

## Title

Concepts and procedures for mapping food and health research infrastructure: New insights from the EuroDISH project

Kerry A Brown<sup>1\*</sup>, Lada Timotijević<sup>1</sup>, Marjolein Geurts<sup>2</sup>, Johanne L Arentoft<sup>3</sup>, Rosalie AM Dhonukshe-Rutten<sup>4</sup>, Léopold Fezeu<sup>5</sup>, Paul Finglas<sup>6</sup>, Martine Laville<sup>7</sup>, Giuditta Perozzi<sup>8</sup>, Marga Ocké<sup>2</sup>, Krijn Poppe<sup>9</sup>, Nadia Slimani<sup>10</sup>, Harriette M Snoek<sup>9</sup>, Inge Tetens<sup>3</sup>, Pieter van 't Veer<sup>4</sup>, Cécile Vors<sup>7</sup>, Karin L Zimmermann<sup>9</sup>

<sup>1</sup>Food, Consumer Behaviour and Health Research Centre, University of Surrey, UK

<sup>2</sup>National Institute for Public Health and the Environment (RIVM), the Netherlands

<sup>3</sup>Danmarks Tekniske Universitet, Denmark

<sup>4</sup>Wageningen Universiteit, the Netherlands

<sup>5</sup>University of Paris 13 (UP13), France

<sup>6</sup>Institute of Food Research, United Kingdom of Great Britain and Northern Ireland

<sup>7</sup>Centre Européen pour la Nutrition et la Santé (CENS), Université Claude Bernard Lyon 1, France

<sup>8</sup>CREA-NUT, Food & Nutrition Research Centre, Rome, Italy

<sup>9</sup>LEI, Wageningen UR, the Netherlands

<sup>10</sup>Lifestyle and Cancer Group, International Agency for Research on Cancer (IARC), France

**\*Corresponding author & present address:** Kerry A Brown, 15-17 Tavistock Place, London School of Hygiene & Tropical Medicine, London, WC1 9SH, UK. E-mail: [kerry.brown@lshtm.ac.uk](mailto:kerry.brown@lshtm.ac.uk), Tel: +44 (0)20 7927 2112, Fax: +44 (0)20 7927 2701

## **Abstract**

### *Background*

Recent initiatives in Europe have encouraged the formalisation of research infrastructure to unify fragmented facilities, resources and services; and to facilitate world-class research of complex public health challenges, such as those related to non-communicable disease. How this can be achieved in the area of food and health has, to date, been unclear.

### *Scope and approach*

This commentary paper presents examples of the types of food and health research facilities, resources and services available in Europe. Insights are provided on the challenge of identifying and classifying research infrastructure. In addition, suggestions are made for the future direction of food and health research infrastructure in Europe. These views are informed by the EuroDISH project, which mapped research infrastructure in four areas of food and health research: Determinants of dietary behaviour; Intake of foods/nutrients; Status and functional markers of nutritional health; Health and disease risk of foods/nutrients.

### *Key findings and conclusion*

There is no objective measure to identify or classify research infrastructure. It is therefore, difficult to operationalise this term. EuroDISH demonstrated specific challenges with identifying the degree an organisation, project, network or national infrastructure could be considered a research infrastructure; and establishing the boundary of a research infrastructure (integral hard or soft facilities/resources/services). Nevertheless, there are opportunities to create dedicated food and health research infrastructures in Europe. These would need to be flexible and adaptable to keep pace with an ever-changing research environment and bring together the multi-disciplinary needs of the food and health research community.

**Key words:** Research infrastructure; food and health; determinants of dietary intake; Europe; EuroDISH

## 1 Introduction

Research infrastructure provides a platform for inter-disciplinary/multi-national collaboration to facilitate world-class research (EC, 2013). This is designed to create an opportunity for large scale innovative research, as well as the efficient use of resources and the transfer of knowledge/best practice across borders (ERA, 2013). The exact nature of a research infrastructure can be various; ranging from major equipment, to sets of instruments, or knowledge containing resources (e.g., collections, archives or data banks).

Furthermore, these infrastructures can exist in a single site, as a network of distributed sites, or within a virtual framework (ESFRI, 2010). A well-known example of research infrastructure is CERN, the European Organisation for Nuclear Research. This is a single-sited laboratory-based research infrastructure, that was established in Geneva in 1954 to assist with the study of particle physics. CERN is recognised as a world-class research facility, which has facilitated several scientific breakthroughs, as well as providing economic, political, educational and social benefits (OECD, 2014).

A survey by the European Commission (EC) and European Science Foundation (ESF) in 2006-2007 suggested the success of CERN has translated into a clear definition, widespread recognition, and use of research infrastructure in physics (ESF, 2007). In contrast, the concept of research infrastructure was considered relatively new in the Biomedical and Life Sciences, and in the Humanities and Social Sciences (ESF 2007). This promoted a series of initiatives from European bodies to support the further development of infrastructure in a range of research areas. The ESF; the European Heads of Research Councils (EUROHORCs); European Research Area (ERA); EC Innovation Union; Horizon 2020; European Strategy Forum for Research Infrastructure (ESFRI); and the introduction of European Research Infrastructure Consortium (ERIC) status, have all been central to obtaining Member State support and progressing European Union (EU) research infrastructure, across scientific fields from physics to nanotechnology (ESF/EUROHORCs, 2008). Despite these initiatives, in recent years there has been a particular focus on the lack of research infrastructure available to assist with the study of food and health. This is illustrated by the EC supported commissioning of the Food and Health Research in Europe (FAHRE) project; the theme of the recent Expo Milano 2015: feeding the planet, energy for life; and the establishment of both the ESFRI food and health working group and the Joint Programming Initiative - healthy diet for a healthy life (JPI-HDHL).

