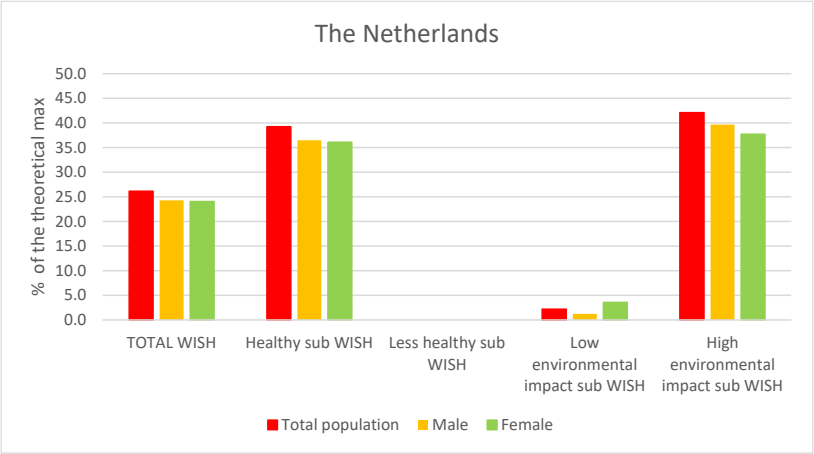


Figure 33 – Total and sub-score WISH of the adults in The Netherlands (total population, male and female).

Scores of the food categories of WISH of Adults in The Netherlands were reported in Table 23. Among the animal food categories, the highest scores (adequate/near-optimal intake) were found for dairy, eggs, and chicken in both sexes and fish only for males. Other animal foods were excessively consumed. Plant-based foods were insufficiently consumed. Alcoholic beverages and added sugars needed to be reduced. Females had better consumption level than males of fruits (1.2 vs 0), chicken (10.0 vs 8.1), and eggs (9.9 vs 7.1) while males had better consumption levels than females of fish (7.7 vs 2.4) and nuts (2.8 vs 1.7).

Table 23: Scores* of each food group/dietary elements used for WISH calculation of Adults in The Netherlands				
Food Groups/Dietary Elements	**Total population**	**Male**	**Female**	**Change for improving WISH**
Whole grains	0	0	0	Increase
Vegetables	0	0	0	Increase
Fruit	0.5	0.0	1.2	Increase
Dairy foods	**10.0**	**10.0**	**10.0**	**Adequate**
Red meat	0	0	0	Reduce
Fish	7.2	7.7	2.4	Increase
Eggs	8.5	7.1	9.9	**Adequate**
Chicken and other poultry	**10.0**	8.1	**10.0**	**Adequate**
Legumes	0.8	0.8	0.9	Increase
Nuts	2.2	2.8	1.7	Increase
Unsaturated oils	0	0	0	Increase
Saturated oils	0	0	0	Reduce
Added sugars	0	0	0	Reduce
Alcoholic beverages	0	0	0	Reduce
Processed meat	0	0	0	Reduce

* A higher score indicates a healthier and more sustainable dietary pattern, for the food groups and dietary elements and for the total and sub-scores. In bold the maximum scores

Nutrition-related health conditions

In terms of public health, The Netherlands showed limited progress toward achieving the diet-related non-communicable disease targets. 22.2% of adult (aged 18 years and over) women and 23.8% of adult men were living with obesity. The Netherlands' obesity prevalence was lower than the regional average of 25.3% for women and 24.9% for men. However, the Netherlands diabetes affected 5.5% of adult men and 3.6% of adult women (https://globalnutritionreport.org/resources/nutrition-profiles/europe/western-europe/netherlands/). The study of (Loyen et al., 2019) reports high levels of total non-occupational sitting time of Dutch adults. On average, participants spent 8.0 hours (61.1%) of their daily waking non-occupational time on sedentary activities. More than 87% of leisure time was spent sedentary. Men, participants aged 18–34 and 65+ years, full-time employed participants, and obese participants had higher levels of total non-occupational sedentary time.

Dietary patterns and socioeconomic conditions

In the Netherlands non-alcoholic beverages, cereal products (especially bread), dairy, and fats and oils were popular food groups and were consumed almost daily. Fish and legumes were consumed once a week or less. In the last five years, consumption of alcoholic beverages, potatoes, fats and oils, dairy products, sugar, and confectionary, and meat (products) has decreased and that of fruit has increased. Women consumed more fruit and non-alcoholic beverages, and men and women consumed similar amounts of vegetables. The composition of the diet differed little among the age groups. However, children consumed relatively more milk and fruit and drank less beverages than adults. In the Netherlands women, people of older age, people who are not overweight, and the better educated follow the guidelines better than men, young adults, and the lower educated. There are not definite differences between regions and between cities and rural areas (van Rossum et al., 2020).

3. Comparative evaluation

Summary of the WISH score and sub-WISH scores in the eleven EU countries and the target groups covered by LLs of the PLAN'EAT project were reported in Figure 34 and Table 24. The WISH score was not calculated for the clinical LL to be carried out in Italy on diabetic adults of low socioeconomic status because, for this group of the population, no data on food consumption were available. However, the population group was mapped according to the existing statistical data and published literature.

At the country level, the highest WISH scores were found in Italy, Spain, Greece, and France, meaning in countries largely characterized by Mediterranean Diet patterns. Sub-scores have different patterns. Italy, Greece, and Spain showed the highest adherence for healthy food consumption ("healthy sub-WISH"); for this sub score the fourth position was for The Netherlands. Ireland, followed by Italy, Greece, and Spain, had the highest figures as far as concerning the adherence to limiting the consumption of less healthy foods ("less healthy sub-WISH"). Ireland, and Poland with Italy and Greece, had the highest adherence for the consumption of low environmental impacting foods ("Low environmental impact sub-WISH"). Greece, Spain, France, and Italy showed better adherence to the limitation of the consumption of highly environmentally impacting foods ("High environmental impact sub-WISH").

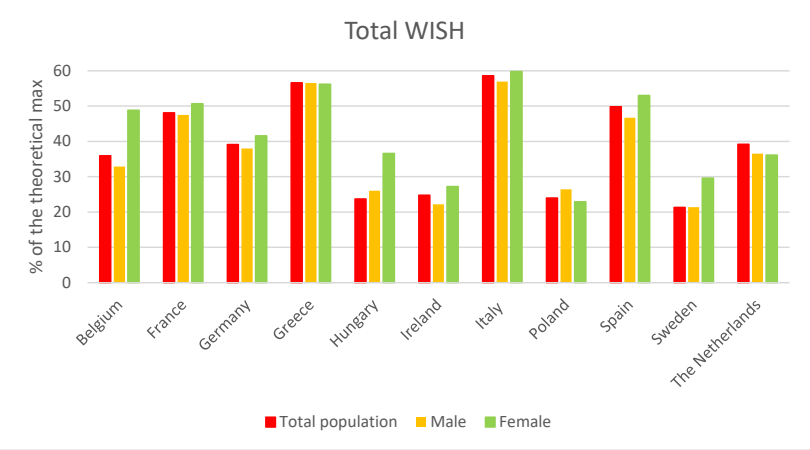


Figure 34 – Total WISH of the adults in the eleven countries of PLAN'EAT (total population, male and female).

