Reviews of Scientific Evidence and Policies on Nutrition and Physical Activity

Objective B1: A comprehensive review of the scientific evidence about the source of calories consumed and types and frequency of physical activity among Europeans

Written by ICF Consulting Services Ltd

March 2018

EUROPEAN COMMISSION

Directorate-General for Health and Food Safety

Directorate C — Public health, country knowledge, crisis management

Unit C.4— Health Determinants and international relations

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LEGAL NOTICE

Luxembourg: Publications Office of the European Union, **2018**

ISBN 978-92-79-97425-0 DOI 10.2875/586086 EW-06-18-318-EN-N

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Preface

About this project

Overweight, obesity and their related diseases represent a leading cause of morbidity and mortality, and pose a major challenge for the sustainability of healthcare systems of EU Member States. The growing prevalence of overweight and obesity among all age groups across Europe constitutes a serious concern for policy makers. Tackling this issue requires a comprehensive response that reflects the multifactorial and complex nature of obesity and overweight. One particularly important area of focus has been on the development of preventative strategies, which include nutritional and physical activity interventions.

The European Commission Directorate General for Health and Food Safety (DG SANTE) recognises the significant challenges policy makers face in developing effective and efficient policy interventions relating to diet and physical activity. One such challenge includes the complexity and breadth of the evidence base. By providing independent, accurate summaries of recent and relevant information and statistics on determinants of diet and physical activity and their impact on health, this project aims to support policy makers to continue to develop policy instruments, which enable people to make healthier lifestyle choices. In particular, this project aims to support the development of healthier behaviours in vulnerable and/or at-risk subpopulations (including children, pregnant and lactating women, and older adults) and low socio-economic status groups (including low income and education).

About this series

This evidence review is one of eight reviews relating to different determinants of diet and physical activity.

Seven of the reviews are of the scientific evidence and policies in the following areas:

- Knowledge, attitudes and behaviours contributing to positive energy balance (objective area A1);
- Dietary and physical activity patterns in Europe (objective area B1);
- Consumption of fruit juices, artificially and sugar-sweetened beverages and its impact on weight status and health (objective area B2);
- Consumption of high-fructose syrup and its impact on weight status and health (objective area B3);
- Relationship between weight status and physical activity with school and work performance outcomes (objective area C);
- Early warning indicators of obesity and physical inactivity trends (objective area D);
- Nutrition and physical activity guidelines for specific population groups (objective area E).

Building on these seven reviews, the final review (objective area A2) examines specifically the evidence for effective and efficient policies and interventions in terms of promoting, supporting and improving nutritional and physical activity behaviours at both individual and population level.

All reviews, and their summaries, are available on the DG SANTE webpage here.

Approach and purpose

The reviews have been designed to provide policymakers with summaries of recent and relevant evidence in these key areas of interest. Given the broad scope of each of the reviews, it should be stressed that they are not intended to be rigorous systematic reviews of all literature published in this field. Rather, they are intended as pragmatic

reviews combining a comprehensive search methodology with expert academic input, facilitated through workshops, to provide a practical and accurate summary of key issues and tackling broad lines of enquiry, with the greater aim of supporting the development and improvement of policies in this area. Each of the project's eight methodologies and analyses was reviewed by DG SANTE and academic experts in these topics.

While the methods to conduct this comprehensive literature review are systematic, it is *not* a systematic review. This review does not systematically analyse literature to identify *all* relevant published data and/or appraise its quality. Methods to conduct the literature review consisted of five steps: (1) refining the research questions, (2) developing a search approach and databases, (3) conducting literature searches, (4) screening articles for inclusion; and (5) abstracting and synthesising relevant data.

To minimise bias, the literature search approach included identification of a priori search parameters (also considered first level inclusion and exclusion criteria), agreed with DG SANTE, to guide searches and inform screening and selection processes for data inclusion. Due to the immense number of literature search results at step 3, the application of quite limiting exclusion criteria at step 4 was deemed necessary. This may however have resulted in not screening all potentially relevant literature. All relevant articles that were found appropriate for inclusion were reviewed for relevance to each objective area, and the scope of the specific research questions. Furthermore, the inclusion of different types of scientific evidence (from systematic reviews and peer-reviewed original articles down to BSc theses) and the presentation of this scientific evidence next to grey literature information presented a challenge in terms of maintaining an understanding of the quality and weight of the evidence. The authors addressed this to some extent by structuring the document in such a way that peer-reviewed and grey literature are clearly identified. The full methodology and steps taken for each review is included in Annex of this document.

DG SANTE and the Joint Research Centre (JRC) provided input on all stages of the project and comments on the literature reviews. Expert workshops were organised to discuss findings, highlight additional relevant sources to fill gaps and improve the series of reviews. Experts were carefully selected from academic and policy-making fields, based on expertise of the specific topics addressed.

The methodology used across all eight reviews remained consistent, and within each review a detailed summary of the approach is provided, along with a full bibliography for further reading.

Glossary

The following definitions are common definitions that are used across all eight objective areas. Where a study uses a different definition, this will be highlighted on an individual basis in the review.

Table 1. Definitions of terms used across the reviews

Term	Definition	Source
Adult obesity	An abnormal or excessive fat accumulation that presents a risk to health, with a BMI of 30 or more.	World Health Organisation (WHO) (http://www.who.int/topics/obesity/en/)
Adult overweight	An abnormal or excessive fat accumulation that presents a risk to health, with a BMI equal to or more than 25.	WHO (http://www.who.int/topics/obesity/en/)
Alcopops	Pre-mixed beverages containing a spirit, wine or malt combined with a non-alcoholic drink.	1. Anderson, P., Suhrcke, M. and Brookes, C. (2012) An overview of the market for alcohol beverages of potentially particular appeal to minors. London: HAPI.
Artificially sweetened beverages (ASBs)	Beverages sweetened with low-calorie or zero-calories sweeteners such as sucralose, aspartame, saccharin, stevia or sugar alcohols.	ICF definition based on all literature identified in objective area B2 literature review
Body Mass Index	A person's weight (in kilograms) divided by the square of his or her height (in metres).	WHO (http://apps.who.int/bmi/index.jsp?introPage=intro_3.html)
Child/adolescent obesity	• There are different systems available to measure child or adolescent obesity for different ages. • Children under 5 obesity is weight-for-height greater than 3 standard deviations above WHO Child Growth Standards median;	WHO http://www.who.int/mediacentre/factsheets/fs311/en/ (Other definitions are available for different national and international systems).

Term	Definition	Source
	• Children aged 5-19 overweight is BMI-for-age greater than 2 standard deviation above the WHO Growth Reference median.	
Child/adolescent overweight	There are different systems available to measure child or adolescent overweight for different ages. • Children under 5 overweight is weight-for-height greater than 2 standard deviations above WHO Child Growth Standards median; • Children aged 5-19 overweight is BMI-for-age greater than 1 standard deviation above the WHO Growth Reference median.	WHO http://www.who.int/mediacentre/factsheets/fs311/en/ (Other definitions are available for different national and international systems).
Exercise	Exercise, is a subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective.	WHO (http://www.who.int/dietphysicalactivity/pa/en/)
Insufficient physical activity	Physical activity that does not meet WHO recommended levels of at least 60 minutes a day of moderate-vigorous activity for children and adolescents and at least 150 minutes of moderate-intensity aerobic physical activity throughout the week for	WHO http://www.who.int/mediacentre/factsheets/fs385/en/

Term	Definition	Source
	adults.	
Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure.	WHO (http://www.who.int/topics/physical_activity/en/)
Physical inactivity	A lack of physical activity	WHO (http://www.who.int/dietphysicalactivity/pa/en/)
Sedentary behaviour	Any waking behaviour characterized by an energy expenditure ≤1.5 metabolic equivalents (METs) while in a sitting or reclining posture.	Tremblay, M. S., et al. (2017). Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. *The International Journal of Behavioral Nutrition and Physical Activity*, *14*, 75. http://doi.org/10.1186/s12966-017-0525-8
Sugar sweetened beverages (SSBs)	Any beverage with added sugars. This includes soft drinks, soda, fruit drinks, punch, sports drinks, sweetened tea and coffee drinks, energy drinks and sweetened milk. These beverages may be sweetened with added sugars such as sucrose (table sugar) or high fructose corn syrup, which is what distinguishes them from 100% fruit juice and beverages with non-caloric sweeteners (e.g., aspartame, saccharin or sucralose).	US Department of Agriculture. 2010. *US Department of Health and Human Services. Dietary guidelines for Americans, 2010.* 7th edition, Washington (DC): US Government Printing Office

Objective B1: A comprehensive review of the scientific evidence about the source of calories consumed and types and frequency of physical activity among Europeans

This report presents a comprehensive review of the scientific literature about dietary and physical activity behaviours among Europeans. Specifically, the sources of calories consumed and the types and frequency of physical activity. The review is structured by the following sections:

- Introduction, describing the relevance of this topic, the scope of the reviews, the principal research questions; and the methodology.
- Findings from the peer reviewed and grey literature, and a discussion presented according to each research question;
- Conclusions drawn from the reviews overall and an assessment of the current scientific evidence, including any gaps in the knowledge.

1 Introduction

This review aims to capture current consumption and physical activity levels in Europe, whilst comparing how these have changed over time. In order to carry out this review, guidelines have been used to provide a rough benchmark for comparison. However, this report does not make any judgements or inferences on the health consequences of these trends as both national as well as population-based guidelines vary considerably for Europeans.

Additionally, this review considers research on dietary and physical activity habits separately. Whilst recognising that the link between the two is important in discussions about weight status and obesity, this review is intended to provide a high-level overview of current practices among Europeans and not to comment on overall energy balance (as examined in a separate review, Objective A1). Nonetheless, the information provided here remains valuable in identifying areas in which the EU can focus its policies and guidelines.

1.1 Scope of this review

To ensure the most relevant sources were reviewed, we:

- Focused on studies and reports with the most recent data (published after 2004, unless stated) and excluded studies and reports with (older) data less relevant to the situation today;
- Did not exclusively focus our search on high fructose corn syrup or sugar sweetened beverages (SSBs) as related literature was the focus of Objective B3 and Objective B2 reports, respectively; however findings from the current review include SSBs or sugar when it was one of the food groups assessed; and
- Did not search for food expenditure, purchasing or availability data, unless there was a lack of information about consumption patterns.

1.2 Research questions

In this review, we focus on the most current literature (peer reviewed research and systematic reviews, as well as grey literature) on dietary and physical activity behaviours among Europeans with the goal of answering the research questions listed below.

Research questions are grouped by those relating to dietary and consumption habits (questions 1 and 2) and by those relating to physical activity (questions 3 and 4):

- What and how much do Europeans eat and drink, what kinds of food groups are more relevant and what trends are noticeable?
- When and where do Europeans eat and drink?
- How much physical activity do Europeans engage in?
- What types of exercises are Europeans engaging in?

2 Methodology

The review is based primarily on peer reviewed literature (which is prioritised), with grey literature used to supplement any gaps (but treated with caution and the strength of the evidence assessed). Given the types of questions addressed in this review, publicly available datasets which were commonly referenced in both literature searches were analysed further to identify additional trends and patterns – when relevant, this analysis is presented alongside the findings from the literature review. For each set of literature specific search terms and inclusion and exclusion criteria were used; and quality checks undertaken. The research questions and search terms were confirmed with DG SANTE at the start of, and then refined during a review point within, the process.

After the initial searching and extraction of literature, drafts were provided to DG SANTE and the Joint Research Centre (JRC) for review. Expert workshops (with experts from relevant academic and policy-making fields) were then held to discuss findings and highlight any additional sources to fill gaps, in order to improve the series of reviews. The final outputs of the study ('the reviews' as presented here for B1) were then reviewed by a topic expert at the University of Birmingham.

While the methods to conduct this comprehensive literature review are systematic it is not a systematic review. More information on the methodology can be found in the Annexes.

2.1 Peer reviewed method

To search for and extract the most relevant peer reviewed literature the following steps were taken: refining the research questions; developing a search approach and databases; conducting literature searches; screening articles for inclusion; and abstracting and synthesizing relevant data.

A total of 15,468 search hits of peer reviewed literature were initially retrieved using selected search terms per research question. A total of 15,468 duplicates were found and removed from the search hits resulting in 14,325 search results as for B1. From these, the team aimed to screen 200 of the most recent titles and abstracts for each research question, to create a manageable amount of material within the resources for the study; and on the premise that the most recent material was most relevant science. Where there was a lack of relevant literature for a research question, more than 200 articles were screened. From the 942 most recent titles and abstracts screened, 50 were deemed of potential relevance and reviewed as full texts. From the 50 deemed relevant and reviewed as full texts, 20 publications were selected for inclusion in the initial review. In Stage 5, supplementary searches were conducted and/or articles recommended by experts during the workshops were looked at and another 30 peer-reviewed publications were included in the final review.

The full peer reviewed searching and extraction methodology is outlined in Annex 1.

2.2 Grey literature method

To search for and extract the most relevant grey literature the following steps were taken: searching for publications using agreed keywords and databases; screening of search results and exclusion of less relevant literature; and, extraction and review of remaining documents. The grey literature search process was a more fluid and dynamic process, where hand searching was also utilised to find the most relevant sources. Details in relation to the search strategy can be found in the Annexes.

In the initial search, 190 relevant sources were identified after excluding references based on the absence of key search terms in the title of the reference and abstract. These 190 references were saved in the library. The second exclusion exercise, conducted according to the set exclusion criteria and relevance to the objective's aim,

resulted in 100 excluded references. Filtering the remaining references using a quality checklist resulted in the exclusion of 32 references due to a lack of relevant information. From the 90 deemed relevant and reviewed as full texts, 58 grey literature sources were selected for inclusion in the initial review. In Stage 5, supplementary searches were conducted and/or articles recommended by experts during the workshops were looked at and another 20 grey literature sources were included in the final review.

The full grey literature searching and extraction methodology is outlined in Annex 4.

3 Findings and discussion

3.1 Introduction to Research Questions 1 and 2

3.1.1 Definitions and guidelines

The main focus of Research Question 1 and 2 is calorie consumption (or energy intake) from food and drink products. Definitions and guidelines from three sources were examined (and referenced accordingly) in order to provide contextual information, and enable some comparison by Member States (MSs):

- World Health Organisation (WHO): In 2003, the WHO produced food based dietary guidelines for the European region, which synthesised national, government-endorsed food-based dietary guidelines in Europe. Whilst a large proportion of these recommendations are still relevant today, additional sources from the WHO were also consulted, including the overview of 'Country profiles on nutrition, physical activity and obesity in the 28 European Union Member States of the WHO European Region' published in 2013.
- The European Food Safety Authority (EFSA): Dietary Reference Values and nutrition guidelines for Europe have also been published by EFSA's Panel on Dietetic Products, Nutrition and Allergies[1].
- The Food and Agriculture Association of the United Nations (FAO): The FAO website compiles a list of up-to-date national guidelines for Europe (and beyond)[2]. These were consulted to provide examples of how and when MSs food-group based dietary guidelines differed, or how far they converged with WHO or EFSA recommendations.

3.1.2 Search results

Overall, the literature search revealed that almost all the data available on consumption is self-reported, and based on methodologies such as food diaries or memory recall, which are known to have significant inaccuracies. Additionally, as most dietary surveys are conducted on a national basis, cross-comparison of even the most robust data sources is difficult given diverging methodologies, sample sizes and definitions of food groups and products.

Nonetheless, this review found that there have been multiple attempts to compile the most recent food and drink consumption data from all MSs into one coherent database. For example, EFSA has tried to combine national surveys in its Comprehensive European Food Consumption Database (a descendent of the Concise European Food Consumption Database), which makes it possible to assess (though not systematically compare) self-reported data on food and drink intake across the EU. In the future, EFSA's EU Menu project will provide more harmonised and longitudinal data from MSs to more easily

[1] For a full list of guidelines by nutrient or reference value, please see: https://www.efsa.europa.eu/en/topics/topic/dietary-reference-values-and-dietary-guidelines

[2] For a full list of guidelines by country, please see: http://www.fao.org/nutrition/education/food-dietary-guidelines/regions/europe/en/

compare patterns across the European Union (EU) and the rest of Europe. Similarly, the European Nutrition and Health Report (Elmadfa et al., 2009) provides a broad overview of the nutrition and health situation in Europe, using available food consumption, availability, supply and expenditure data from published and non-published sources.

Data from recent pan-European surveys (e.g. the European Health Interview Survey; Survey of Health Ageing and Retirement in Europe; and Health Behaviour in School Children surveys) and larger studies across multiple countries (e.g. the Survey in Europe on Nutrition and the Elderly: a Concerted Action (SENECA) study, and the Identification and Prevention of Dietary- and Lifestyle-induced Health Effects in Children and Infants study) was regularly identified in both the peer reviewed and grey literature searches. When possible, the original data was assessed or further exploited to provide additional information for this review.

3.1.2.1 Peer reviewed literature

In total, 23 peer reviewed articles examining dietary behaviour patterns and trends among Europeans were used to answer Research Questions 1 and 2.

To address Research Question 1, searches were conducted using terms such as food consumption, beverage consumption, dietary, food groups, and were combined with secondary terms such as prevalence and trend. Supplementary searches were conducted on Google Scholar to identify further literature relevant to each of the food groups, by specifying what they were (according to the structure of Section 3.2.4). Additional keywords were used to find more relevant literature on specialised diets (i.e. by specifying the Mediterranean diet) and portion sizes.

For Research Question 2, searches included terms such as eating, feeding behaviour, meals, beverage consumption and food consumption and were combined with secondary terms such as intervention, pattern, prevalence and trend. Supplementary searches on Google Scholar focused on additional key words, such as "food consumption locations Europe", "food consumptions times Europe", "beverage consumption locations", "beverage consumption times Europe" and other similar phrases, to ensure the most relevant literature was used in this review.

3.1.2.2 Grey literature

In total, 43 grey literature articles were identified for Research Questions 1 and 2, though importantly this number also included a few less relevant sources which provided further information on guidelines, definitions, the historical and cultural context, etc. One of the sources identified was the European Nutrition and Health Report (2009) which provided a comprehensive overview of the dietary habits of Europeans by drawing on results of multiple surveys across Europe. The grey literature search identified few other European dietary surveys focused on calorie consumption in the European Union (other than those identified in the peer-reviewed literature search), but the search did provide a rich source of information at the national level, particularly on the key factors influencing European dietary habits.

3.2 Research Question 1: What and how much do Europeans eat and drink, what kinds of food groups are more relevant and what trends are noticeable?

3.2.1 Section summary

This section focuses on the eating habits of Europeans by examining **how many calories** Europeans consume and **what types of products** according to food groups and trends in consumption patterns over time. The section starts with an overview of the total dietary intakes among Europeans, broken down by geography and different age groups. This is followed by a discussion of changes to the types of foods Europeans consume, as well as an examination of consumption data by food groups and against guidelines where possible.

Summary: What and how much do Europeans eat and drink, what kinds of food groups are more relevant and what trends are noticeable?

This section outlines the consumption habits of Europeans. Overall:

- Consumption habits appear to be changing and converging across Europe because of several factors including individual preferences and choice, the increased availability of food products through global food manufacturers, and higher disposable income etc. These factors have also influenced the amount of food and drink and that Europeans tend to consume.
- On the whole, European consumption habits do not align with certain aspects of EU or national food-based dietary guidelines. For example, levels of consumption remain low for promoted food groups (such as fruit and vegetables) and conversely exceed guidelines for discouraged food groups (such as foods high in salt, fat and sugar). Differences can be noted by age (children, adults and older adults).
- The daily consumption of fruit and vegetables varies between MSs, and data shows that the average consumption vegetables is much lower than fruit. Consumption of vegetables, salads and fruits also increases by age, though not among children and adolescents. There are also differences among men and women, and by socio-economic status. Despite these recommendations and an increase in the consumption of fruit and vegetables in recent years, EU intake is still well below WHO recommendations.
- Bread and potatoes are important components of meals in Northern, Central and Eastern Europe, possibly contributing to the reported comparatively high carbohydrate intake in these regions. In spite of the relatively high consumption of foods containing starch, high proportions of the public do not eat wholegrain foods at all (which limits intake of dietary fibre).
- Average dairy consumption in Western Europe is equivalent to approximately 300 kilograms (per person, per year) in milk and milk-based products, which is up to six times greater than consumption in Asia and Africa. However, it is reported that there is also a different among MSs, with Scandinavian countries consuming the highest amount of dairy produce in the EU.
- On average, EU citizens are recorded as consuming roughly 68.3kg per capita of meat (excluding fish) per year– this is more than the world average but less than North America. However, data reported shows that

fish and seafood consumption in the EU has increased by a greater percentage (13%) than average meat consumption over the same period (1995 - 2011). The consumption of meat, fish and eggs varies among MSs, and there is an increased focus on non-animal food products which can replace the consumption of meat, fish and eggs for protein.

- Data suggests that European countries still eat too much saturated fat, with consumption levels on average 40% higher than the maximum recommended by WHO guidelines. Sugar intake is highest amongst individuals living in Eastern European countries (Latvia and Lithuania) and tends to be lowest among the EU-15 countries. Salt intake among Europeans also remains high, with nearly all countries exceeding the 5g target in the EU.
- Research gaps still exist. Whilst there is a large amount of high-quality and relevant data on the consumption of fruit and vegetables, further research is required in order to make the same assessments for all food groups.

3.2.2 How much do Europeans eat and drink?

This section presents an overview of the amount that Europeans eat and drink, by considering two measurements: energy intake (i.e. calories consumed) and portion size. This section uses available data to describe the **average consumption patterns** of Europeans, and does not make judgements about the health consequences of particular diets, energy intakes or portion sizes.

Importantly, consumption can fluctuate daily and for a number of reasons, such as when socialising or on holiday periods/occasions. Additionally, consumption may be higher among groups that have a higher energy expenditure such as sportspersons.

3.2.2.1 Energy intake

How much Europeans eat and drink a day is likely to be influenced by daily energy intake recommendations. Although these vary between countries, the average recommended intake is around 2,500 and 2,000 kcal for men and women (respectively) engaged in moderate amounts of daily physical activity (corresponding to a physical activity level of 1.60) (Public Health Evaluation and Impact Assessment Consortium, 2013). However, estimates by the Food and Agriculture Organisation of the United Nations (FAO) for the European Union (EU) indicate that average dietary energy supply is closer to 3,500 kcal/ person/day (3,416 kcal in 2011, though actual food intake will be lower due to factors such as food wastage and mismanagement[3] (Eurostat 2011, PHEIAC 2013).
National authorities regularly collect data on food consumption and dietary patterns through national and local surveys, and efforts have been made to compile and modulate these data. In the European Nutrition and Health Report (2009), Elmadfa et al. provide an overview of average, daily energy intake for sixteen European countries[4] by age and

[3] Daily calorie supply per capita by source is easier to measure than calorie consumption, though the figure is a slight overestimation as it includes losses through food distribution and mismanagement (i.e. binning food). Data are based on the food balance sheets available at FAOSTAT. Data sources are primarily questionnaires, national publications and Country visits by statisticians. Calorie supply is calculated by adding together all foodstuffs produced in a country added to the total quantity imported (adjusted for changes to stocks) and dividing this by the population. All major food animal and vegetable items are regarded. More information can be found in the metadata assumptions and definitions (http://ec.europa.eu/eurostat/cache/metadata/en/t2020_rk100_esmsip.htm)

[4] Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Sweden and the UK (EFSA, 2008)

gender (as shown in Table 2) using data compiled by the EFSA in its Concise European Food Consumption Database (published in 2008).

Table 2. Average daily energy intakes in mega-joules and kilocalories by age

Age group	Boys/Males	Girls/Females
Children	6.2 - 11.7 MJ/day (1482 - 2796 kcal/day)	5.5 - 10.6 MJ/day (1315 - 2533 kcal/day)
Adolescents	9.5 and 14.5 MJ/day (2271 and 3466 kcal/day)	6.8 and 9.7 MJ/day (1625 and 2318 kcal/day)
Adults	8.5 – 13.9 MJ/day (2032 and 3322 kcal/day)	6.3 and 11.4MJ (1506 and 2725 kcal/day)
Elderly	7.1 – 13.0 MJ/day (1697 – 3107 kcal/day)	10.9 MJ/day (1386 - 2605 kcal/day)

Source: Data from Elmadfa et al. (2009), ICF analysis

Findings for the elderly are consistent with data collected as part of a mixture of longitudinal and cross-sectional research undertaken as part of the Survey in Europe on Nutrition and the Elderly: a Concerted Action (SENECA) study, which suggests that dietary intake of older adults is sufficient but tends to decline with age (de Groot et al., 2004). Mealtime patterns and dietary intakes of 2,600 elderly participants from 19 towns in 12 European countries[5] were measured and differences in dietary intake were found across Europe. In particular, energy intake varied from 7.2 MJ in Switzerland (1721 kcal) to 10.3 MJ in Spain (2462 kcal) per day, and there was considerable variation among MSs in regards to relative contributions of proteins, fats, carbohydrates, and alcohol to total energy intake.

Similarly, findings for children are consistent with the results of the 'Identification and Prevention of Dietary- and Lifestyle-induced Health Effects in Children and Infants (IDEFICS)' study (covering 16,228 children aged 2-10 in Sweden, Germany, Hungary, Italy, Cyprus, Spain, Belgium, Estonia) (Hebestreit et al. 2016). This study found that in all countries, on average, energy intake increased with age and was higher among boys than girls.

Finally, Elmadfa and Meyer (2015) explored patterns of water and other drink consumption across the European Union using national data compiled in the Concise Food Consumption Database (2008). Their analysis appears to show that in general, MS dietary records show fluid intake in line with the recommended range of 1500-2000 mL/day. However, whilst water is the most commonly consumed beverage throughout Europe there is some variation in what types of drinks are consumed between countries. For example, on the one hand tap water consumption was highest in Austria, and across Northern European countries, but Germany led in the consumption of bottled water, as well as fruit and vegetable juices and soft drinks. Elmadfa and Meyer also found that fluid intake varied by demographic factors such has age and gender, as well as lifestyle factors such as physical activity and food choices.