The above emphasised a requirement for research infrastructure to answer complex, broad, multi-faceted research questions specific to food and health (FAHRE, 2010; EXPO Milano 2015; JPI, 2012). Food remains central to protecting and promoting inter/national public health. Two thirds of global deaths have been attributed to non-communicable diseases, with diet considered an influential modifiable lifestyle factor in chronic disease aetiology and pathology (together with physical activity, tobacco avoidance and responsible alcohol use; Jamison, 2013; WHO, 2012). The range of challenges related to food and health are shown below:

- Combating the burden of rising public health, well-being and economic costs associated with non-communicable diseases and associated conditions (e.g., obesity, cardiovascular disease,

hypertension, stroke, type II diabetes mellitus, musculoskeletal disorders, certain cancers or mental health conditions (WHO, 2012).

- Minimising malnutrition and dietary or nutrient related infectious diseases e.g., iodine deficiency, stunting, iron deficiency (FAO/WHO, 2014)
- Developing sustainable food consumption and production to manage natural resources/water and protect biodiversity and ecosystems (SCAR, 2011)
- Ensuring the success of the European food-related economy and innovative business community (EC, 2012).

These challenges illustrate the multi-disciplinary nature of food and health research, which frequently aligns with and cuts across a range of disciplines (e.g., social and natural sciences including economics, policy, sociology, psychology, environmental, nutrition, biochemistry, medicine, genetics etc.); and levels of analysis (e.g., molecule, cell, organ, body, individual, community, country, region). Research infrastructure can provide the opportunity to assemble inter-/cross-/multi-disciplinary research teams. This would enable the large scale and innovative research required to help overcome the public health challenges of today and those of the future. What is less than clear however, is how these aspirations might be realised.

This commentary paper provides a starting point for identifying which fragmented facilities, resources and services could potentially be unified to achieve an international food and health research infrastructure in Europe. First, working definitions of research infrastructure and the food and health research area will be presented using documentation from the ESFRI and the Mapping of the European Research Infrastructure Landscape project (MERIL), as well as the EuroDISH model of food and health research areas (for a detailed description of the EuroDISH project, please see [www.eurodish.eu](http://www.eurodish.eu); Snoek H et al. unpublished). Second, examples of the types of food and health research facilities, resources and services in Europe identified by EuroDISH will be provided. This will be followed by insights from the EuroDISH project on the challenge of identifying and classifying research infrastructure. This is followed by suggestions for the future direction of food and health research infrastructure in Europe.

## 2 Working definitions of research infrastructure and food and health research

### 2.1 Research infrastructure

Research infrastructure can be described by its activities or by its legal status. The ESFRI definition presented below is primarily related to the former. This definition covers a range of elements, including tangible or hard research infrastructure (e.g., the laboratory of CERN), as well as supporting research infrastructure (e.g., related to Information Communications Technology, ICT), and less tangible or soft research infrastructure (e.g., training, networks or standard operating procedures, SOP).

“The term ‘research infrastructures’ refers to facilities, resources or services of a unique nature that have been identified by European research communities to conduct top-level activities in all fields. This definition of Research Infrastructures, including the associated human resources, covers major equipment or sets of instruments, in addition to knowledge-containing resources such as collections, archives and data banks. Research Infrastructures may be “single-sited”, distributed”, or “virtual” (the service being provided electronically). They often require structured information systems related to data management, enabling information and communication. These include technology based infrastructures such as Grid, computing, software and middleware.” (ESFRI, 2010).

This ESFRI definition is in line with that used by the ESF in their 2006-2007 survey, as well as the 2010-2012 follow-up survey that was conducted by MERIL. The findings of MERIL were used to create an inventory of European research infrastructures. This inventory continues to be updated and is free to access or search via an online portal (<http://portal.meril.eu/converis-esf/publicweb/startpage?lang=1>). In order to decide which infrastructures to include on the MERIL inventory, the term research infrastructure has been operationalised by employing a set of in/exclusion criteria. These criteria include:

- 1) Quality. This primarily relates to a research infrastructure being of greater than national relevance; thus, infrastructures that restrict access to national users are not considered eligible to be included on the MERIL inventory.
- 2) Access. Research infrastructures are required to have clear public rules and procedures for accessing facilities, resources or services. As mentioned above, research infrastructures are excluded if they restrict access to national users only.
- 3) Management. Minimum standards of management are required, including a clear and identifiable, single entry point for the research infrastructure; clear support arrangements for users; and clear procedures for the management of data.