Table 24: WISH score in eleven EU countries and nine target groups

Country/LL target group	WISH			Healthy sub-WISH			Less healthy sub-WISH			Low environmental impact sub-WISH			High environmental impact sub-WISH		
	TOT	M	F	TOT	M	F	TOT	M	F	TOT	M	F	TOT	M	F
Belgium	35.9	32.9	48.8	35.9	32.9	38.8	0.0	0.0	10.0	1.3	0.5	2.0	34.6	32.4	46.9
France	48.1	47.5	50.7	38.1	37.5	40.7	10.0	10.0	10.0	5.4	7.4	6.3	42.7	40.1	44.4
France Children (3-9 yrs)	39.9	38.2	41.2	29.9	28.2	31.2	10.0	10.0	10.0	6.1	5.9	6.3	33.8	32.3	34.9
France Adolescents (10-17 yrs)	48.1	47.5	50.7	38.1	37.5	40.7	10.0	10.0	10.0	5.4	7.4	6.3	42.7	40.1	44.4
Germany	39.1	38.0	41.6	39.1	38.0	39.9	0.0	0.0	1.7	5.2	3.3	6.7	33.8	34.7	34.9
Germany Adolescents (10-17 yrs)	32.0	32.9	39.2	31.5	32.3	30.9	0.5	0.6	8.3	2.0	1.9	2.3	30.0	31.0	36.9
Greece	56.6	56.5	56.2	46.6	46.5	46.2	10.0	10.0	10.0	8.3	9.6	9.4	48.3	46.8	46.9
Greece Elderly (> 65 yrs)	44.1	41.6	46.1	34.1	31.6	36.1	10.0	10.0	10.0	1.0	1.0	0.9	43.1	40.6	45.2
Hungary	23.7	26.0	36.6	23.7	26.0	26.6	0.0	0.0	10.0	8.1	10.9	7.1	15.6	15.1	29.5
Hungary Young adults (20–30 yrs)	22.6	25.4	24.9	0.0	0.0	0.0	7.0	9.7	6.8	15.6	15.7	18.1	22.6	25.4	24.9
Ireland	24.8	22.2	27.2	24.8	22.2	27.2	24.8	22.2	27.2	24.8	22.2	27.2	24.8	22.2	27.2
Ireland Young adults (18–30 yrs)	26.2	23.7	28.3	26.2	23.7	28.3	0.0	0.0	0.0	1.4	1.5	1.1	24.8	22.2	27.2
Italy	58.6	56.9	59.8	48.6	46.9	49.8	10.0	10.0	10.0	16.4	19.1	13.9	42.2	37.8	45.9
Poland	24.0	26.4	22.9	24.0	26.4	22.9	0.0	0.0	0.0	13.0	15.2	11.3	11.0	11.2	11.6
Poland Children (3-9 yrs)	30.8	30.8	29.5	20.8	20.8	19.5	10.0	10.0	10.0	10.0	10.0	8.7	20.8	20.8	20.8
Poland Adolescents (10-17 yrs)	24.8	26.5	32.1	24.8	26.5	32.1	0.0	0.0	0.0	11.2	12.7	9.4	13.6	13.8	22.7
Spain	49.8	46.7	53.0	39.8	36.7	43.0	10.0	10.0	10.0	6.2	6.6	5.9	43.6	40.1	47.1
Spain Elderly (> 65 yrs)	59.4	56.7	59.0	49.4	46.7	48.2	10.0	10.0	10.7	11.5	11.7	11.4	47.9	45.0	47.6
Sweden	21.3	21.4	29.6	21.3	21.4	29.6	0.0	0.0	0.0	1.4	1.1	1.7	19.9	20.2	27.9
Sweden Children (3-9 yrs)	46.0	39.9	45.9	36.0	29.9	35.9	10.0	10.0	10.0	1.1	6.1	1.1	45.0	33.8	44.8
The Netherlands	39.2	36.5	36.1	39.2	36.5	36.1	0.0	0.0	0.0	1.3	0.8	2.1	37.9	35.7	33.9

Dark gray cells indicate countries with the HIGHEST WISH AND SUB-WISH.

In Table 25 the direction of changing of the food consumption patterns to achieve a better WISH score in the eleven PLAN'EAT countries was reported. In all assessed countries there was the need to increase plant-based food intake (whole grains, fruit, vegetables, nuts, and legumes). In all countries there is a need of shift the consumption of red and processed meat towards other source of proteins namely chicken, fish, legumes, and nuts. Adequacy of consumption was found for some animal food categories (dairy, fish, eggs, chicken) even not in all countries. Unsaturated oils resulted insufficiently consumed in all countries while saturated oils resulted at an adequate level of consumption in France, Greece, Italy, and Spain. Alcoholic beverages and added sugars need to be reduced in all countries.

Table 25: Direction of changing of intake to obtain higher WISH score in eleven EU countries

Food Groups/Dietary Elements	Belgium	France	Germany	Greece	Hungary	Ireland	Italy	Poland	Spain	Sweden	The Netherlands
Whole grains	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Vegetables	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Fruit	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Dairy foods	Increase	Adequate	Increase	Increase	Adequate	Adequate	Increase	Increase	Adequate	Adequate	Adequate
Red meat	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce
Fish	Adequate	Adequate	Increase	Adequate	Increase	Increase	Adequate	Reduce	Adequate	Increase	Increase
Eggs	Adequate	Increase	Adequate	Adequate	Increase	Increase	Adequate	Reduce	Increase	Increase	Adequate
Chicken and other poultry	Increase	Increase	Adequate	Adequate	Increase	Increase	Increase	Reduce	Increase	Increase	Adequate
Legumes	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Nuts	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Adequate	Increase	Increase	Increase
Unsaturated oils	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase	Increase
Saturated oils	Reduce	Adequate	Reduce	Adequate	Reduce	Reduce	Adequate	Reduce	Adequate	Reduce	Reduce
Added sugars	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce
Alcoholic beverages	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce
Processed meat	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce	Reduce

European regional differences of total and sub-score WISH were showed in Figure 35. European subregions were defined according to the geographical classification of the Global Nutrition Report (https://globalnutritionreport.org/) since Southern Europe includes Italy, Spain, and Greece, Eastern Europe includes Hungary and Poland, Northern Europe includes Sweden and Ireland, and Western Europe includes Belgium, France, Germany, and The Netherlands. In the nine PLAN'EAT countries, a South-West gradient of adherence to recommendations was found for total WISH and sub-scores. Particularly high sub-WISH was found as far as concerning the adherence to the consumption of healthy foods and to limits the consumption of highly impacting foods.

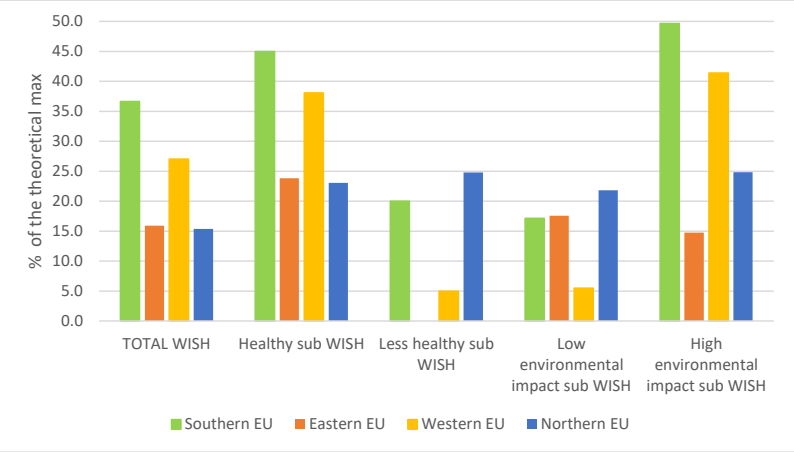


Figure 35 – Total and sub-score WISH of Adults in European Sub-Regions

In terms of population groups, the highest WISH scores were found in the elderly both in Spain and Greece and children in France and Sweden. Elderly (in Spain and Greece), children in Sweden, and adolescents in France showed the highest healthy sub-WISH score. Children in Poland and France, elderly in Greece and adolescents in France had the highest adherence to the limitation of the consumption of unhealthy foods. The recommendation to consume low environmental impacting foods was followed in particular by young adults in Hungary, by the elderly in Spain, and by children and adolescents in Poland. The limitation of consumption of high environmentally impacting foods was followed in particular by the elderly in Spain and Greece, by children in Sweden, and by adolescents in France (Table 24).