[5] Participants were selected from an age- and sex-stratified sample of the inhabitants, and towns had a stable population of 10,000 to 20,000 inhabitants.

3.2.2.2 Portion sizes and single foods

In recent decades there have been only minor changes in the amount of food consumed in the EU (based on serial self-reported data), increasing by less than 5% from 735kg in 1970 to 770kg in 2000, per person per year (according to the EEA, 2005). However, as most dietary data is self-reported, it is difficult to estimate and quantify portion sizes in order to assess consumption patterns among Europeans (Souverein et al, 2011). The ongoing EU Menu project will help to provide more harmonised food consumption data on portion sizes, by offering financial and technical support to all 28 MSs and pre-accession countries to produce new dietary surveys following a more coherent methodology[6]. Two pilot trials assessed the applicability of different tools and procedures for conducting pan-European food intake surveys:

- The PILOT-PANEU project (2010-2013), which consisted of two non-consecutive 24 hour recalls, involved 1157 participants in five European countries (Bulgaria, Finland, Greece, Hungary, and Portugal). The International Agency for Research on Cancer (2013) report that there were differences in the number of single foods eaten per day; the highest number was reported in Finland (approximately 23 per day) and the lowest in Bulgaria (approximately 13 per day).
- As stated by EFSA (2012), the 'Pilot Study for the Assessment of Nutrient intake and food Consumption Among Kids in Europe' (PANCAKE[7]), was a trial of the EU Menu approach for children aged 0-10 years in Belgium and the Czech Republic. One objective of the PANCAKE project was to develop an age-specific picture book that ensures the best possible results in estimating portion sizes for children. Combined results of both dietary assessment methods indicated that the most commonly referenced pictures by all participants in Belgium and the Czech Republic were those of butter (on bread, and in cubes), cheese on bread, and boiled potatoes.

3.2.3 What do Europeans eat and drink?

This section provides an overview of changes to European eating and drinking habits, caused largely by the availability of new products and the increasing popularity of specialised diets. These trends are important as changes to what Europeans consume have consequences for diet and health status in terms of energy and nutrient intake. Furthermore, there is also an implication for expenditure on food, when a larger share of income is spent on high value, specialised or processed produce (Regmi et al, 2002 cited in Fulponi, 2009).

It is important to note that though this review primarily focuses on consumption patterns, food supply and availability data can also be used to assess dietary patterns. Examples of research studies that have employed the 'food availability' measure include Balanza et al. (2007) who used data from Food Balance Sheets (FAO) to examine trends in food availability for three different European regions[8], between 1961-1963 and 1998-2000. Their analysis revealed an overall increase in the total energy available per capita per day for each European region, with a specific increase in the percentage of energy from fats; and a decrease in the percentage of energy from carbohydrates.

[6] Results were not publically available for the EU MENU project at the time of this review

[7] This pilot specifically examined the usefulness of two, alternative dietary record methods: a 3-day food diary checked by a parent, and two consecutive 1-day food diaries followed by a GloboDiet completion interview. The two methods of assessment involved 103 and 92 participants in Belgium and 117 and 114 participants in Czech Republic, respectively.

[8] Balanza et al. (2006) focus on Mediterranean Europe (Spain, Portugal, Italy, Greece, France, Cyprus and Albania); Northern Europe (the UK, Sweden, Norway, Finland, Germany, Ireland, Denmark and Iceland); and Eastern Europe (Czech Republic, Slovakia, Poland, Bulgaria, Hungary, and Romania).

In addition, the European Nutrition and Health Report (Elmadfa et al., 2009) summarises that the most prominent trends in food supply and availability are:

- An increase of the proportion of animal products in Southern and Central-Eastern European countries, a slight decrease in the North region and no change in the West of Europe;
- A decrease in average carbohydrate supply in all countries, accompanied by an increase in fat intake (in line with Balanza et al.'s conclusion); and
- Excessive average supply and availability of meat and meat products in all countries, higher availability of fruits and vegetables in the South of Europe compared to a higher availability of cereals and potatoes in Central and Eastern Europe.

In the remainder of this section, two specific trends influencing European dietary choices are examined: new food markets and the availability of convenience and pre-packed foods; and dietary restrictions, specialised diets and eating 'healthily'.

3.2.3.1 More choices in products

Importantly, the availability of any food and drink is a major determinant of consumption (Elmadfa et al., 2009). Europeans now have more choices as to what they consume or how they prepare their food, which may in part explain the convergence of dietary consumption patterns across the continent.

Convenience and pre-packed foods, from time saving ingredients to complete ready meals, have made it easier to access and eat a variety of products, without spending as much time preparing them (Fulponi, 2009). In this instance, the average family spends as little as six-and-a half minutes preparing the evening meal compared to the typical two-and-a-half hours reported 50 years ago, in part due to the use of convenience products such as frozen vegetables (EEA, 2005).

Europeans now also have more choices of the same or alternative produce, as a result of factors such as to an increase in the number of competing brand suppliers for the same foods. There is also a particular demand for 'higher quality' produce (European Commission, 2014). For example, according to Meredith and Willer (2016), a noticeable trend is the growth of the organic market in the EU, where retail sales increased by 7.4% from 2013 to 2014. Particularly strong growth was visible in Sweden and France, where sales grew by 45% and 10% respectively. However, the authors also note there are still large differences in the per capita consumption of organic food between MSs, with Luxembourg and Denmark leading, and Slovakia and Bulgaria having the least amount of organic food consumption. Additional research into the consumption of organic produce is required to verify these findings.

3.2.3.2 Dietary restrictions, specialised diets and eating 'healthily'

Restrictions on what people eat can be made out of choice or as a result of health-related factors such as allergies or food intolerance. Increasingly, more and more food and drink options are available for individuals who have restricted diets, ranging from gluten-free products to low-fat alternatives, which has led to policy changes around labelling and marketing (see, for example, EU regulation on Food for Specific Groups[9]). Subsequently, according to a report into sustainable diets published as part of the 'Live Well for Life' series, consumers have become more open to changing or specialising their diets (WWF, 2013). For example, UK government research indicates that 62% of respondents were 'very or fairly willing' to give up red meat, while 36% were 'very or fairly willing' to give

[9] The Regulation (EU) No 609/2013 of the European Parliament and the Council on 'Food for Specific Groups' is an example of EU changes to improve the content and marketing of food products for groups of consumers with specialised or energy-restricted diets.

up dairy products (DEFRA, 2011 cited in WWF, 2013), and Dutch research has identified a growing interest in flexitarian diets, which occasionally contain meat (De Bakker and Dagevos,, cited in WWF, 2013).

There has also been an increase in focus on healthy eating and the restriction of nutritionally unbalanced products. For example, in the UK, the British Heart Foundation stated that the *'overall intake of calories, fat and saturated fat has decreased since the 1970s. This trend is accompanied by a decrease in sugar and salt intake, and an increase in fibre and fruit and vegetable intake.'* (British Heart Foundation, 2012 as cited in Snowdon, 2014). Conversely another report also published as part of the 'Live Well for Life' campaign[10] (van Dooren and Kramer, 2012) found that current dietary trends in three European countries with diverse diets (Spain, France and Sweden) were far from sustainable or healthy, and reflected a move towards an average Western diet, consisting of high meat and calorie-dense food consumption, and low fruit, vegetable and legume consumption.

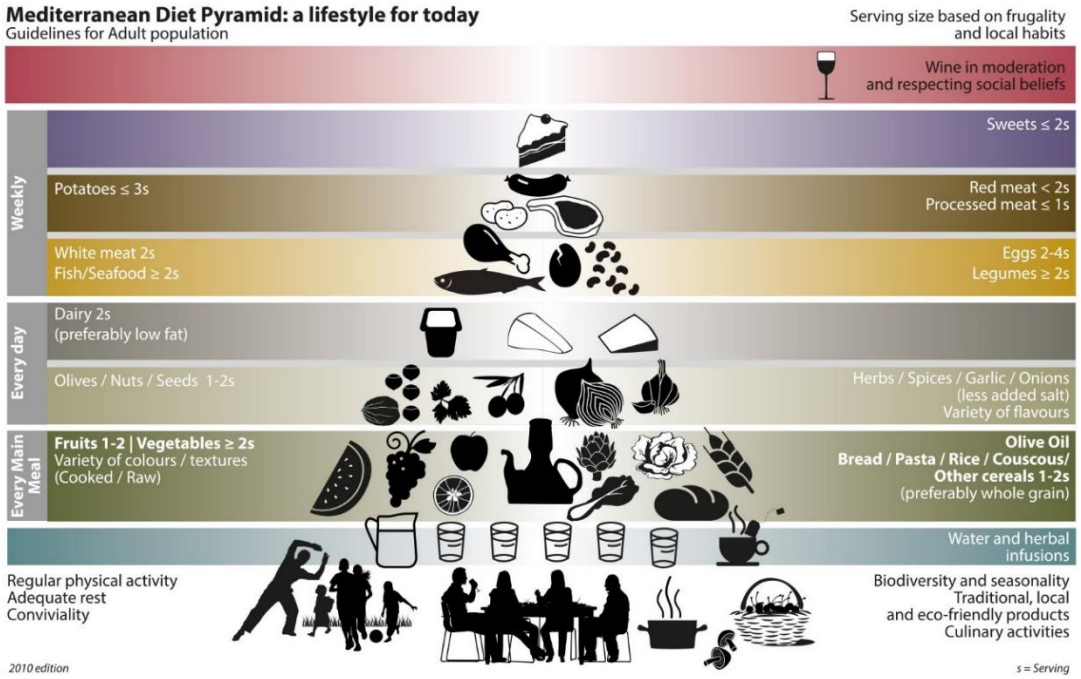
This may result from the fact that some individuals still place little importance on ensuring a healthy, balanced diet, and/or find it difficult to eat healthily. For example, the Department for Environment, Food and Rural Affairs (DEFRA) commissioned a survey of 3,000 households in the UK in 2010 (cited in Bagwell, 2013) and found that 19% of respondents thought it was not greatly important that the food they eat conforms to a healthy, balanced diet. The main reasons respondents gave for not adopting a healthy balanced diet were, 'don't want to give up the foods I like', 'healthy foods are too expensive' and 'can't resist'. Healthy eating may also be linked to other factors such as income, though the relationships may not always be clear. For example Fernandez-Alvira et al. (2014) found a significant association between children whose parents had a lower reported socio-economic status (SES) and eating 'processed' food, though a higher socio-economic status was not associated with a healthy diet for children in Italy, Spain and Sweden[11].

Finally, one commonly studied aspect of European consumption patterns is adherence to a Mediterranean-like dietary pattern, which is shown to improve health and be effective in the prevention of several non-communicable diseases (Vareiro et al., 2009). As shown in Figure 1, the Mediterranean diet consists of a high intake of fruits and vegetables, water and herbal infusions, and carbohydrates such as bread, pasta, rice and cereals (preferably wholemeal); and less intake of sweets, and red or processed meats.

[10] The 'Live Well for Life' campaign is an example of another move towards healthier eating, with a specific focus on 'sustainable' diets, defined as 'more plants and certified sustainable foods; less meat and highly processed food'.

[11] Fernandez-Alvira et al. examined dietary patterns among European children aged 2-9 using data from the 'Identification and prevention of Dietary and lifestyle-induced health EFfects In Children and infantS' study' (IDEFICS, 2007/2008). Parents from eight European countries (Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden) completed a self-administered questionnaire about parental attitudes, child behaviour and parent socio-economic status. The authors performed a principal component analysis to examine the dietary patterns of each country using data about the weekly frequency of consumption for 43 food items

Figure 1. Mediterranean diet pyramid – guidelines for the adult population



Source: Vareiro et al. (2009)

Nonetheless, research has found that current consumption trends in Europe, including in Mediterranean countries, are increasingly moving away from the Mediterranean diet despite efforts to encourage this pattern of consumption.[12] For example, in Spain, despite high levels of fruit consumption, there is also a shift towards more regular fat and dairy consumption (van Dooren and Kramer, 2012). Similarly, based on food availability data from the Food Balance Sheets[13], Vareiro et al. (2009) note a move away from the traditional (Mediterranean) diet for Mediterranean Europe with an increase in meats, vegetables oils and sugars and sweets.

Given the changes to regional European diets, there is some evidence of converging trends in European dietary habits and preferences. In this instance, older data collected in the 1990s (1991 to 1999 depending on country) as part of the Data Food Networking project (DAFNE) was used by Naska et al. (2006) to examine changes in dietary patterns of ten European countries[14] (grouped into Northern, Central and Mediterranean Europe). The authors found that Mediterranean countries had increased meat consumption; and northern and central European countries demonstrated patterns of fruit and vegetable intake similar to that of Mediterranean regions. Additionally, data from 7940 children in the IDEFICS study (Tognon et al., 2014) suggests there are similar adherence levels to a Mediterranean diet among European children from Central, Northern and Mediterranean Europe (with the exception of Italian pre-schoolers). This confirms that dietary differences among European countries have narrowed over time.

[12] As a result of an application by Spain, Greece, Italy and Morocco, the Mediterranean diet is on UNESCO's List of Intangible Heritage and so governments in these countries are obliged to protect the diet as a cultural heritage.

[13] The Food Balance sheets are compiled annually and provide an estimate of consumption.

[14] Data was collected as part of the Household Budget Survey (HBS), and captured foods and beverages available at the household level. Principal component analysis was used to identify food patterns

3.2.4 Consumption of core food groups

This section reviews the dietary habits of Europeans, and is structured on the core food groups specified in the eatwell.co.uk food pyramid developed by the UK Food Standards Agency. These are:

- Vegetables, salad and fruits;
- Wholemeal cereals and breads, potatoes, pasta and rice;
- Milk, yoghurt and cheese;
- Meat, poultry, fish, eggs, beans and nuts;
- Fats, spreads and oils; and
- Foods and drinks high in fat, sugar and salt.

Importantly, certain foods could belong to multiple categories and the classification of foods into these core food groups may vary by country. Therefore, in this review, we use the Eatwell categories solely as a way in which to structure the section. Breaking down diet by food group rather than nutrient group is also a more practical way of interpreting consumption patterns.

Additionally, it should be stressed that many different food pyramid structures and guidelines exist and recommendations depend on: the existing nutritional status of a population; nutrient gaps/identification of nutrients of public health importance; existing diet-health relationships; country-specific diet-related problems; foods relevant to food-based dietary guidelines; and existing consumption patterns. Consequently, no comment or judgement is made regarding the "healthiness" of the consumption patterns identified as this requires a closer examination of the eating and drinking habits of Europeans against specific and targeted benchmarks.

3.2.4.1 Vegetables, salad[15] and fruit

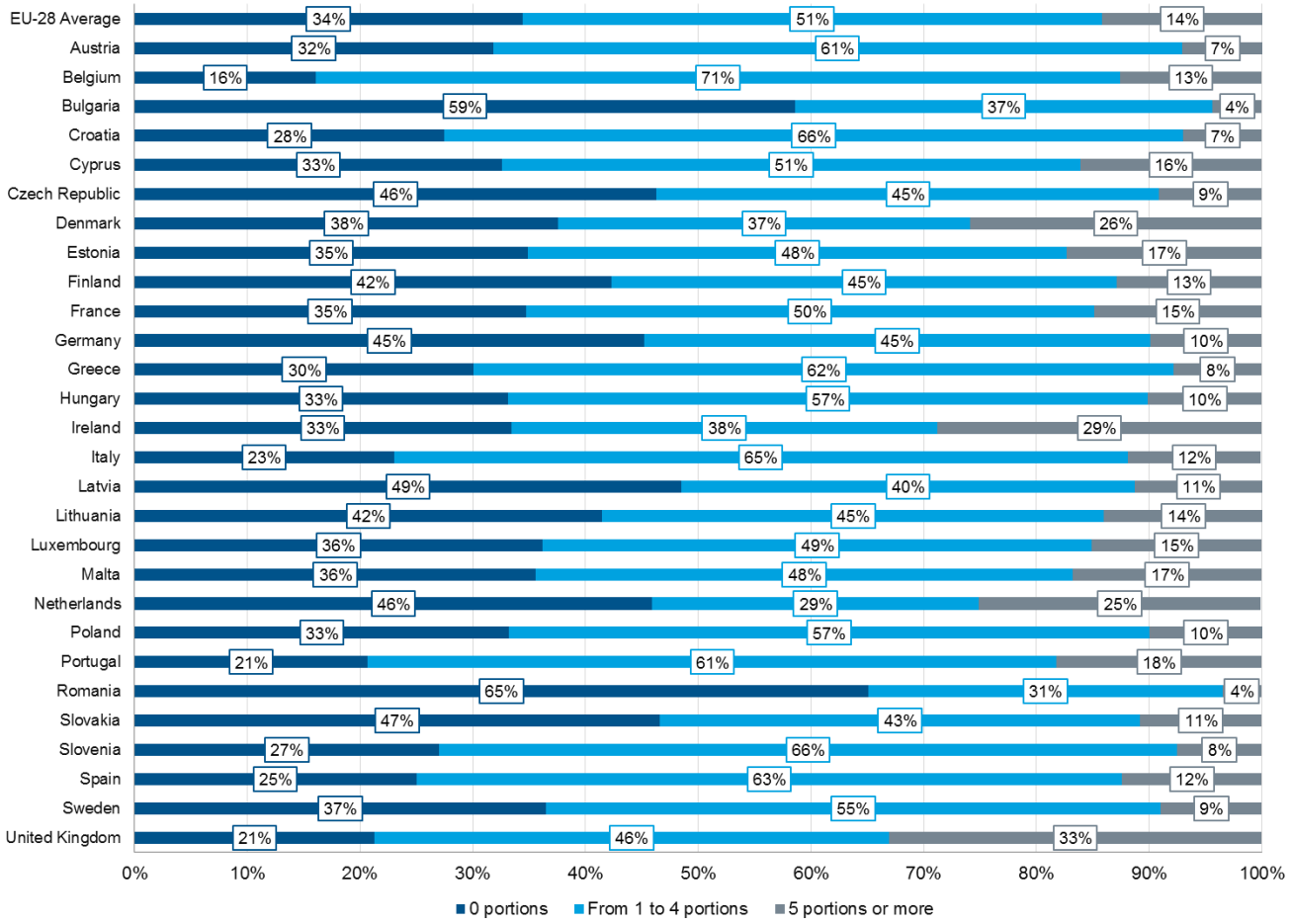
Vegetables and fruits are often associated with a healthy diet because they contain vitamins, minerals, fibre, small amounts of energy and minor components (phytochemicals or secondary plant products) that are considered beneficial for health (European Food Information Council (EUFIC), 2012). Self-reported data, collected in several cross-national surveys, illustrate key differences in the daily consumption of vegetables, salad and fruits by Europeans.

According to information collected during the second cycle of the European Health Interview Survey (2013-2015[16]), the daily consumption of fruit and vegetables varies between MSs. As shown in Figure 2 below, over half of the population in Romania and Bulgaria (65.1% and 58.6% respectively) report no consumption of fruit and vegetables on a daily basis, compared to Belgium which has smallest proportion of people reporting zero consumption (16.1 %). Respondents in the United Kingdom also report high levels of daily fruit and vegetable consumption, with a third of all respondents consuming more than five fruits and vegetables a day.

[15] Salad items are subsumed under the fruit and vegetable categories in this review

[16] The first wave of EHIS (EHIS wave 1 or EHIS round 2008) was conducted between 2006 and 2009. The second wave (EHIS wave 2 or EHIS round 2014) was conducted between 2013 and 2015.

Figure 2. Daily fruit and vegetable consumption patterns among people aged 15 and over in the European Union



Source: Daily consumption of fruit and vegetables by sex, age and educational attainment level (adapted from Eurostat, 2016).

Importantly, fruit consumption appears to be more on the rise than vegetable consumption. Freshfel's Activity Report (2016), which describes results from its Consumption Monitor[17] (which includes trends in production, trade and consumption up until 2013), estimates that the average (net) annual fruit consumption was 188.6g/capita/day in the EU-28 in 2013, an increase of 10.1% compared to 2012, but still 1.5% less than the average met between 2008 and 2012. Average vegetable consumption in the EU-28 in 2013 was 153.22 g/capita/day, and the increase in consumption of vegetables between 2012 and 2013 was much lower than for fruit (0.5%), however was 2.3% higher compared with the average of the preceding five years.

Consumption of vegetables, salads and fruits also differs by age. Further analysis of the EHIS data presented above shows that on average, across the EU, consumption of fruit and vegetables increases by age. The proportion of respondents who reported no consumption of fruit and vegetables on a daily basis was highest amongst those aged 15-24 (44.8%) and declined linearly with age (to only 22.2% for those aged 75 and over). In parallel, the proportion of respondents who ate at least one fruit and vegetable every

[17] This is produced as part of the actions undertaken by Freshfel in the framework of the EU Platform for Action on Diet, Physical Activity and Health. The monitor identifies a number of EU-wide trends on aggregate and single-country basis.

day increased by age, though respondents aged 75 and over were less likely to eat more than five fruits a day than those aged from 55-64 and 65-74.

However, data from the most recent Health Behaviour in School-Aged Children study collected in 2013/14 (HBSC, 2016) suggests a different pattern amongst younger children and adolescents – fruit and vegetable consumption appears to fall with age for this age group. On average in the EU, 44% of 11 year olds ate fruit daily compared to 37% of 13 year olds, and 33% of 15 year olds. Likewise, 39% of 11 year olds ate vegetables daily compared to 35% of 13 year olds, and 34% of 15 year olds.

Using historic HBSC data (2001-2010[18]), Fismen et al. (2016), examined additional trends in eating habits of Danish, Finnish, Norwegian and Swedish adolescents (aged 15). They found that whilst the percentage of adolescents in Nordic countries consuming fruit and vegetables daily has increased over time, this still equates to less than half of adolescents in these countries. Further analysis was used to determine whether there were significant trends over time. In regards to the daily consumption of fruit, there was a significant increase observed from 2001/2002 to 2005/2006 but a levelling off from 2005/2006. Denmark was the only country demonstrating a significant increase in daily consumption over time. A similar pattern was observed in the results for percentage of adolescents consuming vegetables daily, though overall vegetable consumption among all four MSs was slightly lower than fruit consumption.

EHIS (2016) data reveals gender differences in the consumption of fruits and vegetables among men and women. Notably, females eat more fruit than men; 54% of females reported daily consumption of 1-4 portions of fruit and vegetable a day compared to 49% of men, and 17% of females reported consuming more than 5 portions a day compared to 11% of men. There is also a gender difference among younger age groups; amongst 11 to 15 year olds, girls report eating more fruit and vegetables every day compared to boys (HBSC 2016).

Socio-economic status is also a key influencing factor on fruit and vegetable consumption. Lower income households report consuming fruit and vegetables less often, purchase fewer fruit and vegetables (by weight) and spend less money doing so than do higher income households (Douglas et al., 2014). These differences are likely explained by knowledge or education, and availability and price. The European Commission notes that vegetables are relatively more expensive (and have increased more in price) than meat and dairy products. They suggest that low income families may therefore have reduced their consumption of vegetables, compared to other foods, to reduce family expenditure[19]. This price differential may be even more important in those MS where a larger portion of household expenditure is spent on food (notably the new MS) (EEA 2005).

Comparison against guidelines

National dietary guidelines compiled by the Food and Agriculture Organisation of the United Nations (FAO) indicate that most MSs follow the WHO recommendation of a minimum intake of 400g or five different portions of fruit and vegetables a day, though there is some variation, including differences in the form of fruits and vegetables encouraged for consumption (e.g. raw, cooked, natural, prepared, fresh, frozen or canned) as well as in the distribution between fruit and vegetable consumption. For example, dietary guidelines from Finland suggest eating vegetables, fruits and berries frequently (a minimum of 500 g/day, excluding potatoes) and Ireland recommends

[18] The article used data from the Health Behaviour in School-Aged Children (HBSC) study. The data was collected via a questionnaire distributed to a nationally representative sample of adolescents (approximately 1,500 per country) at three time points (2001/2002, 2005/2006 and 2009/2010).

[19] Findings based on data from the consumer price index of different foods.

eating at least 5 to 7 servings a day, whilst guidelines from Hungary recommend eating both fruits and vegetables at least three times a day. Additionally, Greece provides separate guidelines for fruit and vegetable consumption, suggesting six servings of vegetables (including wild greens) and three servings of fruit daily.

Despite these recommendations and an increase in the consumption of fruit and vegetables in recent years, EU intake is still well below WHO recommendations. According to EHIS data, for example, only 14.1% of all Europeans on average eat the recommended five or more portions of fruit or vegetables a day, and only nine MSs (UK, Denmark, Netherlands, Portugal, Estonia, Malta, Cyprus, Luxembourg and France) have a higher proportion of citizens reporting consumption against this target on a daily basis.

- Similar findings are also reported elsewhere. Data collected from 37,599 adults across 19 MSs, and published on the Concise European Food Consumption Database[20] (as cited by EUFIC, 2012), in 2008 also reveals that the mean vegetable intake (including pulses and nuts) in Europe is 220g per day and the mean fruit intake is 166g per day. This implies that the average consumption of fruit and vegetables is only 386g per day, compared to the recommended value of 400g per day (EUFIC, 2012). Similarly, Freshfel's Activity Report (2016) suggests that the estimated net consumption in the EU-28 aggregate stood at 341.82 g/capita/day of fresh fruit and vegetables in 2013, which was under the minimum threshold of 400g recommended by WHO.