The legal status of a research infrastructure provides a formal definition of a research infrastructure. The award of ERIC status to a research infrastructure refers to the acceptance of a legal framework for a European Research Infrastructure Consortium, set up by the European Commission and with full legal capacity recognised in all EU Member States. To be awarded ERIC status research infrastructure must meet the following requirements:

- It is necessary for the carrying out of European research programmes and projects

- It represents an added value in the strengthening and structuring of the European Research Area (ERA) and a significant improvement in the relevant scientific and technological fields at international level
- Effective access, in accordance with the rules established in its statutes, is granted to the European research community, composed of researchers from Member States and from associated countries
- It contributes to the mobility of knowledge and/or researchers within the ERA and increases the use of intellectual potential throughout Europe
- It contributes to the dissemination and optimisation of the results of activities in Community research, technological development and demonstration (EU, 2015).

Ten ERICs were established in 2014 (EU, 2015). In 2016, at least 12 research infrastructures were awarded ERIC status and a further four are awaiting the result of their application

([https://ec.europa.eu/research/infrastructures/index\\_en.cfm?pg=eric#eric](https://ec.europa.eu/research/infrastructures/index_en.cfm?pg=eric#eric)).

The award of both ERIC status or inclusion on the MERIL inventory provides a reference for determining whether research facilities, resources, or services can be considered sufficient to be termed research infrastructure. ERIC status represents the high-profile European research infrastructure, whereas the MERIL inventory can be viewed as a more inclusive list of research infrastructures. The degree to which food and health research was represented by the research infrastructures awarded ERIC status or included on the MERIL inventory was investigated by the EuroDISH project. EuroDISH mapped food and health research infrastructure using the ESFRI definition of research infrastructure. Results were then categorised based upon the award of ERIC status or inclusion on the MERIL inventory<sup>1</sup>.

## 2.2 Food and health research

The EuroDISH model was used to define research areas relevant to the study of both food and health. This (DISH) model comprised of: Determinants of dietary behaviour, Intake of food and nutrients, Status and functional markers of nutritional health, Health and disease risk of foods and nutrients (here after referred to as determinants, intake, status or health). This model built upon previous research by FAHRE which explored food and health research needs in Europe. In FAHRE, food and health research was considered wide-ranging, related to "...the production, marketing, choice, regulation and policy for food as it affects health, and the mechanisms and control of diet-related diseases, nutrition and obesity." (FAHRE, 2010). This definition could be interpreted as related to elements of food safety, toxicology, food security, food sustainability, environmental sciences, agriculture, nutrition and public health. All of which, are relevant to the relationship between food and health. EuroDISH however, focused primarily on nutrition research i.e., the effect of food on health. This represents just one strand of food and health research. Nutrition is however, a multi-disciplinary area, overlapping with numerous other strands of food and health research. The focus of

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<sup>1</sup> The EURODISH final report, together with details on the EuroDISH mapping protocol (desk research, semi-structure interviews and workshop), can be viewed via the EC Community Research Development Information Service:

[http://cordis.europa.eu/project/rcn/104246\\_en.html](http://cordis.europa.eu/project/rcn/104246_en.html)

the remaining commentary foremost relates to nutrition food and health research; yet it is expected that the information presented is only a starting point for unifying research in this area. This commentary therefore, can also be of relevance to those in aligned or wider food and health research areas.

### **3 Examples of the types of food and health research facilities, resources and services in Europe**

EuroDISH mapped over 160 items (table 3) using desk research, stakeholder interviews (n=30) and a workshop in Brussels, Belgium on the 17-18<sup>th</sup> June 2013 (n=49)<sup>1</sup>. Desk research and interview data were analysed by each DISH area using a qualitative method of content analysis (Breakwell, 1995; Greenhalgh, 1997) and a common data recording template (based on the EuroDISH definition of research infrastructure, table 2). The workshop<sup>1</sup> presented the initial EuroDISH mapping findings and discussed the challenge of defining research infrastructure, as well as the breadth and depth of food and health research areas. From this work, nine research infrastructures were identified that were relevant to facilitate food and health research and had been awarded ERIC status or were present on the MERIL inventory (table 2, 3 and figure 1). The majority of these were not specifically designed to facilitate food and health research and no one research infrastructure was considered applicable to cover all four of the DISH research areas. These nine infrastructures were most relevant to the study of *health* with *determinants* considered to be the area of food and health research that was the least represented. As a group however, these nine research infrastructures depicted more than one discipline, with both the Biomedical and Life Sciences, as well as the Humanities and Social Sciences represented e.g., infrastructures ranged from those that facilitated the implementation of randomised controlled trials (ECRIN: European Clinical Research Infrastructure Network); to those that promoted the use of high-quality data in social, economic and political research (CESSDA: Council of European Social Science Data Archives Consortium).

Regarding the remaining c.150 mapped items, EuroDISH recognised a number of these items could be considered eligible for meeting the criteria to be included in the MERIL inventory. For example, long-standing European/multi-country surveys, such as the WHO supported Health Behaviour in School-aged Children cross-national survey. Other items were considered under development with the possibility to meet the eligibility criteria in the future (e.g., the EuroDISH case studies, figure 1, tables 1-3). Interestingly, a small proportion of the items were based in North America, indicating there are international research links with countries outside of Europe (table 3). As a whole, all mapped items appeared to vary in their size, stage of development and relevance to a single or several EuroDISH research areas (determinants, intake, status or health). EuroDISH encountered a number of challenges identifying and classifying research infrastructures and their various stages of development. These have been presented in the following section.