WISH of children in France, Sweden, and Poland was reported in Figure 36 showing that Sweden had higher indicators than other countries in which this age group was assessed. Among the three countries analyzed a similar profile was observed for total WISH and sub-scores.

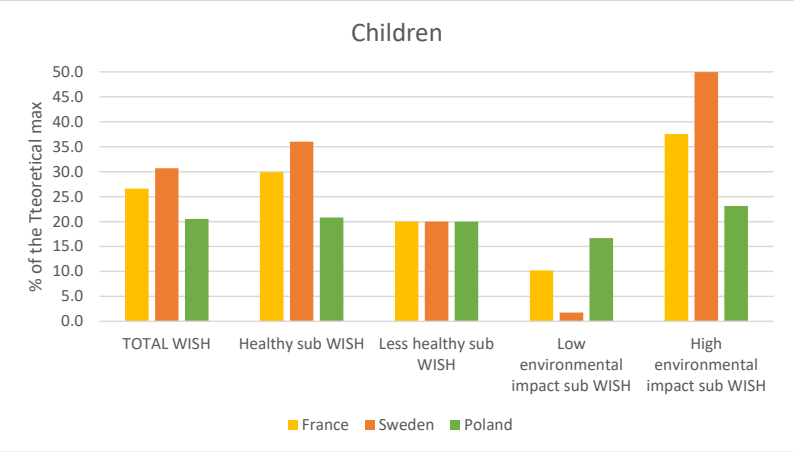


Figure 36 – Total and sub-score WISH of Children in France, Sweden, and Poland.

To achieve better WISH in children in France, Poland, and Sweden it should be increase the consumption of plant-based foods and reduce the intake of red and processed meat, added sugars and sugary beverages. Children food intake in Sweden resulted adequate for 4 food groups (dairy, eggs, chicken, and saturated oils; in Poland adequacy was found for 3 groups (fish, legumes and saturated oils); in France adequacy was found for 2 groups (dairy and saturated oils) (Table 26).

Table 26: Direction of changing of intake to obtain higher WISH score in children in France, Poland, and Sweden			
Food Groups/Dietary Elements	**France**	**Poland**	**Sweden**
Whole grains	Increase	Increase	Increase
Vegetables	Increase	Increase	Increase
Fruit	Increase	Increase	Increase
Dairy foods	Adequate	Increase	Adequate
Red meat	Reduce	Reduce	Reduce
Fish	Increase	Adequate	Increase
Eggs	Increase	Reduce	Adequate
Chicken and other poultry	Reduce	Reduce	Adequate
Legumes	Increase	Adequate	Increase
Nuts	Increase	Increase	Increase
Unsaturated oils	Increase	Increase	Increase
Saturated oils	Adequate	Adequate	Adequate
Added sugars	Reduce	Reduce	Reduce
Sugary beverages	Reduce	Reduce	Reduce
Processed meat	Reduce	Reduce	Reduce

Adolescents were assessed in France, Germany, and Poland (Figure 37) with France showing the highest WISH and Sub scores than other countries.

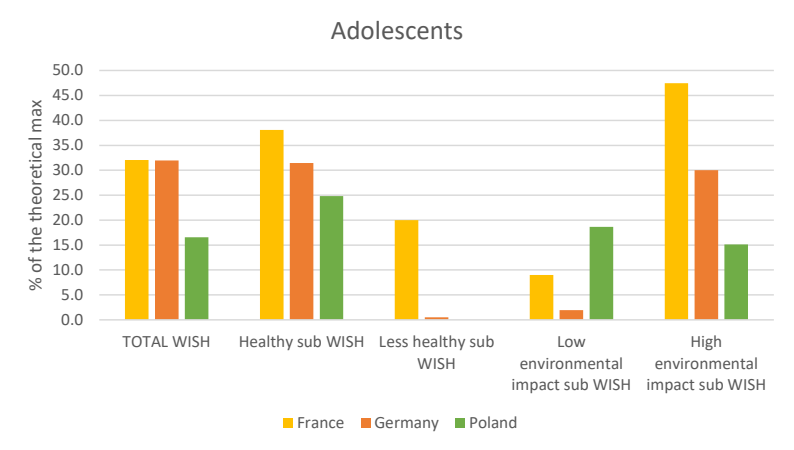


Figure 37 – Total and sub-score WISH of Adolescents in France, Germany, and Poland

To achieve better WISH in adolescents in France, German, and Poland it should be increase the consumption of plant-based foods and reduce the intake of red and processed meat, added sugars and alcoholic beverages. Adolescent food intake in France resulted adequate for 3 food groups (dairy, eggs, and saturated oils; in Germany adequacy was found for 2 groups (eggs and chicken); in Poland adequacy was found for 2 groups (fish and nuts) (Table 27).

Table 27: Direction of changing of intake to obtain higher WISH score in Adolescents in France, Germany, and Poland			
Food Groups/Dietary Elements	**France**	**Germany**	**Poland**
Whole grains	Increase	Increase	Increase
Vegetables	Increase	Increase	Increase
Fruit	Increase	Increase	Increase
Dairy foods	Adequate	Increase	Increase
Red meat	Reduce	Reduce	Reduce
Fish	Increase	Increase	Adequate
Eggs	Adequate	Adequate	Reduce
Chicken and other poultry	Reduce	Adequate	Reduce
Legumes	Increase	Increase	Increase
Nuts	Increase	Increase	Adequate
Unsaturated oils	Increase	Increase	Increase
Saturated oils	Adequate	Reduce	Increase
Added sugars	Reduce	Reduce	Reduce
Sugary beverages	Reduce	Reduce	Reduce
Processed meat	Reduce	Reduce	Reduce

In Figure 38, WISH of young adults in Hungary and Ireland was reported; slightly higher values in Ireland to Hungary were found.

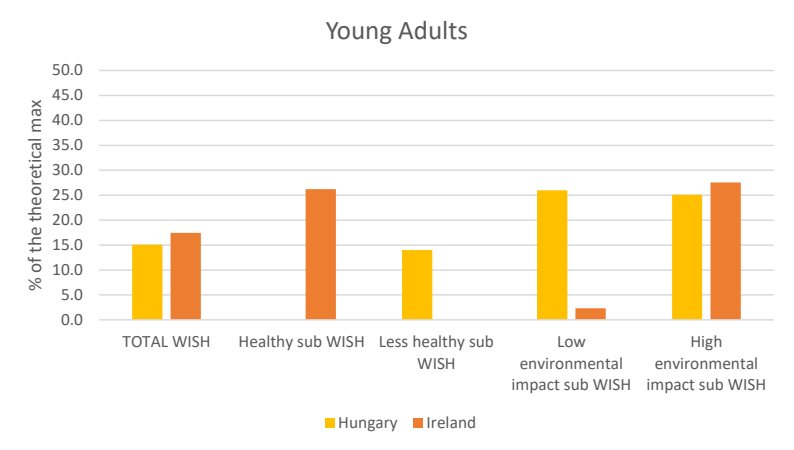


Figure 38 – Total and sub-score WISH of Young Adults in Hungary and Ireland

To achieve better WISH in young adults in Hungary and Ireland it should be increase the consumption of plant-based foods and reduce the intake of red and processed meat, added sugars and sugary beverages. Healthy and less impacting protein sources (fish, eggs, chicken, and legumes) should be increased. Young Adults' food intake was adequate only for dairy in Hungary and Ireland (Table 28).