Additionally, national dietary surveys comparing consumption against dietary recommendations report similar findings. For example:

- According to the food intakes of approximately 5000 respondents[21] to the Living Costs and Food Survey (cited by Wrieden and Barton, 2015), in 2014, the mean fruit and vegetable consumption appeared to be just over three portions or 253g a day, which is considerably less than the national goal of five portions (equating to 400g). Additionally, there was no significant increase in consumption of fruit and vegetables in Scotland between 2001 and 2012; the mean consumption of fruit and vegetables only increased by 10g over the 12 year period, mostly due to an increase in fruit consumption.
- On the basis of limited data, fruit and vegetable consumption appears to fail to meet recommended levels in Southern countries (such as Portugal, Spain, Italy, Greece and Cyprus). For example, in Spain, a nutritional assessment of the national diet[22] (Pozo de la Calle et al., 2012) revealed that the consumption of vegetables and fruits is below the recommended intake levels.

As discussed earlier, sociodemographic differences (age, gender and socio-economic status) contribute to the extent to which recommended fruit and vegetable intakes are achieved. For example, EHIS (2016) data highlighted that the proportion of Europeans consuming the daily WHO recommended intake of fruit and vegetables was highest among those with a higher education level compared to a lower education level (18.8% compared 12.1%). This difference was most pronounced in the United Kingdom; in spite

[20] EFSA compiled national food consumption data (Concise European Food Consumption Database) in order to assess food intake in Europe. Data was collected using a variety of methods (i.e. dietary records, quantitative reports, recall and interviewing) at a country level, and MS sample sizes varied between 853 and 4825. Adjustments of the compiled data allow for a certain level of comparison. Data was collected in: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, the Netherlands, Norway, Poland, Slovakia, Sweden, and the United Kingdom. Data was accessed in 2010.

[21] The results are weighted to the Scottish population - the number provided is approximately 1000th of the Scottish population. Respondent size varied between 2001 and 2012 from 4906-5181. In 2014, the respondent size was 5260.

[22] A survey was conducted with a sample of 8,000 households. Food purchase data was recorded over seven days.

of having the highest proportion of respondents achieving the WHO target in the EU overall, only 24.9% of people with a lower education level were likely to eat five or more portions of fruits and vegetables a day, compared to 40.5% of those with a higher education level. Similarly, HBSC and EHIS data shows that adolescents and males are most likely to fail to meet WHO targets.

Finally external factors, such as the levels of deprivation in an area may also have an influence, as suggested by Gordon, Robinson and McCartney (2011). In their national study of Scotland, only 13% of adults met healthy eating recommendations for fruit and vegetable intake in 2003 and 2008 in the most deprived areas of the country. The authors argue that, based on a linear trend, these inequalities will remain in 2018; an estimated 11-17% of adults in the most deprived areas will be healthy eaters in 2018 compared to twice as many in the least deprived areas (25-34%).

3.2.4.2 Wholemeal[23] cereals and breads, potatoes, pasta and rice

This food group is the main dietary source of starch (a glycaemic carbohydrate), and also contributes to dietary fibre intake (i.e. when wholemeal or wholegrain products are brought) (EFSA, 2009).

Based on food availability and consumption data, The European Nutrition and Health Report (Elmadfa et al., 2009) summarises:

- Bread and potatoes are important components of meals in Northern, Central and Eastern Europe, possibly contributing to the reported comparatively high carbohydrate intake in these regions;
- DAFNE data shows that there is a higher daily availability of cereals and bread in Italy, Cyprus and Latvia compared to in other European countries, though there was variation in what was consumed (i.e. pasta and bakery products including pizza in Italy; and bread and rolls in Cyprus and Latvia); and
- The consumption of starchy roots (tubers) and potatoes was highest in Central and East Europe (around 165g/capita/day respectively), followed by Northern (126g) and West Europe (97g). The value for Southern Europe was notably low (only 48g/capita/day).
- Using historic FAO food balance sheet data, Balanza et al. (2007) also reported that the availability of cereals per capita, per day had decreased over time across Europe. Whilst cereals and breads were key components of the Mediterranean and Eastern Europe diet in the 1960s (and provided greater calories than in Northern countries), there was a significant fall (30%) in the energy supplied by cereals in Mediterranean Europe between the 1960 and 2000.

The consumption of wholemeal foods is not measured routinely in national dietary surveys, but some national data is reported by EUFIC (2015). This suggests that high proportions of the public do not eat wholegrain at all – for example, 18% of adults and 15% of children and teenagers do not consume any wholemeal food products on a daily basis in the UK; and, similarly, in France 55% of children and 68% of adults in France also do not consume any wholegrain every day. Among those that do eat wholemeal products every day, over 70% ate less than 32g of wholegrain in the UK study, and half of all respondents in the French survey ate less than 10g per day. In contrast, Nordic countries seem to have higher intakes of wholemeal products such as rye bread. In this instance, wholegrain consumption in Denmark has reportedly increased (from 32g in the 2000-2004 national dietary survey to 55g per day in the 2011-2012 survey).

[23] Wholemeal, wholewheat and wholegrain are synonymous terms, and used interchangeably in this review

One of the main factors in decreasing wholegrain intakes is the increased availability of cheaper 'refined carbohydrates' (Fulponi, 2009). Notably, access to wholemeal cereals and bread may be linked to income; for example, in Scotland (Wrieden and Barton, 2015) the consumption of brown wholemeal bread and breakfast cereals (all types and wholegrain/high fibre) were highest in the least deprived quintile. However, this may only be true of certain MSs, for example, EUFIC (2015) reports that in Finland, the highest intakes of rye bread were observed in the lower social groups.

Comparison against guidelines

Dietary guidelines for breads, cereals, potatoes, pasta and rice in Europe vary in recommendations from 2-4 to 8-10 servings a day (WHO, 2003) and in general, WHO and national authorities tend to encourage the consumption of starchy and fibre-rich foods for this category. For example, according to the FAO website, Belgian guidelines recommend that citizens "choose carbohydrates and fibre-rich foods, such as baked potatoes (3–5 portions), wholemeal pasta and rice, brown bread and cereals".

It is clear that there is a special focus on improving intakes of wholegrain products. However, EUFIC (2015) reports that even in Nordic countries where higher intakes of wholemeal products are observed, average intakes in Sweden, Denmark and Norway appear to still fall short of the current recommended level of 75 g/day, with only between 16% (of Danish men) and 35% (of Norwegian women) meeting national guidelines. Still, there appears to be some trend towards eating more wholemeal food – the proportion of Danes meeting the recommended daily intake increased from 6% to 27% between 2000 and 2012 (EUFIC, 2015).

3.2.4.3 Milk, yoghurt and cheese

Milk and other dairy products are an important source of animal protein and fat. Average dairy consumption in Western Europe is equivalent to approximately 300 kilograms (per person, per year) in milk and milk-based products, which is up to six times greater than consumption in Asia and Africa (FAO, 2010). Westhoek et al (2011, citing FAO 2006) report that total global consumption of milk is expected to double between 2000 and 2030 and increase by another 20% in the following 20 years, suggesting that consumption of milk and milk-based products will continue to grow in Europe.

However, Westhoek et al. also state that there is almost a threefold difference in consumption of dairy products between the highest and lowest consumption countries. Finland and Sweden consume the highest amount of dairy produce in the EU, at more than 50% the average, followed by the Netherlands and Greece. In France, Denmark, the Netherlands and Greece, cheese is the dairy product of choice, whereas Ireland and Finland consume more milk. Sweden has equally high consumption levels for both milk and cheese.

On the basis of data from the EFSA Concise Database, Elmadfa et al. (2009) also suggest that the highest consumption of milk and dairy-based products is in Northern Europe (e.g. Norway, Finland and the Netherlands) where MSs consume on average over 400g/capita/day, and the lowest in the Southern region where consumption is around half as much (212g) a day. Intake was also low in Austria, Poland and the Czech Republic (less than 200g).

Comparison against guidelines

National dietary guidelines compiled on the FAO website indicate that MSs have large differences in their milk and dairy product guidelines. For example, Denmark and Bulgaria recommend choosing low-fat dairy products; the Netherlands suggest taking "a few portions of dairy produce daily, including milk or yogurt"; and Hungary recommends

drinking 0.5 litres of milk every day, as well as eating fermented dairy products (including yoghurt and reduced-fat or low fat cheese and cottage cheese often. As a result, a cross-comparison of European consumption of milk, yoghurt and cheese compared to guidelines is not possible.

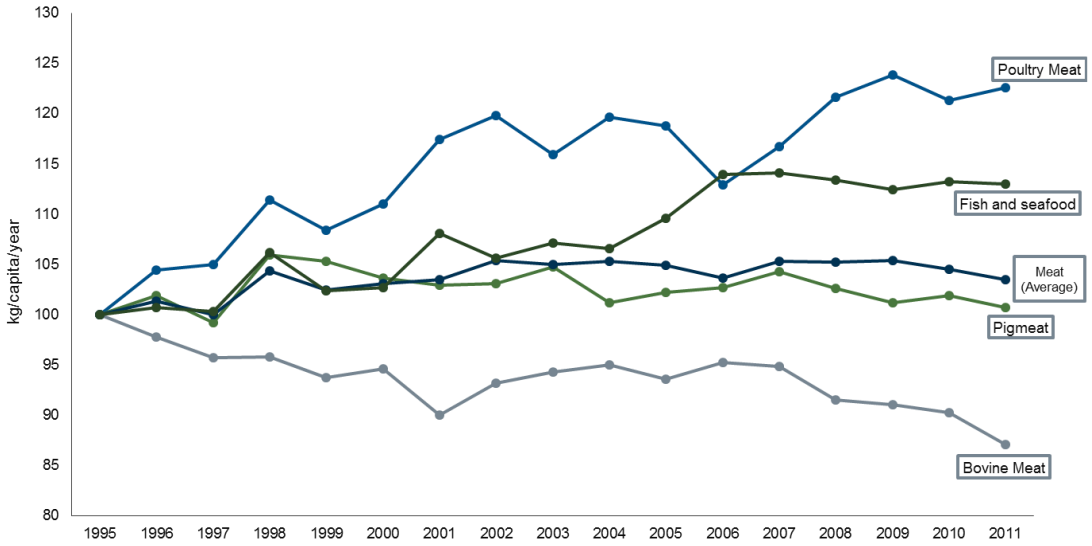
3.2.4.4 Meat, poultry, fish, eggs, beans and nuts

On average, EU citizens are recorded as consuming roughly 68.3kg per capita of meat (excluding fish) per year– this is more than the world average but less than North America. Pork accounts for the largest portion (33kg), followed by poultry (23kg), beef and veal (10.8kg), and sheep (2kg) (OECD 2016[24]).

A trend analysis of meat consumption (Figure 3) using data from the FAO Livestock and Fish Primary Equivalent dataset was published by the EEA in December 2016[25]. This shows that consumption of meat per person, per year has increased by 2% between 1995 and 2011, however, most of this increase occurred before 2008. Other sources confirm these findings. For example, OECD and DG AGRI data suggests that meat consumption in the EU has generally been stable over the last 20 years. However, this masks significant sectoral variations. For example, as shown in Figure 3, between 1995 and 2011, consumption of beef fell by 13%, whilst in comparison the consumption of poultry increased by 23% (EEA, 2016). The decrease in beef sales appears to be attributable to the bovine spongiform encephalopathy (mad cow disease) crisis from 1996, as sales recovered slightly after this. Looking at future trends, the OECD (2016) expects beef consumption to increase around 6% in developed countries (including the EU); no projections were available for other meats.

Figure 3 also shows that fish and seafood consumption in the EU has increased by a greater percentage (13%) than average meat consumption over the same period. In particular, the consumption of freshwater fish (not shown[26]) increased by 95% between 1995 and 2011.

Figure 3. Trends in the consumption of meat and fish (kg/capita/year) in the EU between 1995 - 2011



[24] Consumption measured in thousand tonnes of carcass weight (except poultry, expressed as ready to cook weight), in kg of retail weight. In other words, calculation is based on the amount of meat sold.

[25] The quantities of food available for human consumption, as estimated in the food balance sheet, reflect only the quantities reaching the consumer. The per capita EU-28 consumption is indexed to 1995.

[26] The figures for fish and seafood are summed to form a single final category rather than individual figures.

Source: Consumption of meat, dairy, fish and seafood (adapted from EEA, 2016)

The consumption of meat and fish varies between MSs. In particular, data from the EFSA Concise Database reported in the European Nutrition and Health Report (Elmadfa et al., 2099) shows that the consumption of meat and meat products was higher in Central and Eastern Europe at nearly 200g/capita/day, compared to Western Europe (around 175g/capita/day) and Southern and Northern Europe (less than 150g/capita/day). In contrast, the highest consumption of fish and seafood was found in the Southern region; more than twice the amount of fish and seafood was eaten in comparison with the Central and Eastern regions (43g/capita/day compared to 18g/capital/day respectively).

Likewise, the consumption of eggs also appears to vary by MSs. On the basis of the Concise Database, Elmadfa et al. report that the consumption of eggs followed a similar pattern to the consumption of meat, and was highest in the Central and East region averaging 25 g/capita/day, followed by the South, West and North regions of Europe (18g, 18g and 17g respectively). The highest levels of consumption were found in Poland, Hungary and Estonia, and lowest in Austria, Belgium and Sweden.

Non-animal food products in this food category, i.e. legumes, beans and nuts, seem to have grown in popularity in recent years (in line with a focus on healthy and sustainable diets, as explored in Section 3.2.3.2). For example, in the UK, legumes, nuts and oilseeds have increased as 'natural' meat replacements, and predictions for future 'Live Well' plates suggest that more and more people will opt for environmentally-friendly, healthy and specialised diets which will see an increase in these food products (WWF, 2017). Nevertheless, as emphasised by the United Nation's International Year of Pulses[27] campaign in 2016, the consumption (and production) of legumes, beans and nuts in Europe is still fairly low compared to other countries. Further research into consumption of legumes, beans and nuts is required to verify this finding.

Importantly, along with dairy products (explored in Section 3.2.4.3), meat, poultry, fish, eggs, beans and nuts are important sources of protein for Europeans. This is confirmed by Halkjaer et al. (2009) – their study aimed to describe the total intake of proteins among a sample of 3,6034 adults (aged 35-74) from ten European countries[28] using data from the European Prospective Investigation into Cancer and Nutrition (EPIC) study administered between 1995 and 2000[29]. This study found that fish was a large contributor of animal protein, particularly in Spain, Greece and Norway and processed meat was the major contributor of animal protein in Germany and the Netherlands. Notably, protein intake varied by country with the highest in Spain (107-144g/day) and lowest in Greece (88g/day).

Comparison against guidelines

Definitions of and national dietary guidelines on meat, fish, eggs, beans and nuts vary considerably across the region (WHO, 2003), but according to the FAO website, recommendations tend to emphasise eating:

- Lean cuts of meat, and restricting red meat intakes. For example, Finnish guidelines state: "When eating meat, choose low-fat, low-salt products and limit the amount of red meat and meat products to < 500 g a week"
- More fish, pulses and eggs. For example, in Bulgaria there is a recommendation to "replace meat and meat products often with fish, poultry or pulses, and in the UK

[27] For more information, please see: http://www.fao.org/pulses-2016/resources/non-fao-resources/en/

[28] Denmark, France, Germany, Greece, Italy, Norway, Spain, Swede, the Netherlands and the United Kingdom

[29] Data came were collected using 24-hour dietary recalls were administered through in-person interviews (phone interviews were conducted in Norway).

there guidance is to "eat some beans, pulses, fish, eggs, meat and other proteins (including 2 portions of fish every week, one of which should be oily)".

However, Westhoek et al. (2011) find on average:

- Red meat consumption is about 37 kilograms per capita, per year, which is much more than the recommended 16kg per year. Consumption is highest among the EU-15, with the highest intake recorded in Austria (50kg per capita per year);
- Europeans consume 7kg in fish and other seafood per year, which is half the recommended amount of about 14.5 kilograms, per capita, though there is variation in consumption by country. For example, Portuguese consumption of fish is twice the EU average, and they are the only country meeting the recommendation of 14.5kg.

As previously mentioned, meat, poultry, fish, eggs, beans and nuts are important sources of protein for Europeans. The WHO recommends a daily protein intake of 10 – 15% of the total dietary energy supply, which results in a recommendation of between 50 to 75g of protein a day (Westhoek et al., 2011) and EFSA suggests an average requirement of 0.66g of protein per kg of body weight per day, based on nitrogen balance data (EFSA Panel on Dietetic Products, Nutrition and Allergies, 2012). However, FAO estimates showed that actual protein consumption[30] between 2000 and 2009, was over 100g per person, per day (PHEIAC, 2013), which is much higher than the recommended amount. Halkjaer et al.'s study also illustrated that animal protein accounts for a higher proportion of total protein intake (55-73%) than plant protein (24-39%).

3.2.4.5 Fats, spreads and oils

When eaten in balance, fats and oils are a *"valuable source of concentrated energy and essential fatty acids needed for growth and development"* (Woodgate and van der Veen, 2014). This section specifically considers the general consumption of natural animal and vegetable fats and oils; food products high in fats linked to negative health habits are discussed in the following section Worldwide, 134 million tonnes of natural animal and vegetable fats and oils[31] are consumed every year (REA, 2013, cited in Woodgate and van der Veen, 2014), and the average global supply of fats has increased by 20g per capita per day since 1967-1969 (WHO, 2003). On the basis of dietary surveys available for 16 MSs in the EFSA Concise Database[32], Elmadfa et al. (2009) found that the highest intake of fats was reported in the Central and East region (at around 39g/capita/day), and the lowest intakes were report in the West region (28g/capita/day).

Whilst nearly 3 million tonnes of animal fats produced annually in Europe, this is mainly for animal feed (26%) and pet food (13%); oleo and soaps (22%); and energy and biodiesel (19% and 15% respectively) (data from EFPRA, 2011 cited in Woodgate and van der Veen, 2014). In spite of the aforementioned increase in global supply of fats, according to the European Nutrition and Health Report, the supply of animal fats in the EU has actually remained relatively constant. It is notable that the supply of animal fats to the North region actually decreased over the last 40 years (Elmadfa et al., 2009).

[30] This was is an estimate of average dietary protein availability taken from the Food Balance Sheets (FBS) which provide the most comprehensive measure of food availability at country level. It reveals the extent to which the food supply of a country is adequate in relation to nutritional requirements.

[31] Animal fats classified by FAOSTAT include butter, ghee, fish liver oil, whale oil etc. Vegetable oils include rape and mustard seed oil, sunflower seed oil, cottonseed oil, linseed oil, hempseed oil, sesame seed oil, copra and coconut oil, palm kernel oil, palm oil, soybean oil, olive oil, maize oil etc. (Elmadfa et al., 2009).

[32] As the available data on food consumption is collected using different survey methodologies, this may under- or over-estimate actual consumption in each region.

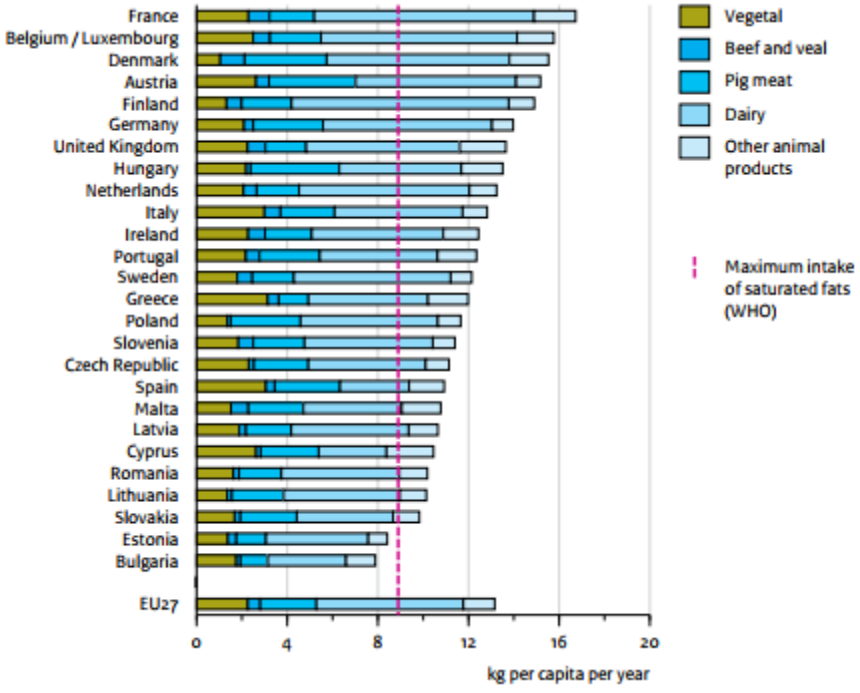
In contrast to animal fats, studies have traditionally documented vegetable oils as the preferred source of fat in the South, and vegetable fat in Central/Northern Europe, though vegetable oils have gained popularity in newer MSs such as Slovenia, Latvia and Hungary (Elmadfa et al., 2009). Analysis of Food Balance Sheets by Elmadfa et al. (2009) shows that the average supply of vegetable oils in the participating countries increased from 1961 to 2003, with high levels of supply in Southern countries. Further, Tennant and Gosling (2015) estimated consumer intakes of vegetable oils and fats in France, Denmark, Hungary, Finland, Germany, Sweden and the United Kingdom, using national dietary data compiled in EFSA's Comprehensive National Food Consumption Database[33]. Whilst results are not directly comparable by MSs because of differences in the methodology of the national surveys, Tennant and Gosling find that vegetable oils make up a significant part of the energy intake in typical European diets.

Comparison against guidelines

According to guidelines in the WHO (2003), total fats should be restricted to under 30% of daily energy intakes. Importantly, dietary guidelines compiled online by FAO, show that MSs try to encourage the use of 'good' fats (for example, unsaturated fatty acids such as olive oil or oils rich in nutrients such as omega-3 and omega-6), whilst also discouraging intake of 'bad' fats – for example, the Danish guidelines suggest that Danes should eat less saturated fat.

Nevertheless, as shown in Figure 4, data suggests that European countries still eat too much saturated fat, with consumption levels on average 40% higher than the maximum recommended by WHO guidelines (Westhoek et al., 2011). The following section focuses specifically on the consumption of such fats.

Figure 4. Intake of saturated fat form vegetal, animal and dairy sources



Source: Westhoek et al., 2011

[33] All FoodExL2 categories in the database were reviewed, and polyunsaturated fatty acids estimates for foods in each of the 22 food categories identified as potentially containing vegetable oils and fats (either endogenous, as direct ingredients, or introduced during cooking) were derived.

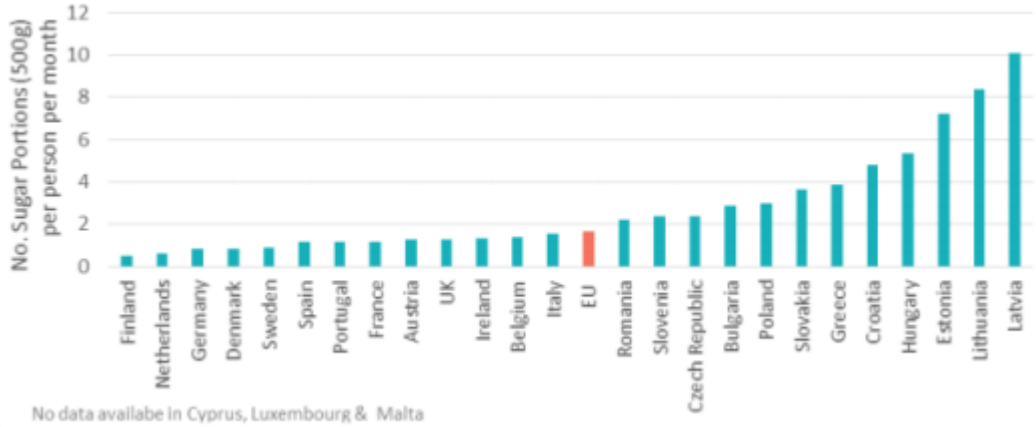
3.2.4.6 Foods and drinks high in fat, sugar and salt

Foods high in fat, sugar and salt are a common source of calories for individuals in the EU, but as they do not contain many nutrients they are often considered 'unhealthy' in larger quantities (WHO International, 2015[34]). There are a number of reasons why Europeans may choose to buy foods and drinks high in fat, sugar and salt despite knowledge of the health risks associated with eating these foods. For example, products that are high in fat, sugar and salt tend to be cheaper, and provide calories at a low cost. Therefore, individuals and families with limited resources may select energy-dense foods that are high in added sugars, fats or salt – compared with more expensive foods (per calorie) like fruits and vegetables – in order to save money (Geurts et al., 2017). Likewise, children may prefer to eat sugary or salty pre-packed snacks and products like chocolate bars as they are *"instantly available, can be eaten straight away, do not require any time-consuming preparation, can be carried in your school bag without getting squashed and soggy and because the taste and quality is guaranteed"* (Krølner et al., 2011).

As the excess consumption of fats, sugar and salt is a worryingly common trend among children, a large proportion of research is dedicated to this age group. For example, based on data from the IDEFICS study, Fernandez-Alvira et al. (2014) found that children commonly ate foods that are characterised as heavily processed (which also tend to be high in fat, sugar and salt, e.g., fried potatoes, fried fish, hamburgers, hot dogs, crisps, savoury pastries, sweetened drinks, biscuits, ice cream or chocolate). National patterns were also apparent, for example in Germany a distinct dietary pattern was characterized by consumption of dessert foods/confectionaries; and Estonia and Hungary had a consumption pattern depicted by consumption of white bread, cold cuts, preserved meat products and fried meats (sandwich products dietary pattern).

In regards to sugar consumption, as illustrated in Figure 5, sugar intake is highest amongst individuals living in Eastern European countries (Latvia and Lithuania) and 'newer' MSs, and tends to be lowest among the EU-15 countries. In general, the average European will consume nearly 1kg of sugar a month.