## 4 Challenges to identifying and classifying research infrastructure

### 4.1 Short-term projects, networks or research infrastructure

The MERIL management criterion states a research infrastructure “does not include short-term projects or networks. However, their component parts may be entries in MERIL in their own right”. EuroDISH mapped a number of projects and networks (particularly European funded) which provided or linked major equipment/sets of instruments (tools) or knowledge-based resources (e.g., HELENA YANA C: Healthy Lifestyle in Europe by Nutrition in Adolescence; BIOCLAIMS: Bio-markers of Robustness of Metabolic Homeostasis for Nutrigenomics-derived Health Claims Made on Food; JPI-HDHL joint actions DEDIPAC: Determinants of Diet & Physical Activity and ENPADASI/DASH-IN: Nutritional Phenotype Assessment and Data Sharing Initiative; DIOGENES ORBAST: Diet, obesity and genes; EMIF: European Medical Information Framework; NUGENOB: Nutrient-gene interactions in human obesity; NU-AGE: New dietary strategies addressing the specific needs of the elderly population for healthy ageing in Europe; SU.FOL.OM3: French randomised double-blind, placebo-controlled secondary prevention trial on the effectiveness of nutrient supplementation in the prevention of cardio-vascular diseases, table 3). These items were initially mapped due to the extensive interactions observed among networks, projects and inter/national research infrastructures. For example, networks were seen to promote specific research consortia, which resulted in active research projects that had the potential to lead to inter/national research infrastructure. It was however, difficult to establish the longevity or potential sustainability of the project repositories, databases or facilities beyond the lifetime of the projects (MERIL management criterion also states “the RI must have funding approved for a period sufficient to deliver the type of access typical for that class of facility”). A lack of available information (often due to facilities, resources or services currently under development or seeking sustainable research activities) resulted in the majority of EuroDISH mapped projects being considered ineligible for the MERIL inventory; thus not classified as research infrastructure. Regarding networks, those considered networks of people (e.g., ESPEN ASBL: European Society for Clinical Nutrition & Metabolism or ARP-PROBS: Automated Self-Administered 24-hour recall) rather than networks of facilities were classified as soft research infrastructure.

### 4.2 Inter/national (including European) relevance of research infrastructure

The quality criterion for inclusion in the MERIL database suggested a research infrastructure is required to be of “...greater than national relevance...”. This criterion was often met for items mapped at the European level (that had not already been discounted as short-term projects or networks). It was more difficult to establish whether this criterion was met for those items funded or predominantly hosted at a national level. For example, the MERIL quality criterion refers to “evidence of the attractiveness of the RI to users from abroad” or “the existence of formal agreements with non-national partners” and this information was rarely available or apparent in the data collected by EuroDISH via desk research, interview or stakeholder workshop. A particular issue was accessing the information to expertly judge whether “appropriate metadata to enable the data to be analysed, compared and re-used” or “harmonised standards with equivalent centres” was in place. This resulted in several items, such as national surveys (e.g., CIQUAL: French food

composition database; ENNS: French national study on nutrition and health; NutriNet-Santé: NutriNet-Santé databank), being classified as national research infrastructure only. Furthermore, it was difficult to decide the hierarchy of research infrastructure (i.e. which national ‘research infrastructure’ was subsumed under a larger international ‘research infrastructure’). For example, the UK bio-bank was initially considered a standalone research infrastructure; yet, it was eventually classified as the UK node of the international research infrastructure BBMRI-ERIC (Bio-banking and Bio-molecular Resources Research Infrastructure-European Research Infrastructure Consortium).

#### *4.3 Boundaries of a research infrastructure*

Considerable difficulty can be seen with distinguishing the boundaries of a research infrastructure i.e., what elements (facilities, resources or services) are integral to and constitute a research infrastructure. An extensive network of associations can be seen between research facilities, resources and services that may be aligned with more than one infrastructure. The MERIL management and access criterion “single entry point for the RI must be clearly identifiable...clear support arrangements for scientific users...clear procedures for management of data” were used to decide the ‘host’ of the research infrastructure. This information was not always explicitly available, nor straightforward to establish. The result of which was inequivalent items being mapped regarding size or stages of development. For example, there remained uncertainty as to whether it was correct to map NOPA (Nutrition, Obesity & Physical Activity database) or whether WHO Europe should be the mapped item, whereby this would include items such as NOPA as well as the VMIS (Vitamin and Mineral Nutrition Information System).

Identifying and classifying research infrastructure in EuroDISH was further complicated by the dynamic nature of this research environment. New research infrastructure could be under development, change identity and constantly evolve in line with new initiatives or broader frames of application. For example, the global nutrition surveillance initiative set-up by the WHO and IARC (International Agency for Research on Cancer) was influential in the renaming of EPIC-Soft (European Prospective Investigation into Cancer and Nutrition programme) into GloboDiet (Global Nutrition Surveillance initiative); as well as the development of the support research infrastructure e-SMP (e-Standardised Methodologies Platform) into the GloboDiet-RI (part of EuroDISH case study 1, table 3, figure 1). Similarly, items changed affiliation, either developing as standalone research infrastructures or integrated and advanced into pan-European research infrastructures. This can be seen with the EuroDISH case study 2 (table 3, figure 1), where the nutritional phenotype research infrastructure (formerly Nutritional Phenotype database, dbNP) could be considered at different time points as part of NuGO (Nutrigenomics organisation), the JPI-HDHL joint action ENPADASI/DASH-IN or potentially as a standalone research infrastructure in the near future.