Table 28: Direction of changing of intake to obtain higher WISH score in Young Adults in Hungary and Ireland		
Food Groups/Dietary Elements	**Hungary**	**Ireland**
Whole grains	Increase	Increase
Vegetables	Increase	Increase
Fruit	Increase	Increase
Dairy foods	Adequate	Adequate
Red meat	Reduce	Reduce
Fish	Increase	Increase
Eggs	Increase	Increase
Chicken and other poultry	Increase	Increase
Legumes	Increase	Increase
Nuts	Increase	Increase
Unsaturated oils	Increase	Increase
Saturated oils	Reduce	Reduce
Added sugars	Reduce	Reduce
Sugary beverages	Reduce	Reduce
Processed meat	Reduce	Reduce

The elderly was the age group showing better results in terms of WISH with values higher in Spain than in Greece (Figure 39) corresponding to a better adherence to traditional Spanish and Greek Mediterranean diet.

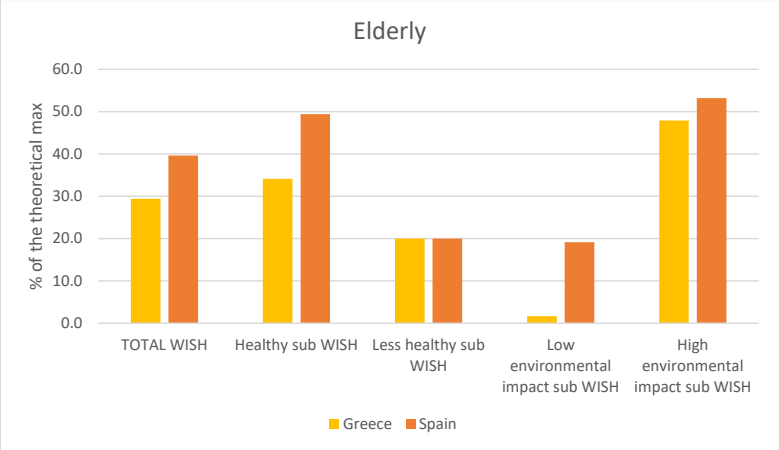


Figure 39 – Total and sub-score WISH of the Elderly in Greece and Spain

To achieve better WISH in Elderly in Greece and Spain it should be increase the consumption of whole grains, vegetables, legumes, and nuts and reduce the intake of red and processed meat, added sugars and alcoholic beverages. Elderly food intake in Spain resulted adequate for 5 food groups (fruit, dairy, fish, chicken, and saturated oils; in Greece adequacy was found for 4 groups (dairy, fish, eggs, and saturated oils) (Table 29).

Table 29: Direction of changing of intake to obtain higher WISH score in Elderly in Greece and Spain		
Food Groups/Dietary Elements	**Greece**	**Spain**
Whole grains	Increase	Increase
Vegetables	Increase	Increase
Fruit	Increase	Adequate
Dairy foods	Adequate	Adequate
Red meat	Reduce	Reduce
Fish	Adequate	Adequate
Eggs	Adequate	Increase
Chicken and other poultry	Increase	Adequate
Legumes	Increase	Increase
Nuts	Increase	Increase
Unsaturated oils	Increase	Increase
Saturated oils	Adequate	Adequate
Added sugars	Reduce	Reduce
Alcoholic beverages	Reduce	Reduce
Processed meat	Reduce	Reduce

Conclusions and next steps

The dietary mapping of the EU countries included in the PLAN'EAT project, and the target groups of the LLs provide an interesting overview of similarities and differences among countries and population groups. South and Western (in particular France) European countries showed better total WISH scores than Eastern and Northern European countries. This finding is related to the similarities between Mediterranean diet principles and EAT-Lancet recommendations on which WISH is based especially in terms of the proportion of plant-based foods in the diet. Overall, females have a better dietary pattern than males both concerning health aspects and environmental protection characteristics. Among population groups, the elderly in southern European countries have the highest total WISH score. This finding is of interest and could be interpreted as an element of better adherence to traditional Spanish and Greek Mediterranean diet close to the boundaries of the Planetary Diet especially as far as concerning the high proportion of plant-based foods. In addition to that it should be considered that elderly people are often affected by non-communicable diseases that require the control of their diets, an occurrence that could explain the better dietary pattern of this age group. Children have better dietary patterns than adolescents and young adults in the analysed countries. This finding could be explained considering that children eating habits were more under the parents' control and less exposed to external inputs (e.g., peers' or social media influence) (Sina et al., 2022).

This work has strengths and weaknesses. The main strength is the use of national representative EFSA food consumption data bases that guaranteed representativeness and comparability of the results. In addition to the secondary analysis of data collected at the EU level for the purposes of the PLAN'EAT project represents a capitalization of EU efforts and resources. Another strength of the work is the application of the WISH indicator that is simple and does not rely on measurements not widely available and could be used with a cross-cutting approach to overcome the differences in the recommendations at the national level. Weaknesses of the present work are related to the fact that the EFSA datasets include surveys carried out decades ago, e.g., Poland in 2000. The coverage of target groups presents some shortcomings related to the lack of complete congruence among the EFSA age classes and the age classes as defined in the LLs activities. Another aspect that is a strength and a weakness at the same time was related to the fact that WISH is a new indicator not widely applied. Even though for diet quality indexes the best validation is their application in different contexts and settings. The positive issue of this is the novelty, the negative is the

lack of the possibility of further comparison out of the present evaluation. For the first time, WHISH was applied in population groups of different classes of age, an aspect that would deserve future reflection.

The present EU dietary pattern mapping needs to be considered as a step of several further elaborations. Once access to the comprehensive EFSA database with all raw data will be completed most detailed information with the possibility of crossing the food consumption data with socio-demographic variables could be further carried out.

The indexes proposed in the present deliverable represents the first exercise that could be further implemented for a harmonized system to assess the level of adherence to recommendations of the dietary pattern of a country or a group of the population including the recommendations on health and environmental aspects. A further evolution of this work will be the use of diet quality indexes different from WISH (e.g., Healthy eating index, adherence to EAT-Lancet diet, etc.) to provide a fine-tuning of the mapping. Finally, the matching of the food consumption data by EFSA with the food composition data by the European Food Information Resources (EUROFIR) network datasets (https://www.eurofir.org/) will facilitate comprehensive EU dietary mapping, encompassing nutrient intake as well. The matching between food consumption data and food composition data is a complex exercise that, however, would represent an important cornerstone for the use of food consumption datasets.