Figure 5. Sugar consumption/sales for individuals living in EU Member Countries



Source: World Obesity

National dietary surveys highlight that there are a wide range of food and drink products consumed by Europeans which tend to be high in added sugar. For example, in the UK, the 2013 Living Costs and Food Survey (LCFS) undertaken in 4,993 households across the UK (cited in Griffith et al., 2016), shows that around 19% of all total added sugar

[34] More information about healthy diets can be found here: http://www.who.int/mediacentre/factsheets/fs394/en/

purchases made by households were related to chocolate and confectionery purchases, followed by raw sugar (18%), biscuits and cakes (15%) and carbonated soft drinks (12%). In addition, consumption of sweets has increased in Mediterranean and Eastern European countries (Elmadfa et al., 2009).

HBSC (2016) data provides further information about sugar consumption among children and adolescents. On the basis of this data, overall in 2013, an average of 22% of 11 year olds, 25% of 13 year olds and 24% of 15 year olds ate sweets once a day. The countries with the lowest frequency of sweet-eating were the Nordic countries (all less than 10%, many less than 5% a day), with French-Belgium (40%) and Scotland (35%) amongst the highest consumers. There were only relatively minor gender differences in sweet consumption (girls are around 3 percentage points more likely to eat sweets daily than boys), particularly compared to other foodstuffs (notably fruit and vegetables). Data on this question was only collected in the 2001/02 and 2013/14 surveys, published in 2004 and 2016 respectively. Additionally, research on the consumption of sugar-sweetened beverages (SSBs) among children and adolescents shows:

High intakes of SSBs among pre-school aged children (age 4-6) in Poland (156 ml/day), Belgium (66 ml/day) and Germany (44 ml/day), and low intakes in Spain (14ml/day) and Greece (13ml/day) – children in Poland consume the most tea and soft drinks and bottled juice on average, whilst children in Greece consumed the most pure fruit juice (De Craemer et al., 2015; Pinket et al., 2015);

In the four Nordic countries, there has been a decrease in the daily consumption of SSBs among adolescents in Norway, Finland and Sweden between 2001/2002 and 2009/2010 (with a significant decrease between 2001/2002 and 2005/2006). In Denmark, consumption of SSBs among adolescents increased between 2001/2002 and 2005/2006, but subsequently fell. (Fismen et al., 2016)

Finally, food products high in salt include bread, meat products, cheeses and ready meals (European Commission, 2013). Salt intake varies across Europe. It appears generally highest in Eastern and Central Europe (countries with the highest intake were Hungary (15g per day), Croatia, the Czech Republic and Bulgaria (all 14g per day)). However, there were exceptions, with Poland and Latvia (both 6g) amongst the lowest consumers (WHO Europe 2013[35]).

Comparison against guidelines

Guidelines for this food group are focused on limiting intake, and vary in description. For example, the WHO recommends that individuals should not consume more than 5g of salt a day, and suggest that 'free' sugars should (at the minimum) not make up more than 10% of the daily energy intake[36]. National guidelines are more prescriptive, and in most countries, there are separate dietary recommendations for total fat intake as well as saturated, monounsaturated, polyunsaturated and trans- fatty acids (EFSA, 2017)

National evidence indicates that fat and sugar consumption has been declining, but still remains above nationally recommended levels. For example, Bollars and Middelbeek (2009) summarised that in Denmark[37], following initial increases, sugar consumption levelled off in 2009, and fat consumption declined since 1985. However some 60% of

[35] Care should be taken in comparing between countries as WHO data is drawn from country level surveys, each of which may have used different data collection methods.

[36] This applies to both adults and children, with the further recommendation that the intake of free sugars should be below 5% of the total energy intake. http://www.who.int/elena/titles/free-sugars-children-ncds/en/

[37] Denmark has been conducting national dietary surveys since 1985. Over 7000 people aged between 4 and 75 years participated in a dietary survey in the period 2000 – 2006. They were asked to record their dietary intake in pre-coded food diaries for 7 consecutive days. Production data for various oils and fats from Eurostat was also examined.

children still consume too much refined sugar, and 8 out of 10 children and adults still consume more than the recommended allowance (30 E%) of fat (particularly saturated fat). Similarly, a DEFRA survey titled 'Family Food 2012' (cited in Snowdon, 2014)[38] undertaken in the UK indicates that per capita consumption of sugar, salt and fat has been falling in the UK for decades (i.e. per capita sugar consumption has fallen by 16 per cent since 1992), but again, daily consumption remains higher than recommended.

A specific focus on children is apparent in regards to monitoring sugar consumption against recommended daily allowances. For example, in the UK a recent survey conducted for Public Health England's Change4Life campaign[39] found children in England consume more than 11g of sugar (almost 3 cubes) at breakfast time alone. National data obtained from the LCFS surveys conducted between 2001 – 2013[40] (cited in Griffith et al., 2016) further show that sugar consumption tends to exceed the national Scottish recommendation of 5% of daily energy intakes – in fact, the amount of added sugar from soft drinks and confectionery alone exceeds the national recommendation of calories from added sugar. As noted by EFSA (2017) in their summary of dietary reference values, it is notable that this trend is consistent with other EU MSs.

Salt intake among Europeans also remains high, with nearly all countries exceeding the 5g target in the EU (EUFIC, 2010). National estimates suggest that salt consumption does appear to be decreasing in some MSs (European Commission, 2013). For example, Public Health England (2015) produced an estimated salt intake trend analysis for England, which suggests salt intake has decreased by 0.9g/day (11%, from 8.8g to 8.0g per day) between 2005 and 2014[41]. However, this still exceeds the recommended daily intake. Similarly, as reported in the Survey on Member States' Implementation of the EU Salt Reduction Framework, three MSs (Finland, France and Lithuania) measured a decrease in salt intake (by 26 %, 5.2 % and 27 % respectively) in the periods preceding the implementation of the Framework (European Commission, 2013).

3.2.5 Concluding remarks

This section has outlined extensive research into the consumption habits of Europeans. Overall, consumption habits appear to be changing and converging across Europe as a result of a number of factors including individual preferences and choice, the increased availability of food products through global food manufacturers, and higher disposable income. These factors have also influenced the amount of food and drink that Europeans tend to consume.

By breaking down research according to food groups, it is noticeable that on the whole Europeans still do not meet European or national food-based dietary guidelines. Whilst there is a large amount of high-quality and relevant data on the consumption of fruit and vegetables to make cross-comparisons by sociodemographic factors (as well as by country) and to compare trends over time, further research is required in order to make the same assessments for all food groups.

[38] Family Food 2012 is a DEFRA report on the 2012 Family Food Module of the Living Costs and Food Survey (LCFS) based on diet diaries compiled by a cross-section of the public (5,425 households) and are supported by till receipts

[39] This was an online survey completed by 200 parents of children aged between 4 and 10 years, on the Bilendi market research panel, and took place in November 2016. Fieldwork was conducted in England only.

[40] Food and drink purchases of a representative sample of UK households (between 5,000 and 7,500 households over 2001 – 2013) were recorded for two weeks, including food brought into the home, takeaways and food eaten out in restaurants and pubs.

[41] Within this overall trend there was a statistically significant reduction of 0.5g/day (approximately 6%) between 2005/06 and 2008/09. Although the data suggested a further gradual decline between 2008/09 and 2014, this did not reach statistical significance.

3.3 Research Question 2: When and where do Europeans eat and drink?

3.3.1 Section summary

This section presents an overview of the frequency and timing of eating and drinking occasions, as well as the locations in which they tend to occur. The first half examines the prevalence of structured mealtimes (e.g. breakfast, lunch and dinner) and snacking among MSs and younger and older Europeans. The remainder of the section focuses on 'where' Europeans eat and drink, with a specific focus on eating out.

Summary: When and where do Europeans eat and drink?

This section outlines the changes to when and where Europeans eat and drinks. Overall:

- A key driver of changing meal patterns appears to be a lack of time, which results in trends towards eating on the go and at irregular times. Nevertheless, the frequency and timing of eating and drinking occasions appears to vary considerably by MSs.
- There is a large amount of research into the consumption of breakfast by children, but little information is available about dietary intakes per meal for adults (including habits around eating at structured meal times).
- Europeans enjoy eating outside of the home, but this can have implications for energy intakes when food choices have a higher fat content and are more energy-dense than meals prepared at home.
- Future research also should focus on understanding the impact of the full range of food and meal options available to Europeans including delivery and meal kit services (as opposed to just a focus on eating away from the home).

3.3.2 When do Europeans eat and drink?

The frequency and timing of eating and drinking occasions appears to vary considerably by MSs. For example, Park et al (2017) compared meal patterns across Belgium, the Czech Republic, (Southern) France, the Netherlands, and Norway in order to investigate the frequency and time between eating occasions. In this cross-sectional study, dietary data, obtained from 559 respondents aged 44-65 years using standardised 24-hour recalls as part of the European Food Consumption Validation Project (EFCOVAL), was analysed. Their findings suggest that mean eating frequency ranges between countries, from 4.3 times a day in France to 7.1 times a day in the Netherlands. The Czech Republic had the longest mean period of overnight fasting; there were nearly 11 hours between the last meal they had and the first meal they had the following morning. Further research is required to understand whether this pattern is representative of the entire population in the countries studied.

In another cross-sectional study, Huseinovic et al (2016) examined 24-hour diet recall data from 36,020 people (aged 35-74) participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) study between 1995 and 2000. This study confirmed that there were distinct differences in meal patterns within and across the ten European countries investigated[42], and among men and women. For example, the authors found that mean intake frequency for women ranged from 5 times a day in Greece and Italy, to 7 times a day in the Netherlands, and for men from 4.9 times a day

[42] Data was collected from 27 research centres in Denmark, France, Germany, Greece, Italy, the Netherlands, Norway, Spain, Sweden and the United Kingdom.

in Italy to 6.8 times in the United Kingdom. There was thus a 'south-north gradient' in intake frequency, with Mediterranean countries having fewer intake occasions a day, compared to central and northern Europe. This is likely linked to cultural variation around the timing and importance of different meals, as well as the setting in which they are eaten.

The remainder of this section considers the consumption habits of Europeans according to the traditional meal structure of three main meals (breakfast, lunch and dinner) and time spent snacking in-between meals.

3.3.2.1 The prevalence of eating breakfast, lunch and dinner

Main meals are traditionally defined as eating breakfast, lunch and dinner at three points of the day – the morning, the afternoon and the evening respectively. A substantial amount of research is focused on breakfast; whether people eat breakfast and, if they do, what they eat. However, as outlined below, research tends to be focused on children, reflecting well-established links between breakfast eating and concentration levels at school, as well as its role in establishing good dietary habits throughout life (HBSC 2016).

Children and adolescents

The breakfast consumption habits of children and adolescents, and the importance they attach to this meal, varies across Europe. Self-reported data collected for the HBSC study in 2013/14 shows that, in general, older children were less likely to eat breakfast daily compared to younger children[43]. However, there were major geographic differences: the Netherlands appears to have the highest percentage of boys and girls, across all age groups, who eat breakfast everyday (around 80%) whilst Slovenia has one of the lowest percentages (around 50%). Historic HBSC data, analysed by Lazzeri et al (2016), further illustrates that daily breakfast consumption in European countries only increased significantly in the Netherlands, Scotland, Wales and England between 2002 and 2010. In addition, the proportion of adolescents reporting daily breakfast consumption was lower in 2010 compared to 2002, and the practice was more common among boys than girls.

Results of the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study[44], which aimed to describe the breakfast habits and food choices of 3528 adolescents across ten European cities in nine MSs (Greece, Germany, Belgium, France, Hungary, Italy, Austria, Sweden and Spain), highlight further variation in the breakfast consumption practices of adolescents. Only half of the adolescents interviewed indicated being 'regular breakfast consumers', and the study also found that there were socio-demographic differences influencing breakfast consumption and food choices at breakfast (Hallström et al., 2011). Specifically, girls with mothers who had a high level of education (compared to lower education); boys from 'traditional' families (compared with boys who lived in single-parent/shared-care families); and, boys who perceived being from a family of less affluence (compared to boys who perceived being from an affluent family were more likely to consume breakfast daily. Parental encouragement (only in boys) and peer influence to eat healthily (in girls only) were also associated with regular breakfast consumption.

This is consistent with findings from some national studies. For example, Butland et al (2007) found that in the UK, breakfast consumption is socially patterned, with children from poorer backgrounds more likely to skip breakfast than those from wealthier families. The authors suggest that this may be a reflection of affordability as well as

[43] Young people were asked how often they eat breakfast, defined as more than a glass of milk or fruit juice, on school days and at weekends.

[44] The HELENA Study is a 'school-based multi-centre study', designed to obtain reliable and valid data on nutrition and health-related factors from a sample of over 3000 adolescents aged between 13 and 17 years in 10 European cities (Athens, Dortmund, Ghent, Heraklion, Lille, Pecs, Rome, Vienna, Stockholm and Zaragoza.

differing social norms and attitudes towards breakfast and what constitutes a healthy breakfast.

Lunchtime food consumption in children and adolescents appears to vary as a result of when and where lunch is consumed. For example, Müller et al. (2013) examined a sub-sample of 891 adolescents in the HELENA study, to estimate food and energy intake at lunchtime[45]. Their study found that adolescents tended to get their lunch at home (67%), followed by at school (26%) or elsewhere (7%). Absolute lunchtime energy intake ranged from 2425 kJ in school lunches to 2927 kJ elsewhere. Although energy intake was nearly always in line with recommendations wherever lunch was obtained from, the food intake was 'suboptimal' when adolescents were not getting their lunch in school. In particular, the consumption of sweet foods (including sugar-sweetened beverages) highly exceeded recommendations when lunch was eaten at home or elsewhere.

Research on dinner patterns among children and adolescents was more limited. The HBSC survey (2016) found that only one in five teens surveyed in the HBSC study (2016) eat dinner with their parents, implying that the timing of eating occasions vary even in the same household.

Adults and older adults

Huseinovic et al. (2016) find that among adults (aged 35-74) participating in the Cancer and Nutrition (EPIC) study between 1995 and 2000, main meals were consumed regularly with above 85% and 76% consuming breakfast and lunch daily, and between 90-99% eating dinner daily. However, Huseinovic et al. note that differences among MSs were found in energy intakes provided by each meal. For example, between 38% and 45% of the daily energy intake was provided by lunch (38-43% for women and 41-45% for men) in Mediterranean countries, compared to between just 16% and 27% (16-27% for women and 20-26% for men) in central and northern European countries. Furthermore, participants in the EPIC study from central and northern Europe appeared to eat lunch less regularly than those in Mediterranean countries. These differences could be influenced by a number of factors, such as the likelihood of the midday meal being eaten away from home as a result of daily schedules or shorter lunch breaks for working adults.

Older adults eat three meals a day less regularly than younger adults, though variations exist between MSs as highlighted by data from the aforementioned 10-year SENCA study, which aimed to understand whether different mealtime patterns can influence the onset and development of disease (in accordance with circadian timing). As summarised by de Groot et al (2004), this baseline study revealed:

- Breakfast and lunch were consumed roughly at the same time across all 12 countries being studied, however dinner in Portugal and Spain was consumed later in the evening than in the northern European countries;
- Participants in towns in the Netherlands and Switzerland consumed foods on more occasions per day than participants in towns in more southern geographic regions such as Portugal and Italy; and
- Lunch contributed to 45-48% of daily energy intake in Italy and France as compared to 21-33% in Northern and central Europe.

[45] This was compared to the lunch described by the Optimized Mixed Diet, which is a tool consisting of food-based dietary guidelines for children and adolescents.

3.3.2.2 Snacking

Snacking is often perceived to be 'unhealthy' as a result of the types of foods consumed, and the opportunities for higher calorie and overall consumption as a result of more frequent eating occasions (Huseinovic et al., 2016).

Snacking appears to be common in younger children across all MSs. For example, De Craemer et al. (2015), examined snacking behaviours among preschool-age (aged 4-6 years) children with data collected from the ToyBox Study. Dietary records from 7,244 parents in six European countries show that more than 50 grams of these unhealthy snacks[46] are consumed per day across countries (Greece: 53 g/day; Spain: 59 g/day; Germany: 61g/day; Bulgaria: 62 g/day; Poland: 68 g/day; and Belgium 73g/day).

Huseinovic et al. (2016) found that among adults the three-meal pattern was still fairly prevalent across Europe, though the number of intake occasions per day were higher on average, especially in Northern and Central Europe. Consequently, energy intakes from snacking were higher for these regions; in Central and Northern European countries, snacking contributed to around 24-34% of the daily energy intake in women and 23-35% in men, compared to just 13-20% of the daily intake in women and 10-17% in men in Mediterranean countries.

However, national evidence does not appear to be fully consistent with this. For example, Tavoularis and Mathe (2010) report that the model of three main meals at relatively fixed times is still a strong characteristic of the French diet, with eating (or 'snacking') between these meals far less common than in the US – snacking in-between meals accounts for 10% of overall calorie intake in France, compared to 22% in the US[47]. Importantly, this proportion only accounts for those admitting regularly snacking between meals; it is likely that there is under-reporting or poor recall, which could explain the higher figures reported by Huseinovic et al. Further research is required to fully confirm the patterns and trends in snacking habits among Europeans.

3.3.3 Where do Europeans eat and drink?

Eating out-of-home has increased during the last few decades in Europe as a result of social, cultural and environmental changes (D'Addezio et al., 2014). 'Eating out' refers to the practice of eating outside the home, though the settings and establishment in which that can happen varies. For example, in her exploration of customer expectations of eating out, Westhead (2012) defines 'eating out' as eating in any establishment which prepares and serves food and drink for consumption on the premises by customers in return for money. However, definitions of 'out-of-home' food consumption can also relate to where food was bought, as opposed to where it was eaten. Thus, two commonly used, but clearly different, definitions of out-of-home consumption are: a) food items sourced from external locations, irrespective of place of consumption; b) food items consumed at external location, regardless of whether items are prepared inside or outside the home (HECTOR Deliverable 2.5, 2009).

The lack of a common definition of 'eating out-of-home' has previously limited comparisons of dietary patterns across MSs. As a result, the 'Eating Out: Habits, Determinants, and Recommendations for Consumers and the European Catering Sector' (HECTOR) project was set up with the primary aim of establishing a collaborative platform between the scientific community, consumer associations and catering enterprises to be able to describe the out-of-home dietary patterns of Europeans

[46] Unhealthy snacks were measured as intake of milk-based desserts; chocolate and candy bars; sugar-based desserts; cakes; biscuits; and salty snacks.

[47] US data source: National Health and Nutrition Examination survey 2005-06; French data source: les Comportements et Consommations Alimentaires en France (multiple years).

(HECTOR Deliverable 2.5, 2009). Eating out information from 25,202 individuals (aged 35-64) in Austria, Belgium, Germany, Greece, Italy, Norway, Poland, and Portugal [48] was analysed, according to a core definition (i.e. meals, beverages and snacks consumed out-of-home)[49]. Findings suggest that ice cream, sweet and savoury products, non-alcoholic beverages (including soft drinks, hot drinks and juices), beer and spirits tend to be consumed more out of home than in home in all eight countries. However, there were some variations by MS:

- In the Northern and Central European countries, fruits are also reported to be eaten more out-of-home than in home;
- In Italy, Greece and Oporto-Portugal, sugar and sugar products (including chocolate and sweets) tend to be consumed more outside than in the home;
- Red meat is consistently reported to be preferred out of home than in home in Germany.

The study also found that the contribution of out-of-home eating to total energy intake was higher in men than in women, and for Northern and Central European countries than Southern ones (with the exception of Poland). On average, the proportion of total energy intake resulting from out-of-home eating ranged from 15% in Poland to 28% in Heidelberg, Germany for men and from 12% in Greece to 27% in Norway for women. The differences in energy intakes from out-of-home eating may reflect choices in terms of food or place of consumption, as well as the frequency of eating outside the home.

In a separate study, D'Addezio et al. (2014) confirmed there were differences between European countries in eating out. Their study employed data from 3003 respondents to a cross-sectional survey carried out in five European countries (Belgium, Denmark, Italy, Poland and the United Kingdom) as part of the Eatwell project[50]. Unlike the HECTOR study, the definition of 'eating-out' was broader and referred to "anywhere lunch and dinner were consumed away from home", which meant respondents were left to make a judgement about whether or not this also required having to buy food products outside the home. The study found that there were differences in out-of-home lunch and dinner consumption, as well as a significant association between nationality and frequency of eating out[51]. In more detail:

- On average, 32.5% of respondents ate lunch out-of-home once or more a week, most likely as a result of practical reasons like being at work or school. The highest rates of eating out more than three times a week were observed in Denmark (23.2%) and Italy (21.3%) had the highest rates of eating out at lunchtime, whilst the UK had the lowest (9.5%).
- Further, 14.8% of respondents on average also ate dinner outside the home once or more a week, with Italians eating their evening meal out the most regularly. In this instance, 25.6% of Italians ate their evening meal out on a regular basis, and

[48] The HECTOR database consists of nine European datasets which provide information on in-home and out-of-home dietary intake. This data was collected through single or repeated 24-hour dietary recalls and/or through 7-day food diaries (in two surveys), and was coordinated by regional or international research activities. As a secondary step, data for adolescents and younger adults was also analysed but data availability varied.

[49] When detailed data was available, out-of-home consumption patterns were also identified specifically for food and drink items produced by food services, including those eaten at home.

[50] The Eatwell project is a European study into issues surrounding nutrition policies and obesity. Stratified samples of 600 respondents (603 in the United Kingdom) were selected from a GFK NOP market research agency panel. The survey contained four questions to assess the frequency that respondents: eat out-of-home at lunch and in the evening; eat out in fast food restaurants; and, eat pre-packaged or prepared meals (e.g. takeout dinners). The response categories were: never, less than once a week, 1-2 times a week, 3-5 times a week, 6 or more times a week.

[51] The UK was chosen as a reference country as it reported the highest household expenditure for catering services in 2011 among the countries in question.

were three times as likely to regularly eat out at dinner compared to respondents from the United Kingdom.

D'Addezio et al. (2014) also investigated the relationship of out-of-home eating against sociodemographic and health factors and found that there was significant variation in eating out habits by age, marital status and body mass index. Younger respondents (aged 16-24 and 25-44), singles, and respondents in the 'normal' weight category ate convenience food and out-of-home, more than older and married/cohabiting people, and those who were in the overweight and obesity category. In addition, there were differences by education. For example, the proportion of people eating out at lunchtime at least once a week increased with education levels.

An increase in disposable income is another key factor in explaining the general increase in out-of-home food consumption. For example, in the UK, 22% of the household expenditure is spent on eating food outside the home, with the average customer spending £663 (approximately €750) a year on out-of-home food consumption (EatOut, 2011 cited in Westhead, 2012). However, the cost of eating out also needs to be taken into account. For example, D'Addezio et al. highlight that Denmark is known for being one of the most expensive countries in Europe to eat out in, and this could explain the low rate of people eating out at dinner[52].

Costs of eating out influence the frequency as well as locations or settings used for eating out. As Westhead (2012) explains, this choice results from a number of intentions – cafes are cheap, informal places to eat; a pub is a good place to socialise, with alcohol and cheaper food options; and, a restaurant was more of a 'special setting' for things like celebrating birthdays. Like cafes, fast-food outlets[53] are also considered places where relatively 'cheap' meals can be eaten conveniently and quickly outside the home, and at any time of the day. D'Addezio et al. (2014) found that 6.2% of respondents would eat at fast-food outlets once or more a week. In the UK, younger consumers (aged between 16 and 24) appear to be heavy users of fast-food chicken and burger restaurants, most likely because they have a smaller amount of disposable income (MINTEL 2012, cited in Bagwell, 2013). Binkley and Eales (1998, cited in Westhead 2012) also found that fast food demand was most likely to be driven by the population density of metropolitan areas.

Finally, even when food and drink is consumed in the home, it is heavily influenced by the availability of food establishments that can provide 'takeaways' and of pre-packaged meals in supermarkets. D'Addezio et al. (2014) found that takeaway food was most popular for respondents in UK, with 15% eating a takeaway 1-2 times a week, and least popular for respondents in Belgium. In comparison to the UK, Polish respondents were 41% less likely to eat pre-packaged meals; and Danish respondents were 50% less likely to eat takeaway food. In addition, females were 41% less likely to eat pre-packaged meals than males.

3.3.4 Concluding remarks

This research question has focused on the changes to when and where Europeans eat and drink. A key driver of changing meal patterns appears to be a lack of time, which results in trends towards eating on the go and at irregular times (Techniker Krankenkasse, 2013 and Ellrott, 2012). Studies which enable the longitudinal monitoring of meal patterns and structure may provide additional contextual information about

[52] D'Addezio et al. also argue that, based on the broad definition of 'eating out' in the Eatwell survey, it is reasonable to think that in spite of the high percentage of people who declared to eat out at lunch, a considerable number of them ate a packed lunch brought from home.

[53] Fast food outlets are defined by Westhead (2012) as settings 'where most food is taken off the premises to be consumed, seating is likely to be limited in relation to the number of customers the take-away typically serves'.

dietary intake and health. As this section has highlighted, more research is required on the consumption habits of adults, particularly in relation to meeting dietary intakes at breakfast, lunch and dinner.

A large portion of research identified on where Europeans choose to eat focused on eating outside of the home, which has implications for energy intakes. This is particularly true when Europeans choose to eat out at fast food venues as they tend to serve foods that have a higher fat content and are more energy-dense than meals prepared at home (Bagwell, 2013). This has wider implications for public health. For example, analysis of a longitudinal cohort study of 9182 Spanish students (the Seguimiento Universidad de Navarra cohort) suggests that the Mediterranean population eat a higher frequency of meals out of the home than ever before and this is linked to weight gain and higher risks of overweight and obesity (Bes-Rastrollo et al., 2010).