## 5 Conclusion and suggestions for the future

This commentary paper provides a starting point for considering how to unify fragmented facilities, resources and services to achieve international food and health research infrastructure in Europe. Insights have been provided on the challenge of identifying and classifying research infrastructure. This can assist those who may be familiar or unfamiliar with the term research infrastructure. In particular, understanding the current landscape of research infrastructure or navigating the relevant literature. In addition, a variety of facilities, resources and services were identified that conduct food and health research valuable to a European audience. These mapped items represented a range of disciplines and types of research. This emphasises the evolution of food and health research into a highly multi-disciplinary scientific domain. EuroDISH focused upon one of these domains, primarily mapping nutrition-related food and health research infrastructure. It is therefore, expected that the full spectrum of food and health research infrastructure would represent an even greater range of disciplines and types of facilities, resources and services. This can be illustrated by the recent additions to the ESFRI health and food research infrastructure landscape, which is more focused upon environmental and food science, and food safety research infrastructure (e.g., all of the following are due to be operational between 2016 and 2020, ANAEE: ANalysis And Experimentation on Ecosystems; EMBRC: European Marine Biological Resource Centre; EMPHASIS: the European Infrastructure for multi-scale Plant Phenomics and Simulation for food security; EHRINA: European research infrastructure on highly pathogenic agents; ESFRI, 2016).

No infrastructures (regardless of meeting the ERIC/MERIL definition of research infrastructure) were considered capable of facilitating both food and health research, across all four of the EuroDISH research areas (*determinants, intake, status, health*). It therefore, appears there is an opportunity to connect, link and develop existing initiatives and infrastructure. This would enable multi-disciplinary research across, at the minimum, the nutrition-related food and health research area. Such an initiative could fall in line with current European strategies which continue to monitor the landscape of research infrastructures to ensure there is sufficient support to meet the scientific challenges of the future (e.g., ESFRI health and food strategy working group which is reviewing research infrastructure that can meet challenges of the future up to the year 2050; EuroDISH Milano conference 2015). Furthermore, there are wide-scale initiatives to link resources and maximise scientific efficiency and impact, such as the BioMedBridges joint effort of 12 biomedical research infrastructures which are present on the ESFRI roadmap (ESFRI 2014b), or the UK cross-council vision for food, nutrition and health research (BBSRC/ESRC/MRC webpage). The EuroDISH findings reported herein suggests that any research infrastructure, which is to be designed to facilitate state-of-the-art multi-disciplinary food and health research, would have to be flexible and adapt to keep pace with an ever-changing research environment and bring together the different research needs of a disparate food and health research community. Caution must be applied however, with creating a wholly open research infrastructure. The advantages of being all-inclusive can be inversely related to the quality of scientific output or the ability to uphold scientific governance, such as complying with socio-legal (including ethical)

obligations. It is therefore, still a sensible - if not difficult - approach to define research infrastructure both by the description of its activities, as well as by its legal status.

## **6 Acknowledgements**

All EuroDISH consortium members are acknowledged, as well as the external expert and stakeholder interview and workshop participants for their invaluable contributions to this work. The work reported herein has been carried out within EuroDISH – studying the need for food and health research infrastructures in Europe. This co-ordination support action is supported by the European Commission under the Food, Agriculture and Fisheries, and Biotechnology theme of the 7th Framework Programme for Research and Technological Development (grant agreement no: 31178). The study does not necessarily reflect the Commission's views or its future policy in this area. Further acknowledgements go to Rachel Berry (IFR) for reviewing the draft manuscript; Jeppe Inversen (DTU) for data collection, Determinants analysis and reviewing the draft manuscript; Camille Hoppe and Astrid Böhm (both DTU) for data collection and Determinants analysis; Julia Bardes for data collection and Health analysis; Lars Eijssen and Chris Evelo for their central roles, alongside Guiditta Perozzi, regarding the nutritional phenotype research infrastructure case study; and finally the ILSI Europe team, in particular Ruth Marquet, regarding workshop organisation.

## **7 Author conflicts of interest**

A number of EuroDISH authors and consortium members have a direct interest in the research infrastructures contained herein. In particular, the pan-European nutrition surveillance research infrastructure and the nutritional phenotype research infrastructure case studies. However, please note that the need for these research infrastructures was identified prior to the development of EuroDISH (e.g., the nutritional phenotype research infrastructure case study 2 was initiated by - and has subsequently been included in - the JPI-HDHL call to establish a European Nutritional Phenotype Assessment and Data Sharing Initiative, ENPADASI).