References

Afshin, A., Sur, P.J., Fay, K.A., Cornaby, L., Ferrara, G., Salama, J.S., Mullany, E.C., Abate, K.H., Abbafati, C., Abebe, Z., Afarideh, M., Aggarwal, A., Agrawal, S., Akinyemiju, T., Alahdab, F., Bacha, U., Bachman, V.F., Badali, H., Badawi, A., Bensenor, I.M., Bernabe, E., Biadgilign, S.K.K., Biryukov, S.H., Cahill, L.E., Carrero, J.J., Cercy, K.M., Dandona, L., Dandona, R., Dang, A.K., Degefa, M.G., El Sayed Zaki, M., Esteghamati, A., Esteghamati, S., Fanzo, J., Farinha, C.S.E.S., Farvid, M.S., Farzadfar, F., Feigin, V.L., Fernandes, J.C., Flor, L.S., Foigt, N.A., Forouzanfar, M.H., Ganji, M., Geleijnse, J.M., Gillum, R.F., Goulart, A.C., Grosso, G., Guessous, I., Hamidi, S., Hankey, G.J., Harikrishnan, S., Hassen, H.Y., Hay, S.I., Hoang, C.L., Horino, M., Ikeda, N., Islami, F., Jackson, M.D., James, S.L., Johansson, L., Jonas, J.B., Kasaeian, A., Khader, Y.S., Khalil, I.A., Khang, Y.-H., Kimokoti, R.W., Kokubo, Y., Kumar, G.A., Lallukka, T., Lopez, A.D., Lorkowski, S., Lotufo, P.A., Lozano, R., Malekzadeh, R., März, W., Meier, T., Melaku, Y.A., Mendoza, W., Mensink, G.B.M., Micha, R., Miller, T.R., Mirarefin, M., Mohan, V., Mokdad, A.H., Mozaffarian, D., Nagel, G., Naghavi, M., Nguyen, C.T., Nixon, M.R., Ong, K.L., Pereira, D.M., Poustchi, H., Qorbani, M., Rai, R.K., Razo-García, C., Rehm, C.D., Rivera, J.A., Rodríguez-Ramírez, S., Roshandel, G., Roth, G.A., Sanabria, J., Sánchez-Pimienta, T.G., Sartorius, B., Schmidhuber, J., Schutte, A.E., Sepanlou, S.G., Shin, M.-J., Sorensen, R.J.D., Springmann, M., Szponar, L., Thorne-Lyman, A.L., Thrift, A.G., Touvier, M., Tran, B.X., Tyrovolas, S., Ukwaja, K.N., Ullah, I., Uthman, O.A., Vaezghasemi, M., Vasankari, T.J., Vollset, S.E., Vos, T., Vu, G.T., Vu, L.G., Weiderpass, E., Werdecker, A., Wijeratne, T., Willett, W.C., Wu, J.H., Xu, G., Yonemoto, N., Yu, C., Murray, C.J.L., 2019. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 393, 1958–1972. https://doi.org/10.1016/S0140-6736(19)30041-8

Aida, T., Cinzia, L.D., Raffaela, P., Laura, D., Lorenza, M., Stefania, S., Deborah, M., Javier, C.A.F., Marika, F., Giovina, C., 2022. Italian national dietary survey on adult population from 10 up to 74 years old – IV SCAI ADULT. EFS3 19. https://doi.org/10.2903/sp.efsa.2022.EN-7559

Antonia, T., Philippos, O., Elisavet, V., Georgia, M., Eleni, P., A, A., E, A., M, K., Maria, K., M, P., P, V., G, Z., Androniki, N., 2018. The EFSA-funded collection of dietary and related data in the general population aged 10-74 years in Greece. EFS3 15. https://doi.org/10.2903/sp.efsa.2018.EN-1499

Aureli, V., Rossi, L., 2022. Nutrition Knowledge as a Driver of Adherence to the Mediterranean Diet in Italy. Front. Nutr. 9, 804865. https://doi.org/10.3389/fnut.2022.804865

Ax, E., Warensjö Lemming, E., Becker, W., Andersson, A., Lindroos, A.K., Cederholm, T., Sjögren, P., Fung, T.T., 2016. Dietary patterns in Swedish adults; results from a national dietary survey. Br J Nutr 115, 95–104. https://doi.org/10.1017/S0007114515004110

Bácsné Bába, É., Ráthonyi, G., Müller, A., Ráthonyi-Odor, K., Balogh, P., Ádány, R., Bács, Z., 2020. Physical Activity of the Population of the Most Obese Country in Europe, Hungary. Front. Public Health 8, 203. https://doi.org/10.3389/fpubh.2020.00203

Bakucs, Z., Fertő, I., Marreiros, C.G., 2014. Socio-Economic Status and the Structural Change of Dietary Intake in Hungary. Acta Universitatis Sapientiae, Economics and Business 2, 5–19. https://doi.org/10.2478/auseb-2014-0007

Bamia, C., Orfanos, P., Ferrari, P., Overvad, K., Hundborg, H.H., Tjønneland, A., Olsen, A., Kesse, E., Boutron-Ruault, M.-C., Clavel-Chapelon, F., Nagel, G., Boffetta, P., Boeing, H., Hoffmann, K., Trichopoulos, D., Baibas, N., Psaltopoulou, T., Norat, T., Slimani, N., Palli, D., Krogh, V., Panico, S., Tumino, R., Sacerdote, C., Bueno-de-Mesquita, H.B., Ocké, M.C., Peeters, P.H., Van Rossum, C.T., Quirós, J.-R., Sánchez, M.-J., Navarro, C., Barricarte, A., Dorronsoro, M., Berglund, G., Wirfält, E., Hallmans, G., Johansson, I., Bingham, S., Khaw, K.-T., Spencer, E.A., Roddam, A.W., Riboli, E., Trichopoulou, A., 2005.

Dietary patterns among older Europeans: the EPIC-Elderly study. Br J Nutr 94, 100–113. https://doi.org/10.1079/BJN20051456

Baxter, A.J., Coyne, T., McClintock, C., 2006. Dietary patterns and metabolic syndrome--a review of epidemiologic evidence. Asia Pac J Clin Nutr 15, 134–142.

Berdzuli, N., Ferreira-Borges, C., Gual, A., Rehm, J., 2020. Alcohol Control Policy in Europe: Overview and Exemplary Countries. IJERPH 17, 8162. https://doi.org/10.3390/ijerph17218162

Berglind, D., Tynelius, P., 2018. Objectively measured physical activity patterns, sedentary time and parent-reported screen-time across the day in four-year-old Swedish children. BMC Public Health 18, 69. https://doi.org/10.1186/s12889-017-4600-5

Bibiloni, M., Julibert, A., Argelich, E., Aparicio-Ugarriza, R., Palacios, G., Pons, A., Gonzalez-Gross, M., Tur, J., 2017. Western and Mediterranean Dietary Patterns and Physical Activity and Fitness among Spanish Older Adults. Nutrients 9, 704. https://doi.org/10.3390/nu9070704

Biernat, E., Piątkowska, M., 2023. Sedentary behaviour as a lifestyle risk factor in public health – Evidence of white-collar and blue-collar workers from Poland. Ann Agric Environ Med. https://doi.org/10.26444/aaem/165980

Bucksch, J., Häußler, A., Finne, E., Schmidt, K., Dadacynski, K., Sudeck, G., 2020. Physical activity and dietary habits of older children and adolescents in Germany – Cross-sectional results of the 2017/18 HBSC study and trends. https://doi.org/10.25646/6900

Burke, D.T., Bennett, A.E., Hynds, P., Priyadarshini, A., 2023. Identifying Novel Data-Driven Dietary Patterns via Dimensionality Reduction and Associations with Socioeconomic Profile and Health Outcomes in Ireland. Nutrients 15, 3256. https://doi.org/10.3390/nu15143256

Clark, M.A., Springmann, M., Hill, J., Tilman, D., 2019. Multiple health and environmental impacts of foods. Proc. Natl. Acad. Sci. U.S.A. 116, 23357–23362. https://doi.org/10.1073/pnas.1906908116

Costarelli, V., Sdrali, D., Konstantopoulou, A., 2013. Mediterranean diet and socio-economic status in Greek adolescents. Nutrition & Food Science 43, 535–542. https://doi.org/10.1108/NFS-04-2012-0037

Csabai J, Szabó B, Kosztyuné Krajnyák E, Szabóné Berta O, Hörcsik ZT. The current state of vegetarianism in hungary, its possible effects on the agricultural structure and the food system. South Western Journal of Horticulture, Biology and Environment 2022; 13 (1). Availble at: https://biozoojournals.ro/swjhbe/v13n1/swjhbe_e22103_Csabai.pdf (accessed on 2 August 2023), n.d.