However, given the range of away-from-home food options available to consumers, it is still unclear whether all food products contribute to the overconsumption of calories. For example, Snowdown (2014) argues that current evidence in the UK in actually inconclusive, citing DEFRA (2013)[54] survey results which mark a decline in sugar and saturated fat consumption in people eating outside the home. As such, future research should focus on the range of food and meal options available to Europeans including delivery and meal kit services.

[54] Data from The Department for Environment, Food and Rural Affairs (DEFRA, 2013) who have carried out annual surveys of the British diet since 1974. These surveys are based on diet diaries compiled by a cross-section of the public and are supported by till receipts.

3.4 Introduction to Research Questions 3 and 4

3.4.1 Definitions and guidelines

Research Questions 3 and 4 address European habits in relation to physical activity. Physical activity can encompass a diverse range of activities including: sport (organised or other); exercise, such as swimming, going to the gym, or running; active tasks such as gardening or housework; and, activities such as walking and cycling as a means of transport (European Commission, 2008). Consequently, studies may define, and categorise, types of physical activity differently. Unless explicitly stated, when this review refers to 'physical activity', it refers to all types of physical exertion undertaken in the home, at work or during leisure-time. The following definitions[55] and guidelines are used in order to answer the two research questions.

The **intensity** of an activity is an important indicator of the effort exerted to perform an activity or exercise. According to the WHO (2013):

- Moderate-intensity physical activity requires a moderate level of effort that results in a noticeable increase in heart rate (e.g., brisk walking, gardening, dancing, active involvement in games/sports, etc.).
- Vigorous intensity activity requires a large amount of effort and results in a substantial increase in heart rate (e.g., running, walking uphill, fast cycling, fast swimming, competitive sports, etc.).

The amount of **time** spent engaged in physical activity is indicated by the frequency and duration of an exercise or activity.

The amount of time engaged in **sedentary behaviour** is linked to physical activity, though the two are not mutually exclusive (i.e. it is possible to have high levels of physical activity whilst also having a high frequency of sedentary time). In general, sedentary behaviour is measured using indicators which measure physical inactivity or a poor energy expenditure such as screen-time (i.e. time in front the computer or television) and sitting time.

Physical activity is associated with improvements in health, and the prevention of a number of non-communicable diseases. Consequently, guidelines provide rough benchmarks to understand minimum recommendations for different groups in the population. This in turn also enables a better comparison of how much physical activity Europeans do, relative to each other and the guidelines. Table 3 illustrates WHO global recommendations for levels of physical activity for three age groups: 5–17 years old, 18–64 years old and 65 years old and above. Additional assessment of these recommendations as well as national guidelines for the European Union is available from a published report from the EU Working Group on Sport and Health (2008).

Table 3. Recommended population levels of physical activity for health, by age

Age Group	Guidelines
Youth aged 5-17	At least 60 minutes of moderate-to-vigorous-intensity physical activity daily, most of which should be aerobic; **and** Vigorous-intensity activities at least three times per week, including those that strengthen muscle and bone.
Adults aged 18-64	At least 150 minutes of moderate-intensity physical activity throughout the week; **or**

[55] Where alternative definitions to those listed have been used in the literature, these have been clearly specified in the text.

Age Group	Guidelines
	At least 75 minutes of vigorous-intensity physical activity throughout the week; **or** An equivalent combination of moderate- and vigorous-intensity activity.
Older adults aged 65 and over	At least 150 minutes of moderate-intensity aerobic physical activity throughout the week; **or** At least 75 minutes of vigorous-intensity aerobic physical activity throughout the week; **or** An equivalent combination of moderate- and vigorous-intensity activity.

Source: WHO (2015)

3.4.2 Search results

Overall, the literature search revealed that the most comprehensive data on physical activity in Europe is available from five sources, outlined in the table below (Table 4). Research tended to focus on specific age groups, and as such Research Question 3 was grouped studies examining physical activity patterns among children and adolescents, adults and older adults.

Table 4. Main data sources identified in the peer-reviewed and grey literature searches in relation to physical activity

Surveys	Description
Eurobarometer Surveys	Three Special Eurobarometer surveys which have collected information on sport and physical activity engagement in the European Union, focusing specifically on engagement in physical activity and sedentary behaviour[56]. These were: Special Eurobarometer 183.6: Physical Activities (2003), distributed in 15 MS[57] to 16,230 citizens aged 15 and over. Special Eurobarometer 72.3: Sport and Physical Activity (2010), distributed to 26,788 respondents aged 15 and over in the EU28 Special Eurobarometer 412: Sport and Physical Activity (2014), distributed to 27,919 respondents aged 15 and over in the 28 MSs Additionally, the grey literature review also identified the Special Barometer: 246: Health and Food (2006), distributed to 29,195 respondents across all 28 MS. However as the main focus was on trying to understand Europeans' perceptions of their health more broadly, this review mainly focuses on the findings of the first three surveys mentioned above.
Health	The Health-Behaviour in School-aged Children (HBSC) surveys

[56] Another Eurobarometer survey (Special Eurobarometer 213: The citizens of the European Union and Sport, 2004) was identified in the search process, but no relevant information was extracted.

[57] The survey was distributed in Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Austria, the Netherlands, Portugal, Finland, Sweden, Great Britain and Northern Ireland. A separate survey was distributed in Germany East and Germany West, and also in Northern Ireland.

Surveys	Description
Behaviour in School Children	provide a longitudinal account of children and adolescents' eating and physical activity habits. This review draws on the 2001/2, 2005/6, 2009/10 and 2013/14 surveys (published by the WHO Regional Office in 2004, 2008, 2012 and 2016 respectively)[58]. Each thesis has a slightly different focus, e.g. the most recent survey looked specifically at the impact of gender and socioeconomic differences on health. The surveys only examine the health and wellbeing of young people (children and adolescents), up to the age of 15 years, who attend school.
European Health Interview Survey	Two waves of fieldwork have been carried out (2006-09 and 2013-15), but only the second wave will be considered in this review due to methodological issues identified in an evaluation of the data collection instrument used in the measurement of physical activity in the first wave[59]. In the second wave, a domain-specific measurement tool, the EHIS-PAQ questionnaire, was developed and implemented across all MS, Iceland and Norway[60]. A total of at least 194,990 people aged 15 and over took part in this cross-national survey in the European Union[61].
Survey on Health, Ageing and Retirement in Europeans	This is a general survey of health, socio-economic status and social and family networks, of a panel of more than 120,000 individuals aged 50 or older in 27 European countries (and Israel). Longitudinal data is available as the survey is distributed every two years.
The WHO Global Health Observatory Data Repository	The estimates on physical activity are based on self-reported physical activity captured using the GPAQ (Global Physical Activity Questionnaire), the IPAQ (International Physical Activity Questionnaire) or an equivalent questionnaire covering activity at work/in the household, for transport, and during leisure time.

The sources identified above tended to rely on self-reported data, which may affect the accuracy of information provided as participants may not respond truthfully to questions, either because they cannot remember correctly (memory recall bias) or because they want to present themselves in a socially acceptable manner (social desirability bias). A few data sources used objective accelerometer or pedometer data.

[58] HBSC surveys are administered at a national level by an international network of research centres and data is subsequently aggregated and appropriately weighted. The surveys aim to reach representative samples (approximately 1500 adolescents) of 11, 13 and 15 year olds in schools; approximately 220,000 young people were surveyed in 42 countries in Europe and North America in the most recent survey.

[59] In the first EHIS wave, physical activity was measured with a modified version of the International Physical Activity Questionnaire – Short Form (IPAQ-SF) which measures total physical activity in the last 7 days. The evaluation revealed a range of problems, including with the wording of some of the questions. As a result, Eurostat issued a grant project to revise and improve the PA module and other problematic modules e.g. alcohol consumption and mental health (Finger *et al.,* 2015)

[60] This tool allows separate data collection and estimation for total physical activity, work-related physical activity, transportation-related physical activity, and health-enhancing leisure-time physical activity.

[61] The total number of respondents is based on Annex II of the Commission Regulation (EU) No 141/2013 which sets out the minimum effective sample size per country for the EHIS data. More information is available here: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R0141

3.4.2.1 Peer reviewed literature

In total, 16 peer reviewed articles examining physical activity and trends among European were used to answer Research Questions 3 and 4.

To address Research Question 3, results on physical activity behaviours and trends among Europeans. Similar to the peer-reviewed literature for dietary behaviours, research tended to focus on specific age groups.

For Research Question 4, searches of the peer-reviewed literature included primary terms such as exercise, leisure activity, physical fitness, physical activity, sedentary lifestyle, physical activity, leisure activity and active transport and were combined with secondary terms such as pattern, prevalence and trend. All possible combinations of the primary and secondary terms were searched, and searches were focused on only those articles based in European or the European Union.

3.4.2.2 Grey literature

Seven datasets and/or survey finding reports were identified in the grey literature search: the EHIS (2016); four Eurobarometer survey reports (published in 2003, 2006, 2010, 2014, with research conducted in the year prior); the HBSC (2016) survey report, with data collected in 2013/14; and the WHO Global Observatory Data Repository (WHO 2013). In addition, 16 other grey literature articles were identified for Research Questions 3 and 4, though importantly this number also included a few less relevant sources which provided further information on guidelines, definitions, the historical and cultural context, etc.

3.5 Research Question 3: How much physical activity do Europeans engage in?

3.5.1 Section summary

This section focuses on **how much** physical activity Europeans engage in by examining the time spent participating in a physical activity; the intensity of the activity or exercise; and the time engaged in sedentary behaviours. The remainder of the section is structured according to three broad age groups: adults, older adults, and children and adolescents.

Summary: How much physical activity do Europeans engage in?

This section outlines how much physical activity Europeans engage in, focusing on intensity, frequency and time as well as the impact of sedentary behaviour. Overall:

- There are noticeable differences in the amount of physical activity Europeans engage in by country and sociodemographic factors such as age and gender. Nordic countries appear to have the highest levels of physical activity engagement for adults, whilst countries in the Southeast of Europe have lower levels of engagement. Men appear to engage in more physical activity than women, particularly in respect to high-intensity physical activity.
- There is less evidence of the association between ethnicity and/or cultural factors and physical activity engagement, though studies have shown that some ethnic minority groups are less active than the majority population.
- A greater percentage of adults and older adults do not meet physical activity recommendations compared to children and adolescents, though even in these groups a high proportion fail to achieve recommended levels.
- Whilst physical activity tends to decline with age, sedentary behaviour appears to be linked to other factors such as screen-time; time spent in school or work, time spent on physical activity, and time spent engaging in 'other' forms of physical activity such as household chores).
- Studies using objective methods such as accelerometers or pedometers can help to verify the self-reported data collected through surveys or diary logs.

3.5.2 Physical activity among adults

3.5.2.1 Levels of physical activity engagement

Population-based data collected from all MSs during the second cycle (2013 – 2015) of the European Health Interview Survey (EHIS, 2016) illustrates that on average, just over half (54.2%) of 18-64 year olds in the European Union[62] seem to be engaging in health-enhancing, non-work related aerobic physical activity each week[63]. Health-enhancing physical activity (HEPA) refers to physical activity that produces health

[62] Data is missing from Ireland and Belgium

[63] EHIS data is aggregated and combines the time Europeans spend on a variety of physical activities, including sport, fitness, recreational exercise and active forms of travel, all performed at different intensity levels. No definition of 'health-enhancing, non-work related aerobic physical activity' was provided in the meta-data for the EHIS survey.

benefits and improves health outcomes; this is widely promoted by the EU[64] (PHEIAC, 2013). The self-reported data reveals some variation; most adults (22%) tend to perform less than 150 minutes of physical activity a week, whilst 15.4% and 16.8% of adults engage in between 150 and 299 minutes and over 300 minutes of physical activity respectively.

According to the Special Eurobarometer 412 (2014), only 8% of adults aged 25 and over played sport or exercised at least five times a week[65]. Adults aged 25-39 were more likely to engage with exercise[66] or sport compared to those over the age of 40; 67% of 25-39 year olds indicated exercising or playing sport compared to 59% of 40-54 year olds. A higher proportion of adults (15% on average) appeared to engage with 'other' types of physical activity, such as cycling from one place to another, dancing and gardening, at least five times a week, with adults aged 40-54 participating in this type of physical activity most regularly.

Given the lack of coherent data on levels of physical activity (collected using harmonised measures and indicators), it is not possible to identify clear overall trends in physical activity engagement across Europe (Cavill, Kahlmeier and Racioppi, 2006). However, as the next sections highlights, national data can provide some explanation of how European engagement in physical activity has changed over time.

3.5.2.2 Levels of physical activity engagement by country

There is evidence that physical activity engagement among adults varies by country. Nordic countries appear to have the highest levels of physical activity engagement; on average, 30.4% of adults in Denmark, Sweden and Finland report spending more than 300 minutes (5 hours) on health-enhancing aerobic physical activity per week (EHIS, 2016). Similarly, according to the Special Eurobarometer 412 (2014), the proportion of adults that exercise or play sport at least once a week is highest in Sweden (70%), Denmark (68%), Finland (66%) and the Netherlands (58%).

Comparatively, EHIS data shows that MSs in Southeast Europe report lower levels of physical activity engagement, with less than a fifth of adults in Romania (16.6%) and Bulgaria (19.8%), and only 31.1% of adults in Greece, spending any amount of time on health-enhancing, non-work related aerobic physical activity per week. Likewise, according to the Eurobarometer 412, the proportion of adults that exercise or play sport regularly is lowest in Bulgaria; only 2% of respondents exercise or play sport at least five times a week. Notably, Eurobarometer findings for countries show that 15% of respondents from Slovenia, play sport or exercise at least five times a week.

National studies show different trends in physical activity engagement, with some MSs reporting increased engagement over time, and other MSs noting declining or static participation rates. For example:

- An increase in physical activity levels in Finland between 1998 and 2008, but stasis in all three Baltic States (data from the Finbalt health monitor, as cited in PHEIAC 2013[67]);
- In England, the proportion of adults meeting the target of at least 30 minutes of Moderate to Vigorous Physical Activity (MVPA) five days a week increased

[64] For example, a Council Recommendation on health-enhancing physical activity was adopted in 2013, and the HEPA Europe network aim to promote further research, policy and practice in this field. More information about this network can be found here: http://www.euro.who.int/en/health-topics/disease-prevention/physical-activity/activities/hepa-europe

[65] Respondents were asked: 'how often do you exercise or play sport?' (Possible responses: 5 times a week or more; 3 to 4 times a week; 1 to 2 times a week; 1 to 3 times a month; less often; never; don't know)

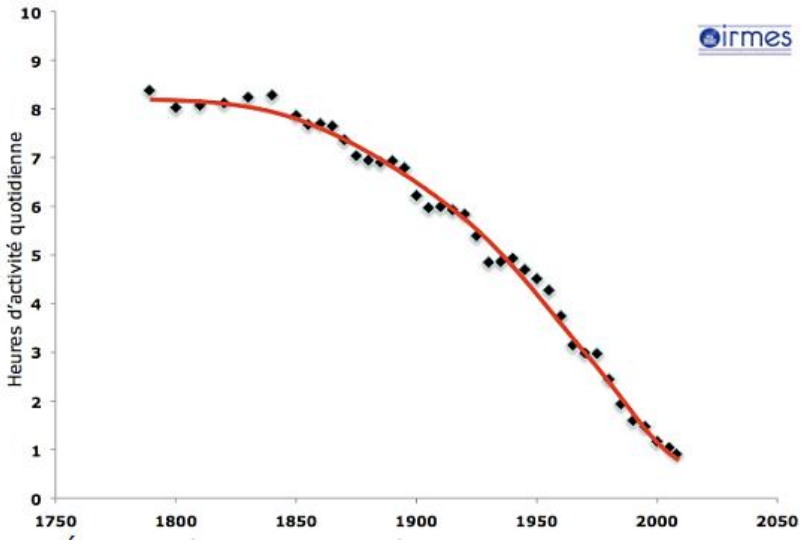
[66] The survey defined 'exercise' as any form of physical activity which is done in a sport context or sport-related setting, such as swimming, training in a fitness centre or sport club, running in the park, etc.

[67] No method reported.

from 27% to 36% over the same time period, whereas in Italy it remained static at 33%[68] (PHEIAC 2013); and

- In France, physical activity levels have been modelled over the previous centuries, and show on-going decline, primarily as a function of decreases in the physicality of work and labour (Ministère de la Santé, de la Jeunesse, des Sports et de la Vie Associative 2008). This is illustrated in Figure 6.

Figure 6. Evolution of French citizens' daily physical activity[69]



Source: Evolution of French Citizens' Daily Physical Activity (Institut de Recherche Biomédicale et d'Epidémiologie du Sport (IRMES))

3.5.2.3 Levels of physical activity engagement by socio-demographic factors

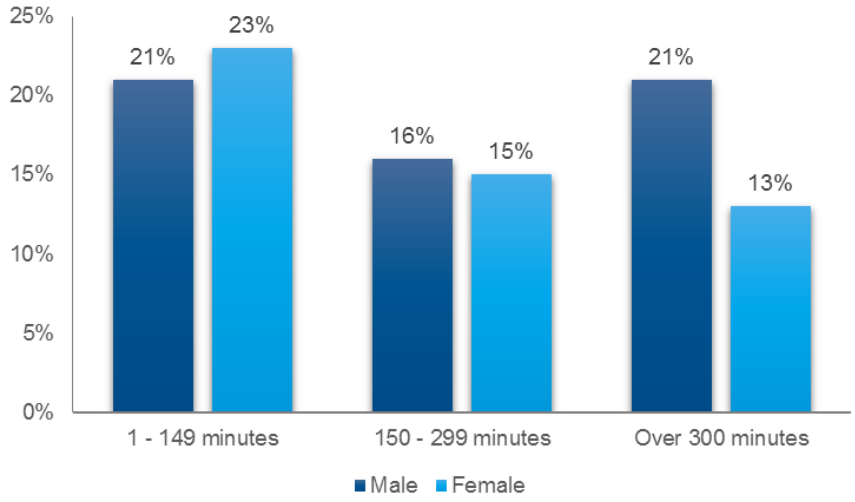
Fully understanding the reasons why adults choose (or don't choose) to spend time engaging in physical activity is outside the scope of this review. However, in addition to personal preferences, socio-demographic factors such as gender, ethnicity, level of education and socioeconomic status can influence levels of engagement in physical activity (Charlton *et al.,* 2010).

As shown in Figure 7, physical activity engagement among adults in the EU appears to vary by gender, with a higher proportion of males (57.2%) engaging in physical activity than females (51.4%). In addition to higher levels of engagement, males also spend more time on physical activity; 36.5% of males reported performing over 150 minutes of health-enhancing, non-work related aerobic physical activity per week, compared to 28% of females (EHIS, 2016).

[68] N.B. the Italian definition included those who do 'hard labour' as well as 30 mins of MVPA.

[69] Methodology not stated.

Figure 7. Time spent on health-enhancing, non-work-related and aerobic physical activity by males and females (average across EU-28)



Source: EHIS dataset (Eurostat, 2016)

The four Eurobarometer surveys undertaken between 2003 and 2014 also show that men, on average, are more likely to engage in physical activity than women. There are notable differences in the type of physical activity carried out by men and women, as examined in Section 3.3, as well as the frequency, intensity and duration of activities. More specifically:

- Men appear consistently more likely than women to engage in vigorous physical activity. In 2003, 43.4% of men reported engaging in vigorous physical activity in the last seven days compared to 30.4% of women, with 16.5% of men reporting bouts longer than 90 minutes compared to only 10.1% of women. In 2014, 20% of men engaged in vigorous physical activity in at least four of the previous seven days, compared with 12% of women.
- Men are also more likely than women to engage in moderate physical activity, though only to a small extent. For example, 27% of men compared to 24% of women did moderate physical activity at least four days a week in 2014.
- Men are more likely to spend more time exercising than women. For example, in 2014, 52% of men in the European Union engaged in vigorous activity for more than an hour per week, compared to only 35% of women. In addition, 40% of men, compared to 32% of women, reported spending over an hour on moderate physical activity.
- According to the 2014 Eurobarometer survey, the gender gap narrows with age. In this instance, the proportion of men exercising or playing a sport more than five days a week was only slightly higher than for women in the 40-54 age group (8% of men compared to 7% of women), compared to a larger difference for 25-39 year olds (9% of men compared to 6% of women).

There is also evidence of links between socio-economic status and educational level and participation in sports or physical activity. For example, according to the Special Eurobarometer 412 (2014) participation in sports is higher among managers (59% of managers played sport at least once a week, compared to 44% of individuals in other white collar jobs). Additionally, data from the EHIS (2016) and Eurobarometer (2014) survey suggests that people with fewer educational qualifications (or who left school at an earlier age) are less likely to spend any time engaging in physical activity outside of work.

National studies appear to show similar results. For example, in Italy, a survey of 60,000 households[70] conducted between 2012 and 2013 found that physical activity levels were lower for those with 'scarce' economic resources (15%), compared to those with 'sufficient' or 'high' economic resources (24%), with a similar pattern seen by educational level (ISTAT 2014). Similarly, population-level data from the Institut National de la Santé et de la Recherche Médicale[71] (INSERM, 2008) showed that, in France, the higher the educational attainment level among adults, the higher the likelihood of engaging in more frequent physical activity

There is less evidence of the association between ethnicity and/or cultural factors and physical activity engagement, though studies have shown that some ethnic minority groups are less active than the majority population (Langøien et al. 2017). In their systematic mapping review of 63 articles published between 1999 and 2014, Langøien et al. found there were183 distinct factors influencing physical activity in ethnic minority groups in Europe, including religious requirements, gender roles, cultural requirements, barriers for migrants and limited resources. National research suggests there is often a complex relationship between these factors. For example, two surveys from the UK – the Health Survey for England, 2008 (cited in Minou, 2011) and Taking Part (Department for Culture, Media and Sport, 2010[72]) suggest there are cultural barriers to participation ranging from concepts of sports based on Western values which are at odds with cultural values espoused by South Asian and Muslim communities, to specific cultural pressures on certain groups such as the appropriateness of mixed-sex exercise for women.

3.5.2.4 Levels of physical inactivity and sedentary behaviour

EHIS data (Eurostat, 2016) collected from all MS between 2013 and 2015 suggests that on average, nearly half (45.8%) of all adult Europeans spend no time engaging in physical activity per week[73]. However, large variations were again reported between MS. The data suggests that newer MS (the EU-13[74]) may be the worst performers: 83.5% and 80.2% of adults spend no time on physical activity per week in Romania and Bulgaria respectively. In contrast, Nordic countries are the highest performers: only 17.4% of the Danish population report spending no time on physical activity per week.

Older data compiled in the WHO Global Health Observatory Data Repository[75] further highlights that the prevalence of physical inactivity varies considerably across MSs – in 2008 it was highest for both men and women in Malta (71% and 74% respectively), and lowest for men in Estonia (17%) and women in Greece (16%) (WHO 2008 as cited in WHO 2013).

If the definition of physical inactivity is restricted to never taking part in sport and exercise, on average, according to the Special Eurobarometer 412 (2014), more Europeans are likely to never exercise or play sport (42%) than to play sport or exercise with some regularity (33%). Between 2009 and 2014 the proportion of respondents stating that they never exercise or play sport has increased from 39% to 42%, while the proportion that does so seldom has decreased from 21% to 17%

[70] Distributed in 1,456 municipalities of different demographic sizes in Italy.

[71] Data gathered in 2006. Survey was distributed to the French population aged 18-74.

[72] The research comprised a questionnaire distributed to 188 respondents using computer-assisted telephone interviewing (CATI), followed by 12 focus groups with eight participants each, and eight depth interviews.

[73] Physical activity is defined as doing sport or fitness activities that cause at least a small increase in breathing or heart rate, and are performed for at least 10 minutes continuously. This definition also includes cycling as a means of transport.

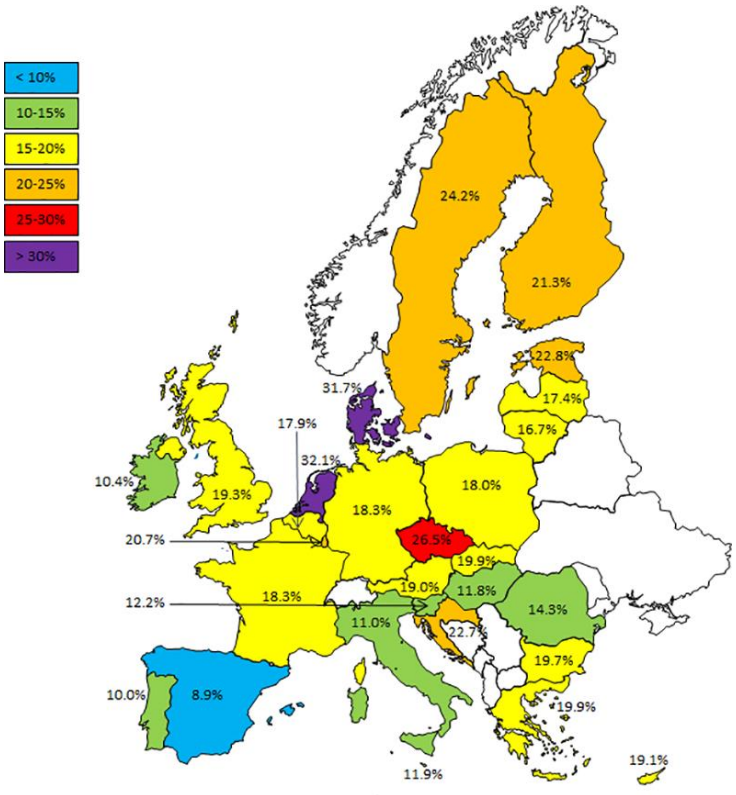
[74] Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.

[75] National sample sizes, methodologies and definitions vary

(Special Eurobarometer, 2010, 2014). The 2014 Eurobarometer results also reveal that women are more likely to report doing no moderate or vigorous physical activity than men; in 2014, 61% of women reported not engaging in any vigorous physical activity in the last week compared to 46% of men, and 48% of women reported not engaging in any moderate physical activity in the last week compared to 39% of men.