## **Highlights**

- Identifying and classifying research infrastructure is challenging
- Research infrastructure is dynamic and constantly developing
- Food and health research is a highly multi-disciplinary scientific domain
- Research infrastructure relevant to food and health remains fragmented and disparate
- There is a lack of infrastructure to facilitate research on both food and health

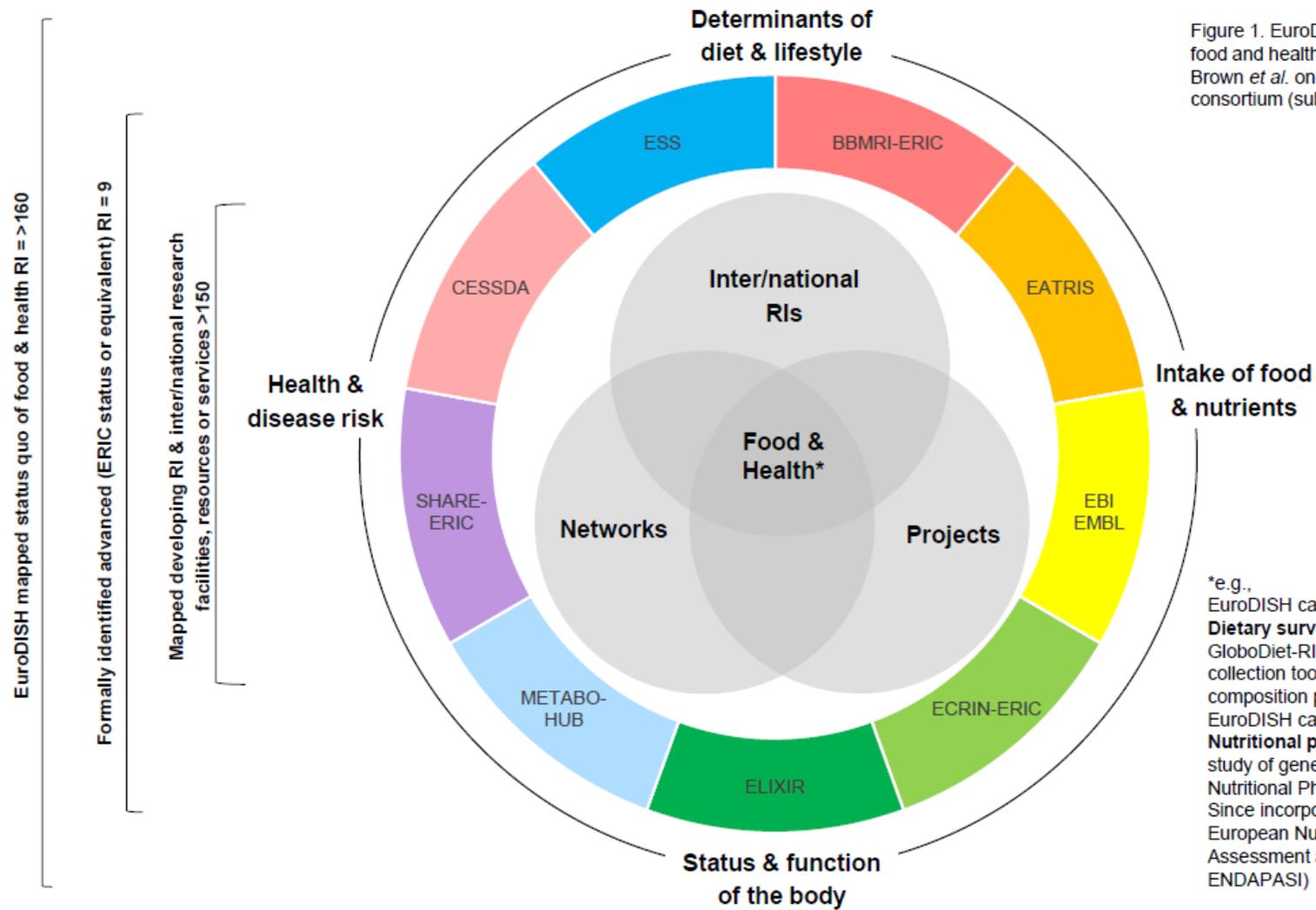


Figure 1. EuroDISH mapping of European food and health research infrastructure (RI) Brown *et al.* on behalf of the EuroDISH consortium (submitted TIFS 2015)

\*e.g.,  
 EuroDISH case study 1:  
**Dietary surveillance RI** via integration of GloboDiet-RI (standardised dietary data collection tool) and the EuroFIR food data composition platform.  
 EuroDISH case study 2:  
**Nutritional phenotype RI** to support the study of gene and diet interactions (formerly Nutritional Phenotype database, dbNP. Since incorporated into JPI-HDHL/ European Nutritional Phenotype Assessment and Data Sharing Initiative, ENDAPASI)

Table 1 Working definition of research infrastructure

<b>ESFRI/EuroDISH</b>	<b>MERIL</b>	
>national relevance	1) Quality	>national relevance
Top level research resource/service		Metadata available
Quality science/tech. performance & support	2) Access	Rules & procedure
Knowledge containing resource	3) Management	Identifiable entry
		User support
Major equipment or set of instruments		Data management
		Sufficient funding
Exclude: Soft RI	Exclude: Projects, networks, national	

ESFRI: European Strategy Forum for Research Infrastructure; EuroDISH: Studying the need for food and health research infrastructure in Europe; MERIL: Mapping of the European Research Infrastructure Landscape

Table 2 Examples of food and health research infrastructure in Europe: Nine ERIC status/MERIL inventory research infrastructures