Czarnocinska, J., Wadolowska, L., Lonnie, M., Kowalkowska, J., Jezewska-Zychowicz, M., Babicz-Zielinska, E., 2020. Regional and socioeconomic variations in dietary patterns in a representative sample of young polish females: a cross-sectional study (GEBaHealth project). Nutr J 19, 26. https://doi.org/10.1186/s12937-020-00546-8

Dalla Zuanna, T., Cacciani, L., Barbieri, G., Ferracin, E., Zengarini, N., Di Girolamo, C., Caranci, N., Petrelli, A., Marino, C., Agabiti, N., Canova, C., 2020. Avoidable hospitalisation for diabetes mellitus among immigrants and natives: Results from the Italian Network for Longitudinal Metropolitan Studies. Nutrition, Metabolism and Cardiovascular Diseases 30, 1535–1543. https://doi.org/10.1016/j.numecd.2020.05.006

De Boer, J., Aiking, H., 2022. Do EU consumers think about meat reduction when considering to eat a healthy, sustainable diet and to have a role in food system change? Appetite 170, 105880. https://doi.org/10.1016/j.appet.2021.105880

De Ridder K. Rapport 3 : Activité physique et sédentarité. Résumé des principaux résultats. In : Lebacq T & Teppers E (ed.). Enquête de consommation alimentaire 2014-2015. WIV-ISP, Bruxelles, 2016., n.d.

Desbouys, L., De Ridder, K., Rouche, M., Castetbon, K., 2019. Food Consumption in Adolescents and Young Adults: Age-Specific Socio-Economic and Cultural Disparities (Belgian Food Consumption Survey 2014). Nutrients 11, 1520. https://doi.org/10.3390/nu11071520

Diabetes in Italy Years 2000-2016. ISTAT, 2017. Availble at: https://www.istat.it/it/files/2017/07/Report_Diabetes_En_def.pdf (accessed on 2 August 2023), n.d.

Drygas, W., Kwaśniewska, M., Kaleta, D., Ruszkowska-Majzel, J., 2008. Increasing recreational and leisure time physical activity in Poland–how to overcome barriers of inactivity. J Public Health 16, 31–36. https://doi.org/10.1007/s10389-007-0151-z

Dubuisson, C., Dufour, A., Carrillo, S., Drouillet-Pinard, P., Havard, S., Volatier, J.-L., 2019. The Third French Individual and National Food Consumption (INCA3) Survey 2014–2015: method, design and participation rate in the framework of a European harmonization process. Public Health Nutr. 22, 584–600. https://doi.org/10.1017/S1368980018002896

Dupuy, M., Godeau, E., Vignes, C., Ahluwalia, N., 2011. Socio-demographic and lifestyle factors associated with overweight in a representative sample of 11-15 year olds in France: Results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) cross-sectional study. BMC Public Health 11, 442. https://doi.org/10.1186/1471-2458-11-442

Erdélyi-Sipos A., Badacsonyiné Kassai K., Kubányi J., Szűcs Z., Biró L., Raposa L.B., 2019. 0–3 éves korú csecsemők és kisdedek táplálkozási szokásainak felmérése, különös tekintettel a makro- és mikronutriens-bevitelre. Orvosi Hetilap 160, 1990–1998. https://doi.org/10.1556/650.2019.31585

European Food Safety Authority, 2014. Guidance on the EU Menu methodology. EFS2 12. https://doi.org/10.2903/j.efsa.2014.3944

European Food Safety Authority, 2011. Use of the EFSA Comprehensive European Food Consumption Database in Exposure Assessment. EFS2 9. https://doi.org/10.2903/j.efsa.2011.2097

Fedeli, U., Casotto, V., Ferroni, E., Saugo, M., Targher, G., Zoppini, G., 2015. Prevalence of diabetes across different immigrant groups in North-eastern Italy. Nutrition, Metabolism and Cardiovascular Diseases 25, 924–930. https://doi.org/10.1016/j.numecd.2015.06.010

Forouhi, N.G., Misra, A., Mohan, V., Taylor, R., Yancy, W., 2018. Dietary and nutritional approaches for prevention and management of type 2 diabetes. BMJ k2234. https://doi.org/10.1136/bmj.k2234

French Agency for Food, Environmental, and Occupational Health & Safety (ANSES). Opinion of the French Agency for Food, Environmental and Occupational Health & Safety on "the Third Individual and National Survey on Food Consumption (INCA3 survey)". Maisons-Alfort (France): ANSES; 2017. Available at: https://www.anses.fr/en/system/files/NUT2014SA0234EN.pdf. (accessed on 2 August 2023), n.d.

Garemo, M., Arvidsson Lenner, R., Karlge Nilsson, E., Borres, M.P., Strandvik, B., 2007. Food choice, socio-economic characteristics and health in 4-year olds in a well-educated urban Swedish community. Clinical Nutrition 26, 133–140. https://doi.org/10.1016/j.clnu.2006.07.005

Gil, Á., 2015. Indicadores de evaluación de la calidad de la dieta. NUTRICION HOSPITALARIA 128–144. https://doi.org/10.3305/nh.2015.31.sup3.8761

González-Gil, E.M., Martínez-Olivan, B., Widhalm, K., Lambrinou, C.P., Henauw de, S., Gottrand, F., Kafatos, A., Beghin, L., Molnar, D., Kersting, M., Leclercq, C., Sjöström, M., Fosner, M., González-Gross, M., Breidenassel, C., Castillo, M.J., Dallongeville, J., Rodríguez, G., Moreno, L.A., 2019. Healthy eating determinants and dietary patterns in European adolescents: the HELENA study. Child and Adolescent Obesity 2, 18–39. https://doi.org/10.1080/2574254X.2019.1615361

Hagman, E., Danielsson, P., Lindberg, L., Marcus, C., the BORIS Steering Committee, 2020. Paediatric obesity treatment during 14 years in Sweden: Lessons from the Swedish Childhood Obesity Treatment Register—BORIS. Pediatric Obesity 15. https://doi.org/10.1111/ijpo.12626

Hellenic Statistical Authority, Health determinants: year 2014. Available at: https://www.statistics.gr/documents/20181/986574/Health+determinants+%28nutrition%2C+smoking%2C+physical+activity%2C+etc.%29+%28+2014+%29.pdf/1bcf40c9-284e-4440-a74e-6c32da37862b?version=1.0&t=1465991292093&download=true (Accessed on 28 July 2023), n.d.