The Special Eurobarometer 412 (2014) also measured levels of sedentary behaviour, defined as time spent in a sitting position. The survey showed that about two-thirds of Europeans (n = 27,919) reported spending between 2.5 and 8.5 hours sitting per day, with 11% sitting for more than 8.5 hours. In further analysis[76] of the Eurobarometer data, Loyen et al. (2016a) find that the median sitting time was five hours a day, and nearly a fifth of all respondents on average (18.5%) reporting to sit more than 7.5 hours a day. However, this varies by MSs, for example, only 8.9% of respondents in Spain said they spent more than 7.5 hours a day sitting, compared to 32.1% in the Netherlands. More generally, as shown in Figure 8, respondents in northern Europe report more sedentary time than respondents in the south of Europe, with notable exceptions to this observation in Ireland, Croatia and the Czech Republic.

Figure 8. The distribution of the proportion of European adults reporting sitting more than 7.5 hours per day across the EU28.



Source: Loyen et al. (2016a)

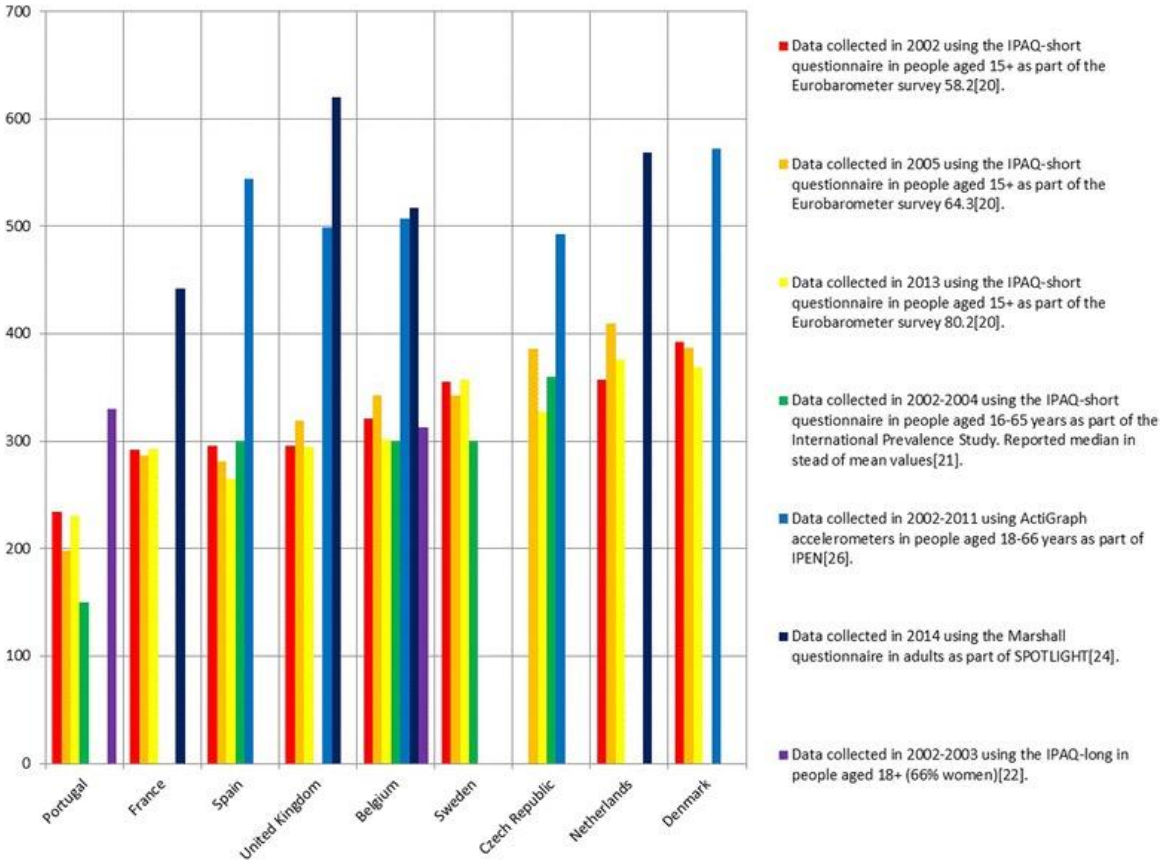
In a separate study, Loyen et al. (2016b) examined the prevalence of sedentary behaviour among adults in Europe by conducting a systematic review of 12 articles (covering 2-29 countries[77]). Again, they found that people living in northern European

[76] Uni- and multivariate odds ratios were assessed by country and sociodemographic variables using binary logistic regression analyses. Whilst data was obtained from people aged 15 years and over by the Eurobarometer, Loyen et al. only used data from people aged 18 years and over.

[77] Countries included the following: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Turkey, and the United Kingdom.

countries reported more sedentary time than in southern European countries. However, as different measurement tools and definitions[78] were used in each of the 12 studies, there was some inconsistency in the results reported as shown by Figure 9 (taken from the review) below – overall, total reported sitting time varies from 2.5 h/day up to 10 h/day depending on both the studies and countries. Importantly, data collected using the ActiGraph accelerometers appears to show that Europeans spend more time sitting than reported in all but one of the questionnaires, which reinforces the notion that self-reported data (based on recall) may not be an accurate measure of physical (in)activity or sedentary time (Loyen et al., 2016c).

Figure 9. Minutes per day of total sitting time in adults across countries based on different studies



Source: Loyen et al. (2016b)

Finally, sedentary time appears to also vary according to other characteristics. For example, respondents in white collar, or managerial occupations and students (i.e. those still studying)[79] reported more sedentary time than those in manual work, as did those who were less physically active and those who use the internet every day (Loyen et al., 2016a). However, the Special Eurobarometer surveys on physical activity (2003, 2010, 2014) revealed that the amount of time spent sitting on a usual day does not significantly vary between females and males.

[78] In ten studies questionnaires were used, whilst two studies used accelerometer data.

[79] Level of education was assessed by the question "How old were you when you stopped full-time education?" and was recoded into four categories. The odds ratio for sitting more than 7.5 hours per day was 3.84 for those still studying, which is higher than people who were 15 years or younger when they stopped full-time education, as well as people who were 20 years or older when they stopped education

3.5.2.5 Comparison with guidelines

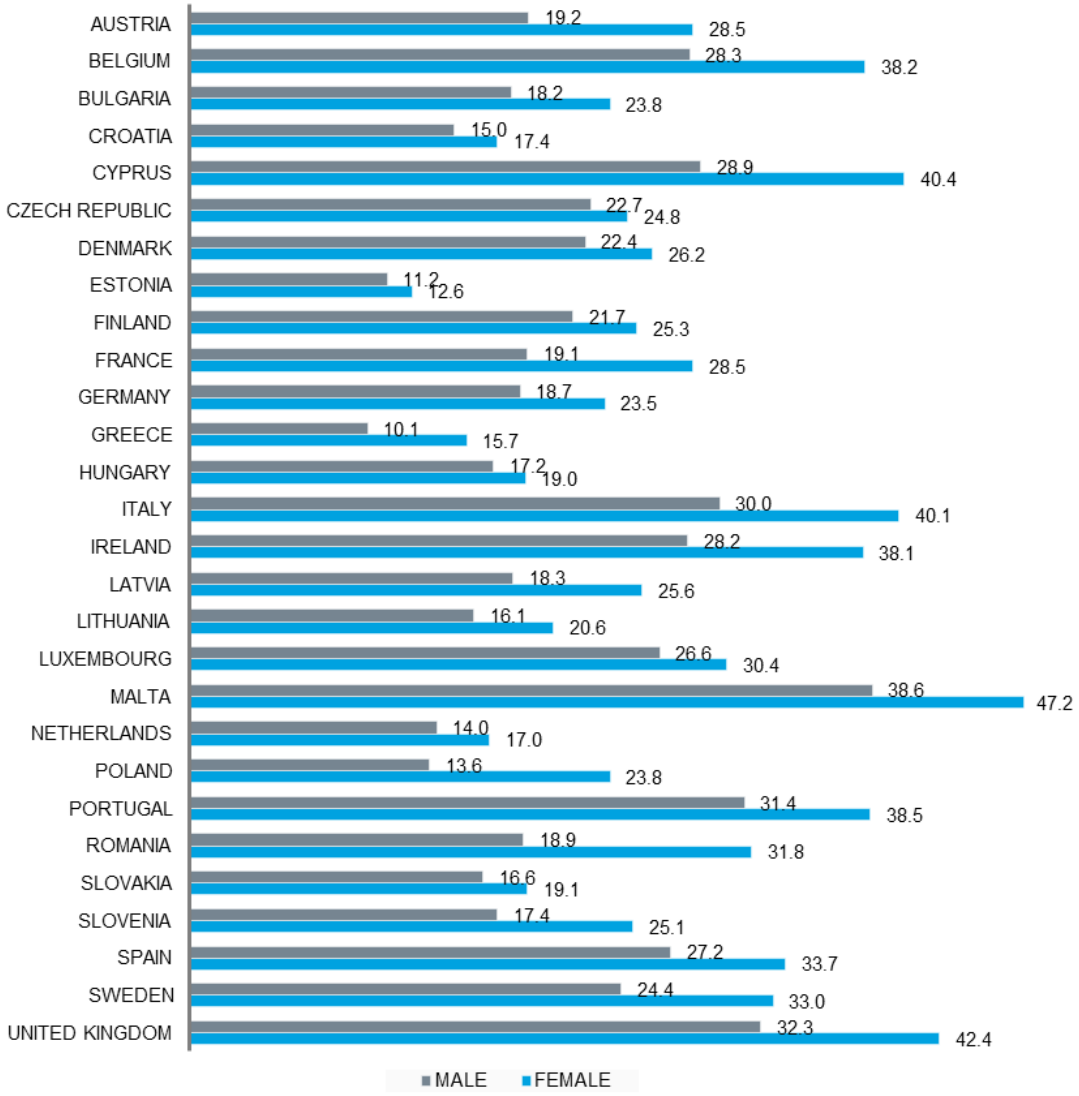
As outlined in Section 3.4.1, WHO Global Recommendations stipulate at least 150 minutes of moderate-intensity or at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity. However, according to data from the WHO Global Health Observatory Data Repository[80] (2013) more than 30% of adults in 18 MS were insufficiently physically active in 2008. As shown in Figure 10, Maltese adults (both male and female) were least likely to meet the WHO recommendation in 2010, whilst Estonia and Greece had a higher proportion of adults (of both genders) meeting the guidelines.[81]

In terms of non-sport physical activity, the Special Eurobarometer on Health and Food (2006) found that almost 9 out of 10 Europeans had performed 'some physical activity' over the last 7 days by working in or around their house. However, as noted above, for health benefits, exercise needs to be moderate-to-vigorous; this was the case for only 27% of respondents.

[80] Sample size varies

[81] This data covers all respondents aged 18+ and so will also cover older adults discussed in the following section

Figure 10. Percentage of adults (over 18) that are insufficiently active in 2010



Source: ICF analysis, data from the Global Health Observatory (GHO) (WHO, 2013)

3.5.3 Physical activity among older adults

3.5.3.1 Levels of physical activity engagement

Population-based data collected from all MSs during the second cycle (2013 – 2015) of the EHIS (2016) illustrates that on average, 37% of older adults (aged 65 and over) in the European Union[82] are engaging in health-enhancing, non-work related aerobic physical activity each week[83]. The self-reported data reveals variation in the time adults spend on physical activity; 15% of adults aged 65 and over tend to perform less than 150 minutes of physical activity a week, whilst 9% and 13% of older adults engage in between 150 and 299 minutes and over 300 minutes of physical activity respectively.

[82] Data is missing from Ireland and Belgium

[83] EHIS data is aggregated and combines the time Europeans spend on a variety of physical activities, including sport, fitness, recreational exercise and active forms of travel, all performed at different intensity levels.

Data from the Special Eurobarometer 412 survey (2014) suggests fewer older people are engaged in moderate physical activity than younger groups – a result consistent with older Eurobarometer data. For example, the 2010 Eurobarometer Survey highlighted that older people are less inclined to devote spare time to exercising (i.e. while 64% of 15-24 year-olds say they are interested in exercise and do not have better things to do with their time, this falls to 54% among 40-54 year-olds, 47% among 55-69 year-olds, and 41% among the 70+ age group). Similarly, results from the Eurobarometer (2003) further emphasise that older adults are the least likely age group to spend time engaging in physical activity for recreational purposes: only 35.5% reported participating in some leisure-time physical activity in the last week. However, national variations are apparent – for example, according to the EHIS data, 31% of older adults in Austria are more likely to engage in over 300 minutes or more of exercise per week, which is notably higher than the proportion of adults (18-64) who engage in this amount of physical activity a week (28%).

In another study, physical activity patterns of 12,652 men and 15,007 women aged 50 years old living in 13 European countries[84] were analysed by Myck (2010) using data collected in 2004/05 and 2006/07 as part of the longitudinal Survey of Health Ageing and Retirement in Europe (SHARE). Myck's analysis revealed that there are visible cross-national differences in the proportion of respondents who report to engage in vigorous (defined as sports, heavy housework, or a job that involves physical labour) and moderate physical activity (defined as gardening, cleaning the car, or doing a walk). Specifically, the highest proportions of older adults engaging in vigorous physical activity at least once a week are men in Switzerland (68%) and women in the Netherlands (66%). In contrast, respondents in Poland appear to have the lowest levels of vigorous physical activity engagement (38% of men and 29% of women engage in vigorous physical activity at least once a week). Older adults in the Czech Republic, Italy and France also report similarly low levels of physical activity when individual characteristics are controlled for.

3.5.3.2 Levels of physical inactivity and sedentary behaviour

At the European level, the EHIS dataset (Eurostat, 2016) shows that in general, older people (aged 65 and over) tend to spend less time overall on physical activity than 18-64 year olds. For example, 63% of all persons aged 65 and over do not spend any time on physical activity in an average week (compared to 46% of adults in general). The Eurobarometer surveys (2003, 2014) confirm the EHIS finding that time spent exercising or taking part in any other form of physical activity, including walking, decreases with increasing age. In 2014, 56% of people aged 55 or over said that they did no moderate physical activity the previous seven days (compared to 38% of 25-29 year olds and 42% of 40-54 year olds) and 69% said they did no vigorous physical activity (compared to 45% of 25-39 year olds and 51% of 40-54 year olds). Comparable results were also reported in 2003: 80% of people aged 65 and over reported doing no days of vigorous physical activity in the past week; and 20% of people aged 65 and over said they had not walked, for at least 10 minutes at a time, in the past 7 days.

In addition, according to EHIS (2016) data, similar national patterns to those observed in the adult age group were also found for older people in regards to levels of physical inactivity. For example, in Bulgaria and Romania almost none of the elderly population engage in (some form of) physical activity (95% of the elderly population report physical inactivity in both countries). Denmark reports the lowest percent of inactivity, with only 27% of the older population reporting no engagement in physical activity.

[84] Sample sizes varied by country: Austria (n = 948), Belgium (n = 2,635), the Czech Republic (n = 2,607), Denmark (n = 2,015), France (n = 2,405), Germany (n = 2,222), Greece (n = 2,755), Italy (n = 2,531), the Netherlands (n = 2,234), Poland (n = 2,323), Spain (n = 1,447), Sweden (n = 2,280), and Switzerland (n = 1,257)

Variation in the prevalence of physical inactivity by MSs is also noted by Gomes et al. (2017). Using data from a select sample of 19,298 people, aged 55 or older, available from 16 European countries[85] in the fourth wave of the SHARE survey, Gomes et al. found that that respondents in Sweden reported the lowest levels of physical inactivity (4.9%) compared to those in Portugal (29%) in 2011/12. Gomes et al. also found that along with increasing age, physical, cognitive and psychological factors (e.g. physical limitations, depression, memory loss and a poor sense of meaning of life) were significant variables associated with physical inactivity.

Loyen et al., (2016a) report that older adults engage in less sedentary behaviour than younger age groups, though the authors note this may be linked to the fact that younger groups have different practical constraints during the week (i.e. school or work where a large amount of time is spent at a desk) compared to the weekend (i.e. when they may actively engage in sedentary behaviours like watching television). Indeed, accelerometer data collected in England, Portugal, Norway and Sweden using Actigraph accelerometer count data from 9509 participants, illustrates that older people spent more time actively choosing sedentary activities than younger groups (Loyen et al., 2016c).

3.5.3.3 Comparison with guidelines

Physical activity guidelines have the same recommendations for moderate intensity and vigorous intensity exercise for older adults as for other adults.

However, as shown in another study employing SHARE data, this time from 2004 to 2013 (de Souto Barreto et al., 2016), even doing physical activity once a week (less than current recommendations) is associated with a reduced risk of incident diabetes, heart diseases, and cerebrovascular disease. Thus some national guidelines e.g. Denmark and the Netherlands, have evolved to encourage any amount of activity for older adults, even if it is less than the WHO recommendations.

Nevertheless, as this section has shown, the majority of older populations in some MSs (e.g. Bulgaria and Romania) still continue to report doing no physical activity at all.,

3.5.4 Physical activity among children and adolescents

3.5.4.1 Levels of physical activity engagement

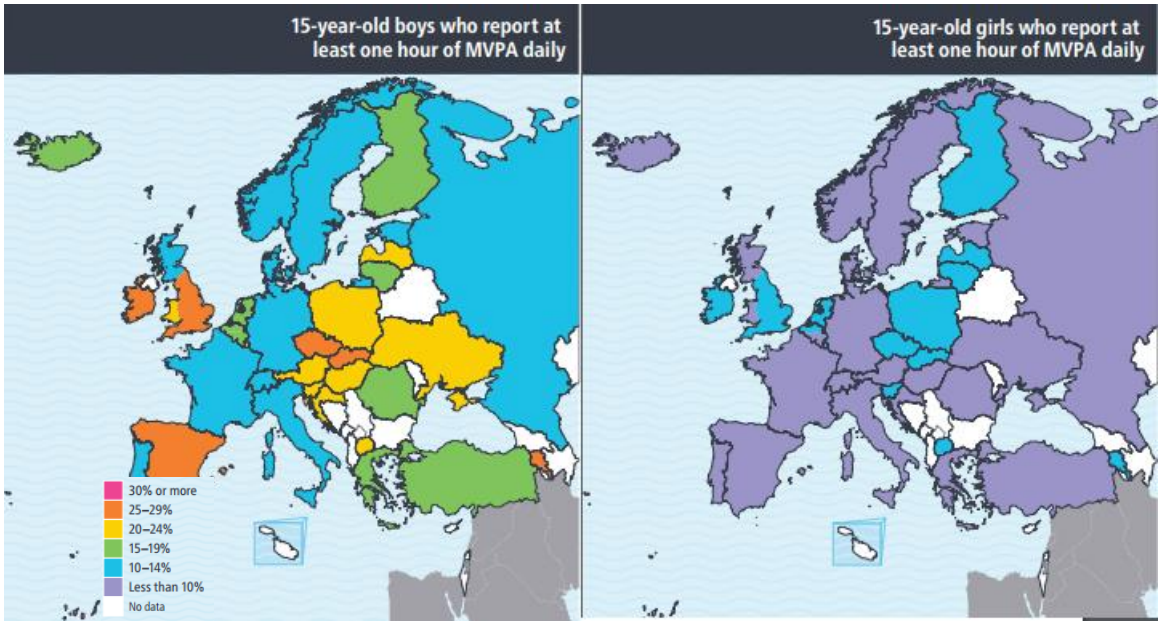
Longitudinal data on physical activity engagement is available from HBSC surveys, with the most recent data available for the year 2013/14 (as published in 2016). This suggests that despite a drop in (60 minutes of) moderate-to-vigorous physical activity between 2005/2006 and 2009/2010 for both boys and girls, across all MSs, levels of daily activity have slightly increased for boys and girls in all age groups since 2009/2010. Results from the latest round also indicate that physical activity levels decrease with age (particularly for girls), with a significantly higher frequency of daily moderate-to-vigorous physical activity among 11 to 15 year olds in most countries.

As shown in Figure 11, there is noticeable variation between MSs in the extent to which children and adolescents engage in physical activity, with more pronounced differences for boys than girls. Italy, Denmark and France are consistently amongst the poorest performers for all three ages (11, 13 and 15), with Italy taking bottom place in all three years (only 5% of girls, and 12% of boys engage in sufficient physical activity at age 15). The highest performers include Ireland, Austria (though not for 15 year olds), Czech Republic and Finland. For example, in Ireland in 2013/14, 12% of 15 year old girls and 28% of 15 year old boys engage in sufficient levels of

[85] Austria, Germany, Sweden, The Netherlands, Spain, Italy, France, Denmark, Switzerland, Belgium, Czech Republic, Poland, Hungary, Portugal, Slovenia and Estonia

physical activity. It is notable that the Nordic countries, which tend to have a high number of adults engaging in physical activity, as shown in Section 0, perform poorly in regards to adolescents (with the exception of Finland).

Figure 11. Percentage of boys and girls participating in at least 60 minutes of MPVA daily (HBSC 2016)



Source: Boys and girls reporting at least 60 minutes of MPVA daily (HBSC, 2016)

- Results from the latest HBSC survey also show that boys are significantly more likely than girls to achieve sufficient moderate-to-vigorous physical activity in most countries and across all age groups. This is consistent with Special Eurobarometer 412 (2014) which records the largest gender difference in engagement in the 15-24 year old age group. For example, 15% of 15-24 year old men compared to 8% of 15-24 year old women exercise or play sport, compared to 8% of men and 6% of women in the 40-54 age group and no difference in the 55+ age group. These findings are confirmed by Acitgraph accelerometer data recorded in the International Children's Accelerometry Database (ICAD) (Cooper, 2015).
- Other socio-demographic factors may impact the ability of children and adolescents to get involved in physical activity. For example, results from the latest HBSC (2016) survey show that family affluence can influence the extent to which children and adolescents are likely to engage in physical activity, though only in fewer than half the countries studied and generally by less than 10%. In addition, external factors may also influence adolescents' engagement with physical activity. For example, Kopcakova et al. (2017) used HBSC data collected in 2013/2014 from four countries (Czech Republic, Germany, Poland, and Slovakia) to examine associations between physical activity and the social and physical environment. They found that an increased perception of an activity-friendly environment is significantly associated with adolescents meeting the recommended amount of daily physical activity in the four countries studied. The perception of a more activity-friendly environment was also associated with lower odds of excessive screen-based activities (defined as watching TV, playing computer games, and working with the computer during the week, especially for older adolescents and boys.

3.5.4.2 Levels of physical inactivity and sedentary behaviour

According to Global Health Observatory (WHO) data, there is a higher prevalence of insufficient physical activity among school-age adolescents in the EU compared to adults. Crude estimates show that over 70% of 11-17 year olds are insufficiently active in all MSs[86], with noticeably higher levels of physical inactivity in Ireland, Denmark and France. National literature further supports these findings, suggesting that physical inactivity is becoming an increasing problem. For example, France's 'Plan National de prévention par l'Activité Physique ou Sportive' noted that several studies suggest that the level of physical activity amongst children and adolescents in France has decreased around 40% in recent decades, (Ministère de la Santé, de la Jeunesse, des Sports et de la Vie Associative 2008).

Screen time, especially time spent watching TV or playing videogames, is regularly used as proxy for sedentary behaviour. In relation to this, Verloigne et al. (2016) conducted a literature review of 42 articles (of which 38 were cross-sectional studies) to examine levels of sedentary behaviour (assessed through activity diaries, questionnaires and accelerometer data) among children and adolescents in Europe. Data were collected for a sample of children and adolescents (aged 2-18) and suggested that the average amount of time spent watching television ranged from 1 to 2.7 hours in children, and 1.3 to 4.4 hours in adolescents.

Some of the articles reviewed by Verloigne et al. (2016) suggested that children in Eastern European countries (Bulgaria, Slovakia and Ukraine) spend more time being sedentary when compared with those in other European countries, however cross-country comparisons are difficult given the range of methodologies, definitions and samples employed in each of the studies. In addition, sedentary behaviour appears to differ according to a complex set of factors. For example, using data collected as part of the ToyBox-Study, De Craemer et al. (2015) found that screen-time varies by both country and time of the week (weekday or weekend). Their study examined the extent to which pre-school age children (4-6 years) in six European countries (Belgium, Bulgaria, Germany, Greece, Poland and Spain) engage in high levels of sedentary behaviour (defined as time spent watching television, playing games on or using the computer in leisure time, and quiet play time during leisure time)[87]. Results showed that German pre-schoolers had the lowest average time spent in television viewing on weekdays (43 minutes on average) and weekend days (65 minutes on average).

Other factors may also influence sedentary behaviour. For example, using data from the recent HBSC study (2016), Pavelka et al. (2016) find age, gender, and country differences in the prevalence of activities associated with sedentary behaviour[88] (i.e. watching TV or using the computer) and family-related factors among school-aged children (11 and 15 year olds) in Slovakia (n = 488) and the Czech Republic (n = 418):

- Approximately two-thirds of respondents reported watching television or using a computer for at least two hours a day, with nearly three-quarters of children having a personal computer available in their bedrooms, and more than half having a TV;
- Older children reported spending more leisure time on screen-based activities, specifically with regards to time spent watching TV – television viewing was

[86] With the exception of Cyprus as no data is available

[87] Questionnaire data was obtained from 8,117 parents, and accelerometer or pedometer data was obtained for a sub-sample of 4,045 pre-schoolers on six consecutive days during all waking hours. Bulgaria, Germany, Greece, Poland and Spain collected pedometer data; Belgium collected accelerometer data.