<b>Research infrastructure (RI)</b>	<b>Includes</b>	<b>Description</b>
BBMRI-ERIC (Bio banking and Bio molecular Resources RI)	BBMRI-HSERN (Human Sample Exchange Regulation Navigator); BBMRI WIKI; BBMRI-LPC (Large Prospective Cohorts)	Pan-European biomedical RI which integrates biobanks/ biomolecular resources/enabling ICT, SOP, codes of conduct)
CESSDA (Council of European Social Science Data Archives Consortium)	CESSDA-PPP (Preparatory phase project for a major upgrade of the CESSDA RI)	Umbrella organisation for social science data archives across Europe, providing data for secondary use
EATRIS-ERIC (European Advanced Translational RI in Medicine)	Biomarkers Product Platform	Network of academic institutes providing cutting edge infrastructure and expertise along the translational value chain (translational research in medicine). Biomarkers Product Platform facilitates the validation and development of biomarkers for the prevention, diagnosis and prognostic assessment of disease. New functional markers and translational research in medicine (not nutrition specific)
EBI EMBL (European Bioinformatics Institute, European Molecular Biology Laboratory)		UK academic research institute. Part of European Molecular Biology Laboratory (EMBL). Provides and supports courses to teach the use of a range of free, open-source bioinformatics resources, in particular in the domain of nutrition research for academics and researchers with an interest in improving the interface between nutrition and bioinformatics and/or with an interest in -omics.
ECRIN-ERIC (European Clinical RI Network)	ECRIN-IA (integrating activity); ECRIN-PPI (preparatory phase infrastructure); ECRIN-RKP (reciprocal knowledge programme); ECRIN-TWG (Transnational Working Groups)	Operations and support to multinational clinical trials. Database of existing clinical research centres in translational-interventional and epidemiology domains across Europe.

ELIXIR (European Life-science Infrastructure for Biological Information)		Infrastructure for biological information in Europe to support life science research and translation to medicine and environment, the bio-industries and society. Database and data collection tools.
ESS (European Social Survey)		Academically driven cross-national survey every 2 years since 2001. Social structure, conditions and attitudes in Europe (e.g., democracy). Provides social not food data.
MTH (MetaboHUB)		Provides new methods to interpret nutrition and health associations. Originally a French project MetaboHUB developed a distributed coordinated infrastructure for metabolomics dedicated to innovation, training and technology transfer restructure and coordinate France's highest quality research platforms in metabolomics (Bordeaux, Paris, Toulouse, Clermont-Ferrand). These four partners will develop shared tools and expertise for basic and applied projects related to human health and nutrition, food production and quality, sustainable agriculture
SHARE-ERIC (Survey of Health, Ageing & Retirement in Europe-ERIC)	SHARE-I3 (integrating activity), SHARE-PREP (upgrading preparatory phase), SHARE-LEAP (longitudinal enhancement & access improvement), SHARE-M4 (multinational advancement of RI on ageing)	RI on ageing. Study on health, ageing and retirement. Does not include any dietary information. The SHARE database may be useful for food and health research for providing a data baseline for health status in elderly in Europe
ICT: Information Communications Technology; SOP: Standard Operating Procedures		

**Table 3. Examples of food & health research infrastructure (RI) in Europe: mapped items by the EuroDISH project 2012-2013† (n=9 ERIC status/MERIL inventory identified RI, in bold; n>150 developing RI, inter/national research facilities, resources or services).**

<b>Initials/Acronym</b>	<b>Full name</b>	<b>DISH relevance</b>	<b>ERIC status/ MERIL inventory RI</b>	<b>Inter-/national relevant</b>	<b>Food and health research relevance</b>
AFRESH	Activity & Food for Regional Economies Supporting Health	DH		International (based in Europe)	FP7 funded 2010-2013. Developed a research agenda for reducing diet- and physical activity-related diseases by developing innovative products & services
ALIFERT	Diet & its relationship with couple infertility	ISH		National (European country)	French on-going observational, case-control, multi-centric study. Impact of diet and wide range of lifestyle factors (e.g., physical activity, sleep, anxiety) on male and female fertility. Questionnaire, anthropometrics, blood samples (expected N=300 couples)
ARP-PROBS	Atelier Reflexion Prospective-Prospective et Recherche sur les Obesites	SH		National (European country)	French network. Nutrition health and status
ASA24	Automated Self-Administered 24hr recall	I		International (based outside Europe)	Example of national dietary collection tool that can be adapted for use in Europe. USA online 24 hour recall.
BACCHUS	Beneficial effects of dietary bioactive peptides & polyphenols on	ISH		International (based in Europe)	FP7 funded 2013-2017. Databank/base on consumption of bioactive peptides and polyphenols

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	cardiovascular health in humans				
<b>BBMRI-ERIC</b>	<b>Bio banking and Bio molecular Resources Research Infrastructure-European Research Infrastructure Consortium</b>	<b>ISH</b>	<b>X</b>	<b>International (based in Europe)</b>	<b>ERIC RI. Pan-European biomedical RI (integrates biobanks/biomolecular resources/enabling Information Communications Technology, SOPs, codes of conduct)</b>
BIOCLAIMS	Biomarkers of Robustness of Metabolic Homeostasis for Nutrigenomics-derived Health Claims Made on Food	IS		International (based in Europe)	FP7 funded 2010-2015. Biological technologies (e.g., nutrigenomics) to identify biomarkers for measuring the effects of food/food components on health. Database/databank/new methods
BIOSHARE-EU	Biobank Standardisation & Harmonisation for Research Excellence in the EU	H		International (based in Europe)	FP7 funded 2010-2015. Network biobanks and cohorts for large-scale pooled analyses. Development of harmonisation and standardisation tools
BIRTHCOHORTS.NET	Birthcohorts.net	H		International (based in Europe)	Inventory of Birth Cohorts provides details about design and data of world-wide registered birth cohorts