Heuer, T., Krems, C., Moon, K., Brombach, C., Hoffmann, I., 2015. Food consumption of adults in Germany: results of the German National Nutrition Survey II based on diet history interviews. Br J Nutr 113, 1603–1614. https://doi.org/10.1017/S0007114515000744

Irish Universities Nutrition Alliance. National Adult Nutrition Survey (2011). Available at: https://irp-cdn.multiscreensite.com/46a7ad27/files/uploaded/The%20National%20Adult%20Nutrition%20Survey%20Summary%20Report%20March%202011.pdf (accessed on 31 July 2023), n.d.

Jones, A.D., Hoey, L., Blesh, J., Miller, L., Green, A., Shapiro, L.F., 2016. A Systematic Review of the Measurement of Sustainable Diets. Advances in Nutrition 7, 641–664. https://doi.org/10.3945/an.115.011015

Katsarou, A., Tyrovolas, S., Psaltopoulou, T., Zeimbekis, A., Tsakountakis, N., Bountziouka, V., Gotsis, E., Metallinos, G., Polychronopoulos, E., Lionis, C., Panagiotakos, D., 2010. Socio-economic status, place of residence and dietary habits among the elderly: the Mediterranean islands study. Public Health Nutr. 13, 1614–1621. https://doi.org/10.1017/S1368980010000479

Kostakis, I., Paparas, D., Saiti, A., Papadaki, S., 2020. Food Consumption within Greek Households: Further Evidence from a National Representative Sample. Economies 8, 17. https://doi.org/10.3390/economies8010017

Kosti, R.I., Kanellopoulou, A., Notara, V., Antonogeorgos, G., Rojas-Gil, A.P., Kornilaki, E.N., Lagiou, A., Panagiotakos, D.B., 2021. Household food spending, parental and childhood's diet quality, in financial crisis: a cross-sectional study in Greece. European Journal of Public Health 31, 822–828. https://doi.org/10.1093/eurpub/ckab076

Krusinska, B., Kowalkowska, J., Wadolowska, L., Wuenstel, J., Slowinska, M., Niedzwiedzka, E., 2017. Fibre-Related Dietary Patterns: Socioeconomic Barriers to Adequate Fibre Intake in Polish Adolescents. A Short Report. Nutrients 9, 590. https://doi.org/10.3390/nu9060590

Latorre, J.A., Abellan, C., Lopez-Moro, A., Gimenez-Blasi, N., Conde-Pipo, J., Mariscal-Arcas, M., 2023. Review of the Nutritional Status in Older Adult Population. OBM Geriatr 07, 1–18. https://doi.org/10.21926/obm.geriatr.2301224

León-Muñoz, L.M., Guallar-Castillón, P., Graciani, A., López-García, E., Mesas, A.E., Aguilera, M.T., Banegas, J.R., Rodríguez-Artalejo, F., 2012. Adherence to the Mediterranean Diet Pattern Has Declined in Spanish Adults3. The Journal of Nutrition 142, 1843–1850. https://doi.org/10.3945/jn.112.164616

Listorti, E., Torbica, A., Cella, S.G., Fiorini, G., Corrao, G., Franchi, M., 2023. A Cohort Study on Diabetic Undocumented Migrants in Italy: Can Charitable Organizations Contribute to Higher Adherence? IJERPH 20, 2794. https://doi.org/10.3390/ijerph20042794

Loyen, A., Chau, J.Y., Jelsma, J.G.M., Van Nassau, F., Van Der Ploeg, H.P., 2019. Prevalence and correlates of domain-specific sedentary time of adults in the Netherlands: findings from the 2006 Dutch time use survey. BMC Public Health 19, 538. https://doi.org/10.1186/s12889-019-6764-7

Malczyk, E., 2016. Nutritional status of children and youth in Poland on basis of literature from last ten years (2005–2015). Ann. Acad. Med. Siles. 70, 56–65. https://doi.org/10.18794/aams/58971

Mannocci, A., Ramirez, A., Masala, D., De Vito, E., Villari, P., La Torre, G., Hallal, P., 2022. taly physical activity country profile: results from the first set of country cards of the Global Observatory for Physical Activity-GoPA! ebph 12. https://doi.org/10.2427/11649

Marchesini, G., Gibertoni, D., Giansante, C., Perlangeli, V., Grilli, R., Scudeller, L., Descovich, C., Pandolfi, P., 2023. Impact of migration on diabetes burden: audit in the metropolitan area of Bologna, Italy. J Endocrinol Invest. https://doi.org/10.1007/s40618-023-02157-6

Marcos, S.V., Rubio, M.J., Sanchidrián, F.R., de Robledo, D., 2016. Spanish National dietary survey in adults, elderly and pregnant women. EFS3 13. https://doi.org/10.2903/sp.efsa.2016.EN-1053

Martimianaki, G., Peppa, E., Valanou, E., Papatesta, E.M., Klinaki, E., Trichopoulou, A., 2022. Today's Mediterranean Diet in Greece: Findings from the National Health and Nutrition Survey—HYDRIA (2013–2014). Nutrients 14, 1193. https://doi.org/10.3390/nu14061193

McCartney, D.M.A., Younger, K.M., Walsh, J., O'Neill, M., Sheridan, C., Kearney, J.M., 2013. Socio-economic differences in food group and nutrient intakes among young women in Ireland. Br J Nutr 110, 2084–2097. https://doi.org/10.1017/S0007114513001463

Mertens, E., Peñalvo, J.L., 2023. Mapping the nutritional value of diets across Europe according to the Nutri-Score front-of-pack label. Front. Nutr. 9, 1080858. https://doi.org/10.3389/fnut.2022.1080858

Miregård, J., Nowicka, P., Nylander, C., 2023. National data showed an increased prevalence of overweight and obesity among four-year-old Swedish children during the first year of COVID -19. Acta Paediatrica 112, 1269–1274. https://doi.org/10.1111/apa.16707

Naska, A., Fouskakis, D., Oikonomou, E., Almeida, M.D.V., Berg, M.A., Gedrich, K., Moreiras, O., Nelson, M., Trygg, K., Turrini, A., Remaut, A.M., Volatier, J.L., Trichopoulou, A., and DAFNE participants, 2006. Dietary patterns and their socio-demographic determinants in 10 European countries: data from the DAFNE databank. Eur J Clin Nutr 60, 181–190. https://doi.org/10.1038/sj.ejcn.1602284

National Food Chain Safety Office, Hungary, Csizmadia, K., Larnsak, L., Pfaff, N., Sali, J., 2020. Hungarian national food consumption survey on adults. EFS3 17. https://doi.org/10.2903/sp.efsa.2020.EN-1981

Pérez-Rodrigo, C., Gianzo Citores, M., Hervás Bárbara, G., Aranceta-Bartrina, J., 2022. Prevalence of obesity and abdominal obesity in Spanish population aged 65 years and over: ENPE study. Medicina Clínica (English Edition) 158, 49–57. https://doi.org/10.1016/j.medcle.2020.10.026

Piombo, L., Nicolella, G., Barbarossa, G., Tubili, C., Pandolfo, M.M., Castaldo, M., Costanzo, G., Mirisola, C., Cavani, A., 2020. Outcomes of Culturally Tailored Dietary Intervention in the North African and Bangladeshi Diabetic Patients in Italy. IJERPH 17, 8932. https://doi.org/10.3390/ijerph17238932

Richter, A., Heidemann, C., Schulze, M.B., Roosen, J., Thiele, S., Mensink, G.B., 2012. Dietary patterns of adolescents in Germany - Associations with nutrient intake and other health related lifestyle characteristics. BMC Pediatr 12, 35. https://doi.org/10.1186/1471-2431-12-35

Riksmaten adults 2010-2011 - Survey. Food and nutritional intake among adults in Sweden. Available at: https://www.livsmedelsverket.se/globalassets/publikationsdatabas/rapporter/2011/riksmaten_2010_20111.pdf (accessed on 2 August 2023), n.d.