[88] As an indicator of sedentary behaviour, young people in the HBSC survey were asked how many hours a day in their free time they usually spend watching television, videos (including YouTube or similar services), DVDs and other screen entertainments on weekdays.

higher for 15 year olds than 11 year olds in just under half of countries for boys, and in most countries for girls. ;

- Boys appeared more likely than girls to report excessive time spent playing computer (PC) games; and
- Parents seemed to influence the amount of sedentary behaviour that children engaged in: more than half of children reported that their parents rarely (or never) applied rules that limited the time they were allowed to spend watching TV or playing PC games. About a quarter of children watch TV with their parents, with Slovak children reporting this more frequently than Czech children – the only kind of behaviour for which there was a difference based on country.

3.5.4.3 Comparison against guidelines

In general, studies all show that physical activity levels among most young Europeans do not meet current guidelines of 60 minutes of moderate-to-vigorous physical activity per day. For example, HBSC (2016) data shows that less than half of young people surveyed meet the current guideline of 60 minutes MVPA per day in all countries and regions, though results appear to indicate that national policies and guidelines may influence how likely it is that children and adolescents meet recommendations for moderate-to-vigorous physical activity.

Further, Van Hecke et al. (2016) conducted a systematic review of 30 articles (covering between 2-36 European countries) in order to describe variation in population levels of physical activity among young people[89]. Their findings reveal large differences in the percentage of youth (aged 2-18) complying with physical activity recommendations[90]. In most European countries, less than 50% of youth complied with recommended levels of physical activity. Across all countries the percentage of youth meeting recommendations varied from 5-47% when assessed through surveys and total daily minutes of moderate-to-vigorous physical activity varied between 23-200 minutes between countries. The authors also found that boys tended to be more active than girls, and children were more active than adolescents.

Physical activity levels can fluctuate throughout the week, as illustrated by De Caemer et al.'s (2015) study of physical activity and sedentary behaviour among pre-schoolers in six European countries. The authors found that the percentage of pre-schoolers meeting physical activity guidelines (defined as 180 minutes per day or 11,500 steps) differed by time of the week (week day versus weekend) and country. During weekdays, the highest percentage of pre-schoolers meeting guidelines was in Spain (61%) and the lowest in Greece (27%) and Bulgaria (29%). During weekend days, Poland had the highest percentage meeting guidelines (42%) and lowest in Greece (20%) and Belgium (21%).In regards to sedentary behaviour, recommendations for limiting sedentary time and screen time have not been established by the WHO to date, however globally other public health authorities in developed nations have outlined clear recommendations for sedentary time. However, the uptake of this varies among MSs. For example, in De Caemer et al.'s (2015) study, the authors found that Germany had the highest percentage of pre-schoolers meeting the guideline to reduce screen time to 1 hours or less during week days (71%), followed by Spain (44%), Belgium (43%), Poland (37%), Greece (29%) and Bulgaria (25%).

[89] Measurement of physical activity: 16 articles included in the review used accelerometers, two used pedometers, ten used a questionnaire, and two used physical activity logs. Physical activity outcomes measured ranged from total physical activity (n=10), average steps per day (n=2), moderate to vigorous physical activity (MVPA) (n=22), meeting recommendations for moderate to vigorous physical activity (n=12) and 10 minute bouts of physical activity (n=1).

[90] 60 minutes of daily moderate to vigorous intensity physical activity (MVPA), measured subjectively and by accelerometer measured minutes of MVPA.

3.5.5 Concluding remarks

This section has shown that a greater percentage of adults and older adults do not meet physical activity recommendations compared to children and adolescents, though even in these groups a high proportion fail to achieve recommended levels, and there are differences by country and other sociodemographic factors. Whilst physical activity tends to decline with age, sedentary behaviour appears to be linked to other factors such as screen-time; time spent in school or work, time spent on physical activity, and time spent engaging in 'other' forms of physical activity such as household chores). The methods used for assessing physical activity or sedentary time are important, with self-reported and subjective data being less accurate when compared to data collected from objective methods such as accelerometers or pedometers. However, the majority of data sources identified in this review tended to rely on surveys or diary logs which implies more research, using objective measurement tools, is required in this area in the future.

3.6 Research Question 4: What types of exercise are Europeans engaging in?

3.6.1 Section summary

As discussed in Section 3.1, 'physical activity' can refer to a diverse range of activities which can be performed at different levels of intensity, and for different periods of time. Therefore, in order to fully assess 'how much' physical activity Europeans do, it is also essential to examine what types of activities Europeans are engaging in. This section is structured as follows:

- Section 3.6.2 outlines the types of physical activities Europeans tend to engage in, considering first the most popular sports and exercises, and second the 'other' forms of activities Europeans tend to do, such as active methods of travel.
- Section 3.6.3 examines some of the key determinants influencing the types of physical activities Europeans choose to engage in, such as gender, age, access to facilities, income and location.

Summary: What types of exercise are Europeans engaging in?

This section outlines the types of physical activity Europeans engage in, with a focus on the key determinants influencing engagement for certain activities. Overall:

- More individuals engage in physical activity as part of daily life than they do playing organised sport.
- Active travel is especially popular among Europeans
- There is still relatively little comparative research on the types of sports and exercises that Europeans choose to engage with.
- Multiple factors that influence the type of physical activity undertaken, including: accessibility and income; sociodemographic factors such as age and gender; national policies and targets; and individual preference.

3.6.2 Types of physical activity

Section 3.5 highlighted key differences in the amount of sport, exercise and 'other' forms of physical activities Europeans engage in. The majority of (self-reported) studies indicated that participation in physical activity varies considerably by country, age and gender, which suggests there are also likely to be differences in the types of physical activities Europeans choose to do. Whilst the number of people exercising or playing sport a least once a week in the EU increased slightly between 2009 and 2013 (from 40% to 41%), so did the number of people stating they never exercise or play sports (from 39% to 42%) (Special Eurobarometer 2010, 2014). This result is consistent with the finding that, overall across the EU, far more people now appear to engage in physical exercise 'as part of daily life' (e.g. walking, dancing, or gardening) than by playing organised sport (*Ibid.*).Notable exceptions are Spain, which has amongst the highest proportion of respondents playing sport regularly (15%), but amongst the lowest levels of non-sport physical activity (49%), and Ireland which is amongst the best performers for sport, but average for non-sport-based exercise (Special Eurobarometer, 2014).

The remainder of this section outlines specific trends and differences in types of physical activities that Europeans engage in.

3.6.2.1 Sport and exercise

No specific surveys, with sufficiently consistent data collection, have been carried out across MSs to enable a reliable comparison and assessment of the types of sports and

exercises that Europeans tend to engage in. Whilst most European countries have, to some extent, data available on sport participation, this has previously not been directly comparable[91].

Nevertheless, the data available is still valuable in respect to the information they provide about patterns in sports participation and physical activity, and, with necessary caution, trend directions provide some indication of similarities and differences between MSs (Mulier Instituut, 2005). In addition, there have also been attempts to improve the sport participation research in the EU. For example, the Co-Ordinated Monitoring of Participation in Sports (COMPASS) project aimed to improve the comparability of sport participation research in Europe by producing comprehensive research guidelines. More recently, the Meeting for European Sport Participation and Sport Culture Research (MEASURE) expert group was formed at the 7th European Association for Social of Sport meeting in Porto in 2010 to continue the work in harmonising international data collection relating to sports participation and standardising definitions of sport and exercise[92] (Hoekman et al., 2011).

A notable trend is that individual forms of sports and exercise appear to be growing in popularity among Europeans, whilst club sport participation appears to have stabilised (Scheerder et al., 2011). In particular, running, cycling and swimming appear to be popular types of exercise for Europeans; as shown in Table 5, appearing in the 'top 5' sports performed in nearly all countries.

Table 5. Top five most popular sports by region or country[93]

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Denmark	Walking	Running	Fitness	Aerobics	Swimming
England (United Kingdom)	Gym	Swimming	Football	Cycling	Athletics / running
Finland	Walking	Cycling	Gym / weight exercise	Cross-country skiing	Jogging
Flanders (Belgium)	Running	Recreational cycling	Swimming	Fitness	Walking
France	Swimming	Cycling	Pétanque / bowling	Walking & trekking	Running / jogging
Germany	Cycling	Running	Fitness	Swimming	Gymnastics
Italy	Fitness / aerobics / gymnastics	Football	Swimming	Cycling	Running / jogging
The Netherlands	Swimming	Cycling	Fitness / aerobics	Running	Walking

[91] Surveys on sport and exercise tend to be developed and conducted independently of one another, which can lead to differences in questionnaires, research designs, methodology and definition and description of notions of sport and physical activity.

[92] The MEASURE network

[93] National data sources used

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Northern Ireland (United Kingdom)	Swimming / diving	Walking	Exercise bike / spinning class / running machine	Jogging	Dance
Poland	Cycling	Jogging / walking	Swimming	Football	Volleyball
Spain	Swimming	Football	Cycling	Fitness	Mountain-eering
Switzerland	Cycling	Hiking / walking	Swimming	Downhill skiing	Running / jogging

Source: Data from Scheerder et al. (2011), ICF analysis

This is consistent with findings from the Special Eurobarometer (2014) that indicate that only around a quarter of EU citizens (26%) are members of a sports club, a considerable fall since 2009 (33%)but there was a slight increase in memberships of health or fitness centres (from 9% to 11%) where people are more likely to engage in individual forms of exercise.

National surveys can help to illustrate the extent to which Europeans are engaged with these forms of physical activity. For example, an in-depth study (Omyła-Rudzka, 2013) in Poland by the public opinion research centre, CBOS, found that cycling was by far the most popular recreational sport, followed by swimming (undertaken by 51% and 28% of the 904 adults interviewed, respectively). Notably, the ability of respondents to undertake these activities aligned well with the uptake: nearly all of the respondents knew how to ride a bike (97%) and most could also swim (64%). Similarly, 38% of people aged 15 and over in France took part in cycling and 29% took part in swimming (Muller, 2003)[94]. However, larger and more representative samples are required to draw conclusions about the entire population in these countries.

What sports do people play? Findings from Sport England's Active People Surveys (2005-2016)

Sport England conducts an annual survey of 165,000 adults (over the age of 14) in England, with data gathered between 2005 and 2016.The findings show that:

16 million English adults play sport regularly (at least once a week) – just over a third of all adults. This has increased by 1.75 million people since 2005/06 (though no analysis is provided on whether this change is significant, and/or is driven by demographic changes);

The most popular sports are swimming (2.5 million individuals swim once a week); athletics (2.4 million participants); cycling (2 million participants); football (1.9 million participants) and golf (0.74 million participants) and

Participation in sport is higher amongst higher socio-economic groups. Notably, there has been a statistically significant increase in activity amongst the higher socio-economic groups since 2006 (from 37% to 39%), but a decrease amongst the lower groups (from 27% to 26%).

[94] Data comes from the 2003 "cultural and sports participation" survey covering 8,000 households in France.

3.6.2.2 Active living

In 2014, 17% of those surveyed for the Special Eurobarometer 412 engaged in 'other physical activity' regularly (five times or more per week), compared to 8% who played sport. Other physical activity tends to encompass 'daily' activities such as housework, working or gardening, or exercising whilst traveling. In this regard, the Special Eurobarometer on Health and Food (2006) found that almost 9 out of 10 Europeans had performed 'some physical activity' over the last 7 days by working in or around their house, whilst the Special Eurobarometer surveys (2010, 2014) identify that around a third of Europeans who are physically active take their exercise while travelling (though there was minimal breakdown of this number by form of transport).

Longitudinal data collected as part of the SENECA study (de Groot et al., 2004) shows that for older adults in particular, most physical activity is performed as part of daily life. In this instance, a high proportion of particularly elderly men still undertook work activity which required physical activity of some sort, and on average, older adults carried out between 2.4-3.3 hours of housework and between 1.6-2.4 hours of leisure-time activities per day.

In regards to 'active transport' (i.e. exercising whilst travelling) one study found that the frequency of active transport varies by European city. Rojas-Rueda et al. (2016) assessed the potential health risks and benefits of active transit in Barcelona, Basel, Copenhagen, Paris, Prague and Warsaw using statistical modelling[95]. Table 6 provides a summary of these active transit data. Of the six cities included in the study, the highest percentage of all trips completed by walking were found in Barcelona and Paris and the highest percentage of trips completed by bicycle were in Copenhagen. The average trip distance completed by walking was fairly similar across cities; Warsaw had a higher average distance complete by bicycle.

Some data was found also at a national level. For example, a survey of physical activity in Poland[96] (GfK Polonia, 2015), found that 16.5% of people walk for recreational purposes more than five times a week, and 36% use walking as a mode of transportation.

Table 6. Active transit data for six European cities

	Barcelona	Basel	Copenhagen	Paris	Prague	Warsaw
% of all trips completed by:						
Public Transit	30%	25%	17%	33%	50%	49%
Walking	46%	35%	29.3%%	46%	24%	19%
Bicycle	2%	15%	27%	3%	3%	1%
Car	9%	24%	27%	12%	24%	24%
Average distance travelled per trip (km)						
Public Transit	10	13.1	2.8	7.6	15.7	26.6
Walking	1.4	1.3	0.7	1.1	1.2	1.1
Bicycle	3.3	2.9	3.7	3.4	4.4	5.4
Car	8.9	9.5	5.1	11.4	10.1	20.3

Source: Rojas-Rueda et al. (2016)

[95] To inform the model, the authors obtained data from travel surveys and the transport departments of each city to assess the following: percentage of all transit trips completed by walking, bicycle or car; trips per person per day; and average walking and cycling trip distance.

[96] Survey of 1000 Poles over the age of 15 in 2015 (carried out by GfK Polonia on 12-16 March, 1-5 October).

3.6.3 Key determinants affecting choice of physical activity

This section explores how the types of physical activity that Europeans engage in are influenced by time, accessibility and national policies, as well as individual characteristics such as age and gender.

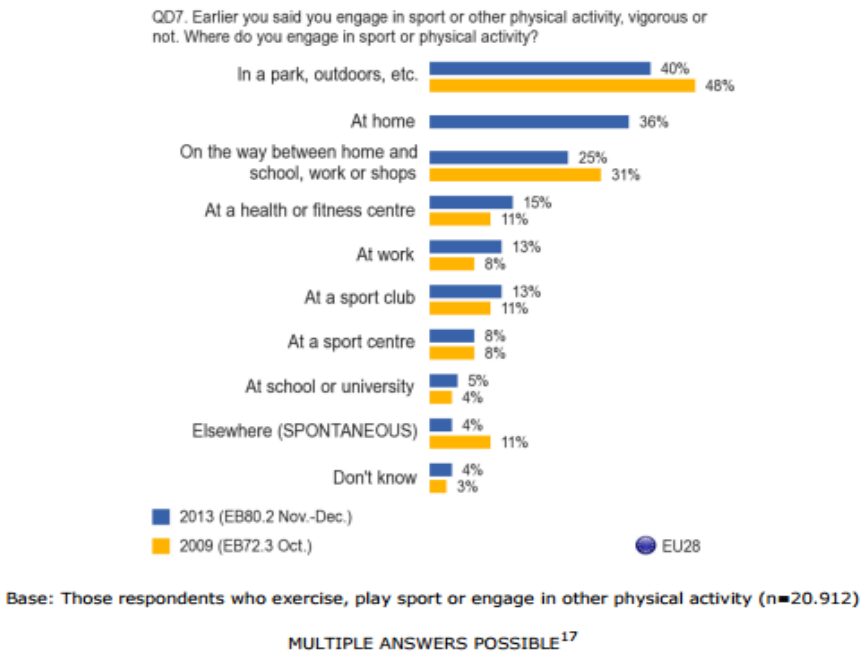
3.6.3.1 Time

A shortage of time was the main reason given by respondents to the Special Eurobarometer (2010, 2014) for not practising sport more regularly; nearly half of all respondents in both surveys (45% and 42% respectively) suggested that they lack time to practice sport more regularly. This explains, in part, why people find it easier to choose to engage in 'other' forms of physical activity, which fit in around daily life. A lack of leisure time may also explain the increased popularity of individualistic sport opportunities, such as going for a jog or cycling to work, as opposed to team sports. In this case, Scheerder *et al.* (2011) argue that a pluralised sports scene increases the number of opportunities to engage in a variety of sports and exercise that individuals can arrange for themselves at more convenient times.

3.6.3.2 Accessibility

Access to sport and exercise facilities also can affect the types of activities that Europeans engage in. The Eurobarometer survey (2014) found that most Europeans engage in physical activity in informal settings – for example parks or outdoors (40%), at home (36%) or on the journey to and from school, work or the shops (25%)[97]. Figure 12 also illustrates that between 2009 and 2013 there were slight increases in the proportion of respondents who choose to exercise, play sport or engage in other physical activity indoors (i.e. at health or fitness centres, at work, at a sports club and at school or university)[98].

Figure 12. Where do Europeans do sport or physical activity? (Special Eurobarometer 2014)



Source: Special Eurobarometer 412 (European Commission, 2014)

[97] N.B. these only include those individuals who do any physical activity.

[98] However, it is important to mention that 'at home' has been added to this question compared to the previous survey

However, there is considerable variation between MSs relating to where people choose to engage in physical activity. According to the Special Eurobarometer 412 (2014):

- Outdoor locations are particularly popular in the Nordic countries (between 50% and 72% do so), Slovenia (60%) and Austria (54%). They are least popular in Hungary (16%) and Romania (19%);
- Home-based activity (such as following fitness videos) is popular in Eastern Europe, with the highest figures reported in Lithuania (63%), Slovakia (54%) and Slovenia (54%). It is much less common in Southern Europe (e.g. 14% in Spain, and 13% in Italy);
- A similar East/South split is seen for work-based physical activity (i.e. heavy lifting); and
- The use of fitness centres/gyms is particularly common in Nordic countries, the UK, and Cyprus (between 22% and 40%). It is uncommon in Eastern Europe and France (where fewer than 6% use fitness or sports centres).

Access is also linked to income, as this can influence the extent to which certain types of sports and exercises are affordable. For example, Muller (2003) concluded that households with above-average income are far more likely to practice disciplines such as golf, canoeing, skiing and sailing. In contrast, combat sports such as boxing, fishing and automobile sports are equally likely to be practised by people with a low income as those with above average income. In addition, Kahn and Norman (2012) also found that young people in the lowest household income bracket are less likely to receive sports tuition and show lower rates of sports club membership than those in the top income bracket.

Finally, access is likely to also be affected by locality, as urban and rural settings offer different opportunities for sport participation. For example, in Poland (Omyła-Rudzka, 2013), urban residents appear do more sport than rural residents (72% versus 56%). However, in France, students from rural areas were more likely to work or cycle (as a mode of transport) than those from urban areas (Ministère de la Santé, de la Jeunesse des Sports et de la Vie Associative, 2008)[99].

3.6.3.3 Sport policies

Since the adoption of the European "Sport for All" charter by member states of the European Union, there has been increased interest in promoting participation in sports. Consequently, national governments often set targets for sports participation. For example, in the Netherlands, the government aimed for a sports participation rate of 75% percent in 2016, from a current action rate of 65 percent, and in the UK in 2008, the national government changed an earlier target of two million more participants in sport by 2012 (set in 2006) to at least one million more by 2012-2013 which may be more achievable (Hoekman *et al*., 2011). As policies and targets are often linked to funding, this may influence the opportunities Europeans have to engage with certain types of physical activities.

3.6.3.4 Age

As reported in Section 3.5, the proportion of people engaging in physical activity declines with age, with children far more likely than adults to engage in physical activity. The type of activity also varies with age. While 22% of respondents in the 70+ age group still play sports (Eurobarometer, 2010), in general people over 50 tend to concentrate on walking and home-related activities, such as gardening, whereas younger people and children are more likely to participate in team (or "collective")

[99] No method or reference provided in the source.

sports than any other age group. Related to this, Muller (2003) illustrated that two-thirds of the people practicing football in France, are young people (15-29 year olds)[100].

One article (Kahn and Norman, 2012) also emphasised the increased take-up of informal and spontaneous sports (such as parkour, skateboarding and kite surfing) by younger people, particularly in response to time pressures in modern life. Further, the authors suggest such sports offer a risk-taking element compared to traditional, organised sports which younger people are more likely to enjoy than other age groups.

3.6.3.5 Gender

Men play more sport than women; the two most recent Eurobarometer surveys (2010, 2014) found that only 37% of female respondents played sports at least once a week, compared to 43% of male respondents in 2010 and 45% in 2014. National surveys show there are also differences in the types of sports and exercises practiced by men and women. For example, a household budget survey conducted in Poland by the Central Statistical Office in October 2012 found that men participate in more collective, team sports such as football (36.7%), volleyball (14.3%) and basketball (10.3%) than women. On the other hand, women participate in more individual forms of physical activity such as: aerobics, fitness, yoga and gymnastics (19.5%); dance (16.5%); and, jogging and Nordic walking (15.8%)[101].

Men are also more likely than women to engage in other forms of physical activities for a longer period. For example, the 2014 Eurobarometer survey found that men typically walk for longer periods than women: while 24% of men walk for more than an hour, the figure is lower (19%) for women.

3.6.4 Concluding remarks

This section found that more individuals engage in physical activity as part of daily life than they do playing organised sport. For example, the review found that a third of Europeans who are physically active take their exercise while travelling. However, there is still relatively little comparative research on the types of sports and exercise that Europeans choose to engage with.

This section also identified multiple factors that influence the type of physical activity undertaken, including: accessibility and income; sociodemographic factors such as age and gender; national policies and targets; and individual preference. Nonetheless, it remains unclear how significant each of these factors are in the choices that Europeans make in regards to engaging in physical activity.

[100] Data comes from the 2003 “cultural and sports participation” survey covering 8,000 households in France.

[101] Survey of 904 persons. People were chose as a representative random sample of adult Polish citizens. Face to face interviews were then conducted with the help of CAPI (Computer Assisted Personal Interview) technology.

4 Conclusion

Overall, this review has captured current consumption and physical activity levels in Europe (including against guidelines), whilst comparing how these patterns have changed over time.

The first half of this review focused **calorie consumption (or energy intake)** from food and drink products. Overall, the literature search revealed that almost all the data available on consumption is self-reported, and based on methodologies such as food diaries or memory recall, which are known to have significant inaccuracies. For particular topics, the ability to identify patterns or trends was also limited by a lack of information or comprehensive data (for example, for certain food groups and the discussion around 'when' Europeans eat and drink).

Based on the data and research available for review, consumption habits appear to be changing across Europe as a result of a number of factors including individual preferences and choice, the increased availability of food products through global food manufacturers, and higher disposable income. A key driver of changing meal patterns appears to be a lack of time, which results in trends towards eating on the go and at irregular times. Nevertheless, the frequency and timing of eating and drinking occasions appears to vary considerably by MSs. These factors have influenced the amount of food and drink and that Europeans tend to consume, as well as how food and drink is consumed. For example, Europeans now spend less time preparing food in the home and there is an increased trend towards food consumption outside of the home, although it is not clear whether or not this has led to increased caloric intakes.

Whilst consumption appears to be converging with the increased availability of and accessibility to foods across the European Union, there are still some variations in the types of food groups consumed by MSs which are often based on cultural or historical habits (for example, the Mediterranean diet). In addition, specialised diets are also becoming more popular with the increased availability and accessibility of alternative food products.

International, European and national food-based dietary guidelines aim to provide recommendations for dietary intakes. On the whole Europeans still do not meet European or national food-based dietary guidelines, and differences can be noted by age (children, adults and older adults). Fruit and vegetable consumption is still below recommended levels for both adults and children, whilst European salt, sugar and fat consumption still exceeds recommended levels.

The second half of this review examined **European habits in relation to physical activity** undertaken in the home, at work or during leisure-time. Again, the studies identified tended to rely on self-reported data, though a few data sources used objective accelerometer or pedometer data. Studies using such objective methods can help to verify the self-reported data collected through surveys or diary logs.

There are noticeable differences in the amount of physical activity Europeans engage in by country as well as by sociodemographic factors such as age and gender. For example, a greater percentage of adults and older adults do not meet physical activity recommendations compared to children and adolescents, though even in these groups a high proportion fail to achieve recommended levels. Multiple factors also influence the type of physical activity undertaken, including: accessibility and income; sociodemographic factors such as age and gender; national policies and targets; and individual preference. More individuals engage in physical activity as part of daily life than they do playing organised sport. Active transport (walking or cycling) is a particularly popular form of physical activity, with a third of physically active adults taking their exercise while travelling. Public health authorities can consider ways to enhance the environment and/or create policies to support active transit, however,

examining transportation data will be an important starting point to ensure efforts are effective and efficient.

Finally, sedentary behaviour was also examined as part of this review. Whilst physical activity tends to decline with age, sedentary behaviour appears to be more closely linked to other factors which are not age-dependent such as screen-time; time spent in school or work, time spent on physical activity, and time spent engaging in 'other' forms of physical activity such as household chores).

Annex 1 Peer-reviewed literature review methodology

This sub-section describes the approach taken during the period March 2016- January 2018 to gather and synthesise the evidence.

A1.1 Research questions for this review

In this comprehensive review, current literature was gathered and synthesised, addressing Objective B1. This literature review provides a review of relevant, recent studies using the methodology presented below to summarise this topic. While the methods to conduct this comprehensive literature review are systematic, it is not a systematic review. Note unlike a systematic review, this review does not systematically analyse literature to identify all relevant published data and/or appraise its quality, but to find the most relevant published data and/or appraise its quality.

To explore this area, the literature review was conducted around the following agreed questions:

- What and how much do Europeans eat and drink, what kinds of food groups are more relevant and what trends are noticeable?
- When and where do Europeans eat and drink?
- How much physical activity do Europeans engage in?
- What types of exercises are Europeans engaging in?

The methodology for the peer reviewed literature is described below, with greater detail on search terms provided in other Annexes.

A1.2 Peer reviewed Literature

Methods to conduct the literature review consisted of five steps: (1) refining the research questions, (2) developing a search approach and databases, (3) conducting literature searches (Stage 1 below), (4) screening articles for inclusion (Stage 2 below); and (5) abstracting and synthesizing relevant data (Stage 3 below).