Riksmaten children 2003: dietary habits and nutrient intake in Swedish school children in grade 2 and 5. Available at: https://snd.gu.se/en/catalogue/dataset/ext0096-2 (accessed on 2 August 2023), n.d.

Robert Koch-Institut, 2018. Overweight and obesity among children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends. https://doi.org/10.17886/RKI-GBE-2018-022.2

Rossi, L., Martone, D., Piccinelli, R., Buonocore, P., Ghiselli, A., the Working Group on Pediatric Nutrition of Italian Dietary Guidelines, 2022. Considerations for the translation of nutrient recommendations as dietary plans for infants, children, and adolescents as reported in Italian Guidelines for healthy eating. Front. Nutr. 9, 935963. https://doi.org/10.3389/fnut.2022.935963

Sandri, E., Cantín Larumbe, E., Cerdá Olmedo, G., 2023. The Influence of Socio-Economic Factors on Diet and Active Lifestyle in the Spanish Female Population. Nutrients 15, 3319. https://doi.org/10.3390/nu15153319

Scientific Institute of Public Health, Belgium, Bel, S. & De Ridder, K. 2018. Belgian national food consumption survey in children. EFSA supporting publication 2018:EN-1467. 26pp.doi:10.2903/sp.efsa.2018.EN-1467, n.d.

Seconda, L., Baudry, J., Pointereau, P., Lacour, C., Langevin, B., Hercberg, S., Lairon, D., Allès, B., Kesse-Guyot, E., 2019. Development and validation of an individual sustainable diet index in the NutriNet-Santé study cohort. Br J Nutr 121, 1166–1177. https://doi.org/10.1017/S0007114519000369

Sina, E., Boakye, D., Christianson, L., Ahrens, W., Hebestreit, A., 2022. Social Media and Children's and Adolescents' Diets: A Systematic Review of the Underlying Social and Physiological Mechanisms. Advances in Nutrition 13, 913–937. https://doi.org/10.1093/advances/nmac018

Slimani, N., Deharveng, G., Southgate, D.A.T., Biessy, C., Chajès, V., van Bakel, M.M.E., Boutron-Ruault, M.C., McTaggart, A., Grioni, S., Verkaik-Kloosterman, J., Huybrechts, I., Amiano, P., Jenab, M., Vignat, J., Bouckaert, K., Casagrande, C., Ferrari, P., Zourna, P., Trichopoulou, A., Wirfält, E., Johansson, G., Rohrmann, S., Illner, A.-K., Barricarte, A., Rodríguez, L., Touvier,

M., Niravong, M., Mulligan, A., Crowe, F., Ocké, M.C., van der Schouw, Y.T., Bendinelli, B., Lauria, C., Brustad, M., Hjartåker, A., Tjønneland, A., Jensen, A.M., Riboli, E., Bingham, S., 2009. Contribution of highly industrially processed foods to the nutrient intakes and patterns of middle-aged populations in the European Prospective Investigation into Cancer and Nutrition study. Eur J Clin Nutr 63, S206–S225. https://doi.org/10.1038/ejcn.2009.82

Suligowska, K., Buczny, J., 2022. Obesity in Polish Children and Parents' Perception of Their Children's Weight Status: The Results of the SOPKARD-Junior Study. IJERPH 19, 4433. https://doi.org/10.3390/ijerph19084433

Szponar, L., Sekula, W., Nelson, M., Weisell, R.C., 2001. The Household Food Consumption and Anthropometric Survey in Poland. Public Health Nutr 4, 1183–1186.

Trijsburg, L., Talsma, E.F., Crispim, S.P., Garrett, J., Kennedy, G., De Vries, J.H.M., Brouwer, I.D., 2020. Method for the Development of WISH, a Globally Applicable Index for Healthy Diets from Sustainable Food Systems. Nutrients 13, 93. https://doi.org/10.3390/nu13010093

Trijsburg, L., Talsma, E.F., De Vries, J.H.M., Kennedy, G., Kuijsten, A., Brouwer, I.D., 2019. Diet quality indices for research in low- and middle-income countries: a systematic review. Nutrition Reviews 77, 515–540. https://doi.org/10.1093/nutrit/nuz017

Van Dooren, C., Douma, A., Aiking, H., Vellinga, P., 2017. Proposing a Novel Index Reflecting Both Climate Impact and Nutritional Impact of Food Products. Ecological Economics 131, 389–398. https://doi.org/10.1016/j.ecolecon.2016.08.029

van Rossum, C., Buurma-Rethans, E., Dinnissen, C., 2020. The diet of the Dutch Results of the Dutch National Food Consumption Survey 2012-2016. Rijksinstituut voor Volksgezondheid en Milieu RIVM. https://doi.org/10.21945/RIVM-2020-0083

Vilarnau, C., Stracker, D.M., Funtikov, A., da Silva, R., Estruch, R., Bach-Faig, A., 2019. Worldwide adherence to Mediterranean Diet between 1960 and 2011. Eur J Clin Nutr 72, 83–91. https://doi.org/10.1038/s41430-018-0313-9

Wennergren, M., Berg, K., Frisk Cavefors, A.-S., Edin, H., Ekholm, L., Gelander, L., Golsäter, M., Hedman, J., Holmgren, A., Karlsson Videhult, F., Levin, A., Silfverdal, S.A., Wallby, T., Fäldt, A.E., 2023. Swedish Child Health Services Register: a quality register for child health services and children's well-being. bmjpo 7, e001805. https://doi.org/10.1136/bmjpo-2022-001805

WHO guidelines on physical activity and sedentary behaviour, 2020. . World Health Organization, Geneva.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., De Vries, W., Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Srinath Reddy, K., Narain, S., Nishtar, S., Murray, C.J.L., 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet 393, 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

Woolhead, C., Walsh, M.C., Gibney, M.J., Daniel, H., Drevon, C.A., Lovegrove, J.A., Manios, Y., Martinez, J.A., Mathers, J., Traczyk, I., Saris, W.H.M., Gibney, E., Brennan, L., on behalf of the Food4Me study, 2015. Dietary patterns in Europe: the Food4Me proof of principle study. Proc. Nutr. Soc. 74, E233. https://doi.org/10.1017/S002966511500275X

Youth Wiki national description Youth policies in Poland 2019. Available at: https://national-policies.eacea.ec.europa.eu/sites/default/files/2021-06/Poland_2019.pdf (accessed on 2 August 2023), n.d.

Zembura, P., Korcz, A., Cieśla, E., Gołdys, A., Nałęcz, H., 2018. Results from Poland's 2018 Report Card on Physical Activity for Children and Youth. Journal of Physical Activity and Health 15, S395–S397. https://doi.org/10.1123/jpah.2018-0540

Zujko, M.E., Waśkiewicz, A., Drygas, W., Cicha-Mikołajczyk, A., Zujko, K., Szcześniewska, D., Kozakiewicz, K., Witkowska, A.M., 2020. Dietary Habits and Dietary Antioxidant Intake Are Related to Socioeconomic Status in Polish Adults: A Nationwide Study. Nutrients 12, 518. https://doi.org/10.3390/nu12020518