In Step 1, in partnership with DG SANTE the research question were confirmed. In Step 2, the 3 stage approach noted below and databases were confirmed. To minimise bias, the literature search approach included identification of a priori search parameters (also considered first level inclusion and exclusion criteria) to guide searches and inform screening and selection processes for data inclusion. Steps 3, 4 and 5 followed the process below:

- Conduct searches and document results (Stage 1)
- Screening search results (title and abstract) for relevance (Stage 2)
- Review full publications and abstract key characteristics and study findings (Stage 3)

Searches were conducted in multiple databases and screened following the procedures below. Following the literature review pilot, it was agreed to merge Stages 1 and 2.

A1.2.1 Stage 1: Conduct Searches and Document Results

In Stage 1, searches were conducted using search terms and criteria agreed with DG SANTE, with filters set for databases to ensure accurate inclusion and exclusion of literature, as shown in tables below. The search terms used were specific to each of the five research questions. Literature searches were conducted in PubMed, EBSCO (CINAHL, ERIC, PsycInfo), SportDiscus, and Embase. The reviewers used title and abstract [tiab] key word searches in EBSCO, PubMed and Embase. Medical Subject Heading (MeSH) terms were also used in PubMed and Embase searches. Searches included publications with all availability types (i.e. free full text and pay/subscription access).

Table 1. Inclusion and Exclusion Criteria Applied at Stage 1

Set Database Filter to Include:	Set Database filters to exclude:
Published between 1/1/2005-5/31/2016	Articles published before 1/1/2005
Peer reviewed scientific publications	Editorial comments/commentaries
Original research	Dissertations
Systematic reviews	Theses
Meta-analyses	Opinion articles
Article published in English, French, German, Italian Polish and/or Spanish	Article not published in English, French, German, Italian Polish and/or Spanish

In addition to reviewing studies in databases noted above, in order to help ensure inclusion of high quality literature (e.g., literature having gone through more formal quality assessments) systematic reviews and meta-analyses were reviewed for inclusion in the literature review. Searches for systematic reviews were conducted in Cochrane Review and healthevidence.org.

As noted a separate search was carried out for each research question, resulting in two groups of publications for screening for B1. After the searches, the results were reviewed to ensure they accurately met search parameters and duplicates were removed for screening in Stage 2.

A1.2.2 Stage 2: Screening search results (title and abstract) for relevance

At Stage 2, two screening levels were used: Level 1 quality check and Level 2 screening. Stage 2 screenings were done simultaneously. These screening inclusion and exclusion criteria are shown below.

A1.2.2.1 Stage 2 Level 1 Initial Screening (Quality check)

Search hits from all databases searched in Stage 1 were grouped by the four research questions and search terms to which they were related. Duplicate hits were deleted, and search hits by research question were organised from the most recent publications in 2017 going back in time to 2005, saved in an Excel file for that specific research question, and provided to reviewers for screening. These date parameters were agreed with DG SANTE as part of the pragmatic approach to managing the review material.

Using screening criteria in Table 1, reviewers screened the title and abstract of up to the first 200 hits per research question in each Excel file to identify literature to move forward for review. This was done to ensure the screening process was manageable given project timelines yet captured the most recent and relevant literature[102]

A1.2.2.2 Stage 2 Level 2 Subsequent Screening

Simultaneous with the Level 1 initial screening check, more detailed overall inclusion and exclusion criteria were applied by the reviewers to the title and abstract to screen publications. These criteria, are shown in Table 3 below under Level 2.

Table 2. Stage 2 Inclusion/Exclusion Criteria: Levels 1 and 2 Screening

Stage 2 – Level 1

[102] Results for each research question were screened separately, however, as screening took place, team members considered if articles might be relevant to other research questions, and if so, coded the article as such.

Category	Inclusion Criteria	Exclusion Criteria
Date	Published between 1/1/2004-5/31/2016[103]	Articles published before 1/1/2004
Publication Type	Peer reviewed scientific publications Original research Systematic reviews Meta-analyses	Editorial comments/commentaries Dissertations Theses Opinion articles Non-academic journal
Language	Article published in English, French, German, Italian Polish and/or Spanish	Articles in all other languages

Table 3. Overall screening criteria for Stage 2

Stage 2 – Level 2		
Category	**Inclusion Criteria**	**Exclusion Criteria**
Geography	Studies conducted in European Countries	Studies in all other countries
Human subject	Human-focused research	Animal-focused research
Behaviour/ Outcome	Studies specific to diet or physical activity behaviour Studies specific to sedentary behaviour or active transport	Studies that do not describe diet, physical activity and/or sedentary behaviour Studies that only examine associations of diet, physical activity or sedentary behaviour on an outcome (e.g., weight, health) and do not describe population estimates for the behaviours or patterns or trends.
General population	Studies where the population of focus includes children, adults or older adults in the general population.	Studies where the population of focus is a narrow population such as critically ill, hospitalized patients, people with a chronic condition or terminal illness, those incarcerated, etc.

From 942 publications screened in Stage 2, 50 publications were deemed of potential relevance, coded as "Include" and selected for full article review after Stage 2 screening.

[103] During screening, publications prior to 2005, and publications such as commentaries, dissertations or editorials were screened out, as were publications focusing on animals (rather than humans). Articles prior to 2005 and post 2016 were included only if they had been suggested by the experts from the expert workshop.

A1.2.3 Stage 3: Full Article Review and Synthesis

50 publications were exported for review of full text in this B1 literature review. After reading the full text, if the article was still deemed relevant for inclusion (based on consideration of the objective and if the article helped answer research questions), it was saved for use and reference in the bibliography. Following reading articles full text in this stage, 20 publications were selected for inclusion.

At each stage in this process, the team met to discuss successful strategies, challenges, and recommendations to improve the literature review processes. Note that although this is a comprehensive literature review and does not include a formal quality assessment process commonly conducted in systematic reviews, the team documented study designs (e.g., cross sectional, experimental) and the articles were checked by reviewers for signs of bias and poor quality research design. Further, the lead reviewer for each objective area conducted blind quality assurance checks for up to 10% of the coded articles. Any disagreements were discussed as a group and resolved with the review task lead.

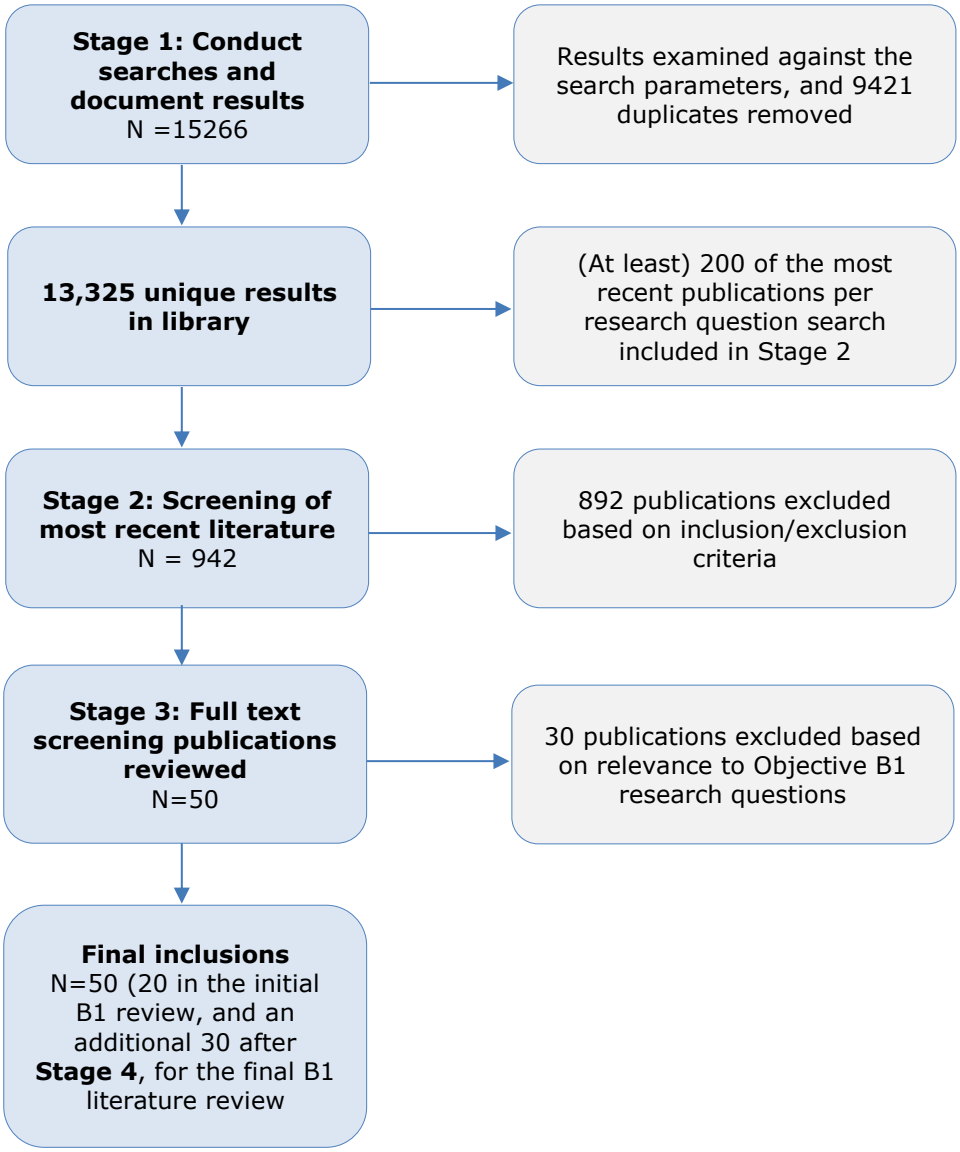
A1.2.4 Stage 4: External expert reviews and input

Upon completion of the draft set of comprehensive literature reviews, subsequent to review by DG SANTE and the Joint Research Centre (JRC), expert workshops were organised to discuss findings, highlight additional relevant sources to fill gaps and improve the series of reviews. Experts were carefully selected from academic and policy-making fields, based on expertise of the specific topics addressed. As a result of this exercise, 30 additional references were screened and incorporated into these reviews.

A1.2.5 Number of included and excluded publications

Figure 1 below shows the number of articles identified in peer reviewed literature searches, and the filtering out of literature at successive stages to arrive at the final number of 50 publications whose full text was reviewed and summarised for this review. The diagram also includes additional relevant references proposed by external experts, and incorporated into this final comprehensive review.

Figure 1. Diagram showing number of included and excluded publications at each stage – peer reviewed literature



As shown in Figure 1**,** a total of 15,266 search hits were retrieved. A total of 9421 duplicates were found and removed from the search hits resulting in 13,325 search results as "data" for B1. From the 13,325 articles, the team screened 942 of the most recent titles and abstracts. From the 942 most recent titles and abstracts screened, 50 were deemed of potential relevance and reviewed as full texts. From the 50 deemed relevant and reviewed as full texts 20 publications were selected for inclusion, in this final review. In addition, 30 additional articles were included in Stage 4 (after the expert workshop).

Annex 2 Peer reviewed literature: search terms

Objective B1 Search Terms

Rules:

Include 2004 or later

Include databases: Pubmed, EBSCO (CINAHL, ERIC, PsycInfo) Embase and SportsDiscus

Include human-focused only (exclude animal studies)

Include only peer reviewed literature and narrative reviews

Exclude non-relevant subheading in Pubmed/Embase*

Questions:

RQ1: What and how much do Europeans eat and drink, what kinds of food groups are more relevant and what trends are noticeable?

RQ2: When and where do Europeans eat and drink?

Primary Term		Combined with:	
"Eating"	**[mh]**	**"Intervention"**	**[mh]**
"Feeding behavior"	[mh]	**"Prevalence"**	[mh]
"Drinking behavior"	[mh]	**"Pattern"**	[mh]
"Diet"	[mh]	**"Intervention"**	[tiab]
"Nutrition surveys"	[mh]	**"Prevalence"**	[tiab]
"Meals"	[mh]	**"Pattern"**	[tiab]
"Beverage consumption"	[tiab]	**"Longitudinal"**	[tiab]
"Food consumption"	[tiab]	**"Trend"**	[tiab]
"Dietary"	[tiab]		
"Nutrient intake"	[tiab]		
"Food groups"	[tiab]		
"Diet"	[tiab]		
"Meals"	[tiab]		
"Feeding behavior"	[tiab]		
"Drinking behavior"	[tiab]		
"Nutrition survey"	[tiab]		
Diet Survey	[tiab]		
"Food groups"	[tiab]		

Questions:

RQ3: How much physical activity do Europeans engage in?

RQ4: What types of exercises are Europeans engaging in?

Primary Term		Combined with:	
"Exercise"	**[mh]]**	**"Intervention"**	**[mh]**
"Leisure activities"	[mh]	**"Prevalence"**	[mh]
"Physical fitness"	[mh]	**"Pattern"**	[mh]
"Physical endurance"	[mh]	**"Intervention"**	[tiab]
"Sedentary lifestyle"	[mh]	**"Prevalence"**	[tiab]
"Exercise"	[tiab]	**"Pattern"**	[tiab]
"Physical fitness"	[tiab]	**"Longitudinal"**	[tiab]
"Physical endurance"	[tiab]	**"Trend"**	[tiab]
"Physical activity"	[tiab]		
"Leisure Activity"	[tiab]		
"Screen time"	[tiab]		
"Sedentary time"	[tiab]		
Physical inactivity	[tiab]		
"Leisure time'	[tiab]		
"Active Transport"	[tiab]		

Annex 3 Peer reviewed literature bibliography

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Annex 4 Grey literature review methodology

This sub-section describes the approach taken during the period March 2016- January 2018 to gather and synthesise the evidence.

A4.1 Detailed search and review methodology

The review followed a process with five main stages:

- Searching for publications using set keywords and databases;
- Screening of search results for relevance;
- Screen results against inclusion/exclusion criteria, quality and relevance;
- Extraction of full texts and final screening process; and
- External expert reviews and input.

A4.2 Stage 1: Conducting searches and documenting results

A4.2.1 Searching for grey literature

The search terms initially used were agreed upon in the inception phase (Table 4). The main key words were either specific to the objective or broader thematic terms; for Objective B1 the main key words included both 'Healthy Eating' and 'Physical activity'. A second list of search terms was also used – these combination words were used to guide the search and produce the most relevant results; i.e. for Objective B1, the key word 'Dining Out' would be combined with the broader term 'Food Groups'.

Table 4. Search terms used for Objective B1 grey literature review

Suggested Search Parameters	
Parameters	
Grey literature Published in English, French, German, Italian, Polish and/or Spanish Date range (1995 – 2017)	
Key Words and suggested Combinations of Search Terms	
Key Words	Combined With
Nutrition	Food trends
Healthy eating	Food sources
Healthy diet	Food consumption locations (e.g., home versus out-of-home)
Physical activity	Eating out
Active living	Dining out
Exercise (e.g., type and frequency)	Physical environment
Consumption	Physical determinants: access, education, skills, time
Calories consumed	Social determinants: culture, family, peers and meal patterns
Food groups	Socio-economic terms: living conditions, employment, poverty, low income
Types of food (e.g., processed versus fresh)	External economic determinants: cost, income,
Fast food consumption	

Healthy food access Body Mass Index (BMI) Unhealthy eating Unhealthy diet Fast food Sedentary behaviour	availability of food Member States (of the EU) / Country (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom)

A4.2.2 Using set key words in databases, search engines and websites

In order to appropriately link and define the relationship between the key and combination search terms, the Boolean operators 'AND', 'NOT' and 'OR' were used in the search engines. In particular, the use of 'AND' helped to narrow the number of hits to ensure that only documents which included all the search terms showed up. Further, if a search led to a high number of irrelevant hits, a repeat search was conducted and key words which were separated by spaces or other characters (e.g. healthy food access) were enclosed in quotation marks (e.g. "healthy food access") to return only those documents that matched the search terms exactly.

The set key words and combination words were used to generate results in databases, search engines and websites recommend by the pilot review:

- Search Europa
- European Sources
- Eurostat
- NICE
- Opengrey
- WHO websites
- Food and Agriculture Association of the United Nations

Search Europa and NICE Evidence Database yielded the most results for Objective B1. The grey literature search was a fluid and dynamic process. As a result, keywords set out in the inception report such as 'Calories Consumed' or 'Healthy Food Access' were rephrased (to 'Calorie Consumption' and 'Accessing Healthy Food' respectively) to improve the searching, and subsequent extraction process. Further, due to the descriptive nature of Objective B1, the search terms led to rich sources of information, such as databases and graphs, which were difficult to extract. As such, during the initial search, a separate list of graphs and databases were collated and re-visited by the reviewer.

Additional hand searching

As per the recommendation made in the pilot review, hand searching was also used to supplement the key word searches. Hand searching involved extending the basic key word searches by using additional, contextual information. For example, in objective B1, phrases such as "Consumption of dietary food groups" were used to generate the most applicable results. This process ensured that highly-focused and relevant search results were generated for the original key words, in this case, consumption and food groups. All hand searches for this objective were completed on Google.

A4.3 Stage 2: Screen Search Results for Relevance

Most databases, search engines and websites offered the use of a relevancy filter[104] which automatically sorts results in order of their applicability to the key terms in the search engine. When a relevancy filter was not available, the links were manually screened by the appearance of the key search terms in the title of the source and the abstract (where available). For database and search engines, initially the top 50 most relevant search results were looked at per search string. If there were less than 50 results, all were looked at. The titles and abstracts were then examined for key search terms in the grey literature and relevance to the research questions.

Extra hand searching was conducted when search strings did not produce enough relevant information, and/or, when the top 50 results did not produce the most relevant literature. Hand searching involved extending the basic key word searches by using additional, contextual information.

Following the expert workshop (see stage 5 below), experts recommend further sources which were reviewed in the final redraft of the review.

Overall 190 results from the literature searches for Objective B1 were saved into a library.

A4.4 Stage 3: Screen results against inclusion/exclusion criteria, quality and relevance

Results were then screened against agreed inclusion and exclusion criteria detailed in Table 5 below.

Table 5. Grey literature inclusion and exclusion criteria

Inclusion	Exclusion
Published between 1995-2017	Published or enacted prior to 1995
Government reports from European Commission, European Parliament and EU Member States.	Non-nutrition and physical activity themed/focused
Think tank reports/publications	Industry-produced publications
Academic papers, conference papers and abstracts	Industry-produced project evaluation reports
Bibliographies	Industry-produced good practice reports
Programme evaluation reports[105]	Publications focusing on animal nutrition and physical activity
Standard/best practices documents	Blog or personal think thought pieces
Policy initiatives at European and/or national level- run by governments, not-for profit organisations	Newsletters or news articles
Industry funded publications (As regards the grey literature reviews,	Theses and dissertations (2010 and older)

[104] 'Sorting by relevance' on databases and search engines enables a connection to be established between the information in the database, the search string entered and any search filters chosen. If the keywords appear in a Title or Author field, the system shows these results first in the list of search returns. Less relevant articles e.g. ones where the keyword appears less often or may only appear in the actual content, appear later in the list of search results.

[105] For example: Hallsworth M, Ling T. (2007) *The EU platform on diet, physical activity, and health: second monitoring progress report. Cambridge: RAND Corporation*, http://www.rand.org/content/dam/rand/pubs/technical_reports/2008/RAND_TR609.pdf

Inclusion	Exclusion
particular care will be exerted in assessing any inclusion of industry-funded literature. These will be justified and discussed with the client).	
Primary theme/focus is human nutrition and physical activity	
Publication available via accessible databases	
Published in English, French, German, Italian, Polish and/or Spanish	
Theses and dissertations (post-2010 only)	

Due to the large number of results still returned after this screening the data parameters were further refined to only include those reports published 2005-2017.

Following this criteria screening and exclusion of search results, the remaining results were checked for quality and relevance.

A4.4.1 Exclusion based on quality checklist

The quality check was based on the AACODS checklist (AACODS)[106] which included:

- Authority
  - Is the author credible?
- Accuracy
  - Is the document supported by documented and authoritative references?
  - Is there a clearly stated methodology?
  - Is the document representative of work in the field?
- Coverage
  - Have limitations been imposed and are they clearly stated?
- Objectivity
  - Can bias be detected (if so the bias was clearly stated in the extraction form)?
- Date
  - Does the document have a clearly stated date relating to the content?
- Significance
  - Is the document relevant?
  - Would the document enrich the findings?
- Exclusion based on relevance to research questions

The remaining grey literature was examined further so that only results most relevant to the objective were extracted. In particular, each article was examined for text relating to the key terms and questions under the objective. For example, in Objective

[106] Please see the full outline of the AACODS checklist here: https://dspace.flinders.edu.au/jspui/bitstream/2328/3326/4/AACODS_Checklist.pdf

B1, the text was examined for reference to the research question 'How much physical activity do Europeans do?"

A4.5 Stage 4: Extraction of full texts and final screening process

A data extraction template in Excel was used to capture the following categories of information: 1) identifying information for each publication, 2) study design characteristics, 3) sample characteristics, 4) intervention characteristics, 5) content (behaviour/outcome) focus, 6) description of results, 7) assessment of rigour/bias and 8) objective specific information. In total 157 results were extracted.

After extraction, the review author read through all of the extracted data and a final screening process excluded more results due to quality or a lack of enough relevant information, now made obvious after extraction. Sources were also excluded from the grey literature where this was superseded by, either more rigorous peer reviewed research on the same theme, or more recent statistics. In total, 32 results were excluded.

A thematic analysis was applied to the remaining extracted data and their findings synthesised with those of the peer reviewed literature. Any identified bias in sources which passed the inclusion criteria is highlighted in the analysis.

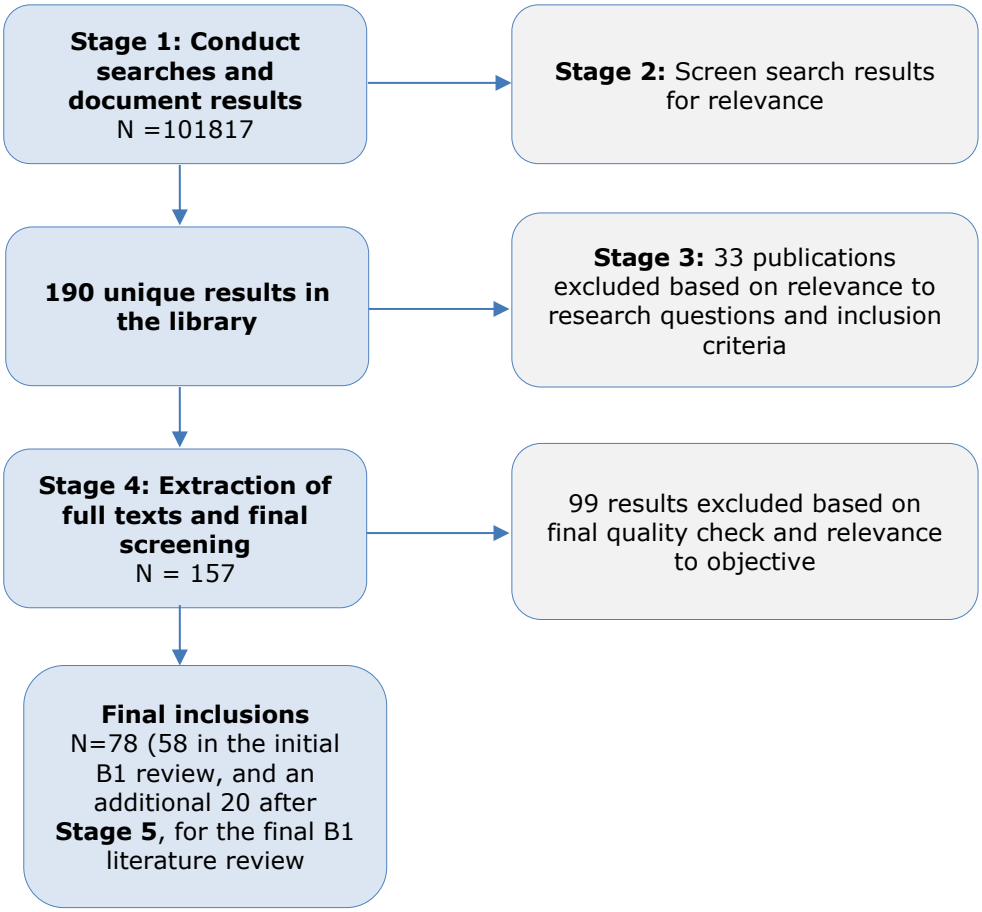
A4.6 Stage 5: External expert reviews and input

Upon completion of the draft set of comprehensive literature reviews, expert workshops were organised to discuss findings, highlight additional relevant sources to fill gaps and improve the series of reviews. Experts were carefully selected from academic and policy-making fields, based on expertise of the specific topics addressed. As a result of this exercise, 20 additional grey literature references were screened and incorporated into these reviews.

A4.7 Number of included and excluded references

The diagram in Figure 2 below shows the number of articles identified in grey literature searches, and the filtering out of literature at successive stages to arrive at the final number of publications whose full text was reviewed and summarised for this review. The diagram also includes additional relevant references proposed by external experts, and incorporated into this final comprehensive review.

Figure 2. Diagram showing number of included and excluded publications at each stage – grey literature



As shown in Figure 2, a total of 101,817 search hits were retrieved. From the 190 results saved in the library, 33 were excluded based on the relevance to Objective B1 research questions. Following this, 157 results were extracted fully. An additional 99 publications were then excluded based on inclusion/exclusion criteria, quality of evidence and relevance to the research questions. In Stage 5, supplementary searches were conducted and/or articles recommended by experts during the workshops were looked at and another 20 grey literature sources were included in the final review.

Annex 5 Grey literature bibliography

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ISBN :978-92-79-97425-0

doi:10.2875/586086