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BOND	Biomarkers of Nutrition for Development	S		International (based outside Europe)	Develop processes to inform appropriate biomarker selection and use (includes development of a query based system tool, with evidence based advice and conditions of use)
CALIBER	CALIBER	H		National (European country)	The goal of CALIBER is to provide evidence across different stages of translation, from discovery, through evaluation to implementation where electronic health records provide new scientific opportunities. CALIBER investigators represent a collaboration between epidemiologists, clinicians, statisticians, health informaticians and computer scientists.
CAPNUTRA	Capacity development network in nutrition in Central & Eastern Europe	I		International (based in Europe)	Report on systematic lit review on dietary intake nutritional tools and methods of dietary data collection in Europe
CBRC	Copenhagen Brain Research Centre	DH		National (European country)	A platform for interdisciplinary collaboration in brain research with a high international impact. Among others, they study effects of hormone (serotonin) on eating behaviour in overweight subjects.
CCPRB	Cancer Control using Population based Registries & Biobanks	H		International (based in Europe)	FP6 funded 2004-2009. Network linking biobanks and cancer registries
<b>CESSDA</b>	<b>Council of European</b>	<b>DIH</b>	<b>X</b>	<b>International</b>	<b>RI. Umbrella organisation for social science data archives</b>

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	<b>Social Science Data Archives</b>			<b>(based in Europe)</b>	<b>across Europe, providing data for secondary use</b>
CHANCE	Low cost technologies & traditional ingredients for the production of affordable, nutritionally correct foods improving health in population groups at risk of poverty	DH		International (based in Europe)	FP7 funded 2011-2014. Address poor nutrition in European populations at risk of poverty by developing attractive, affordable and nutritious food products using low-cost tech & traditional ingredients
CHANCES	Consortium on Health & Ageing: Network of Cohorts in Europe & USA	H		International (based in Europe)	FP7 funded 2010-2015. Combining on-going European cohort studies regarding ageing-related health characteristics/determinants (including nutrition), and socio-economic status
CHICOS	Developing a Child Cohort Research Strategy for Europe	H		International (based in Europe)	FP7 funded 2010-2013. Network of child cohorts. Inventory and integration of European child cohorts by evaluating data from existing birth/parent cohorts, registers and relevant European databases
CHOPIN or CHOP	Childhood obesity: Early programming by infant nutrition	IH		International (based in Europe)	FP5 funded 2002-2006. Multi-centre intervention trial with new-born infants (N=1750, 5 European countries) investigating protein/fat infant formula ratio/complementary feed long-term

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					influence on obesity risk
CIQUAL	CIQUAL	IS		National (European country)	French food composition database. Run in the Observatory of Food Nutritional Quality, unit of ANSES. Collect, access and make available nutritional composition data of foods consumed in France. Adequacy of nutrition status of French population
CLYMBOL	Role of health-related claims & symbols in consumer behaviour	D		International (based in Europe)	FP7 funded 2012-2016. Understanding the effects of food labelling health claims and symbols on consumer purchase and consumption behaviour. Methods of study include eye-tracking equipment.
CODEX	Codex Alimentarius	I		International (based in Europe)	Codex Alimentarius Food Standards is a collection of standards and related information prepared by FAO/WHO.
CRO	Contract Research Organisations	SH		International (based in Europe)	Example of CRO distributed over the world, providing support to the clinical research in health and nutrition
CSC	Clinical Sciences Centre, MRC, Imperial College London	DH		National (European country)	Research facilities (e.g., MR facility, Biological mass spectrometry and proteomics lab, Genomics lab, Transgenics and embryonic stem cell lab, Whole animal physiology imaging, Microscopy lab, Flow cytometry, Computing services) to understand molecular/physiological basis of health/disease

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CSGA	Centre des Sciences du Goût et de l'Alimentation (en. Centre for Taste & Feeding Behaviour)	D		National (European country)	Public research unit studying the different signals coming from food and their impact on feeding behaviour (animal and human models) e.g., chemical, molecular, cellular, behavioural and psychological mechanisms underlying sensory perception
DEDIPAC JPI Joint Action	JPI-HDHL joint action knowledge hub Determinants of Diet & Physical Activity	DIS		International (based in Europe)	JPI joint action. Aligning the study of individual, social and environmental determinants that influence food and physical activity behaviours
DESIR	Data From the Epidemiological Study on the Insulin Resistance Syndrome cohort study	H		National (European country)	A 9-year epidemiological study on the Insulin Resistance Syndrome in France. Clinical, biological and questionnaire data (including dietary intake) collected on 5212 adults aged 30-65 with repeated assessments every 3 years.
DID'IT	Determinants & Impact of the Diet, Interactions & Transitions	DISH		National (European country)	French Institut national de la recherche agronomique (INRA) project. National database on dietary patterns and health
DINO	Diet In Nutrients Out	I		National (European country)	Example of national dietary collection tool. UK Medical Research Council Human Nutrition Research (MRC HNR)
DIOGENES	Diet, obesity and genes	DISH		International	FP6 funded 2005-2009. Prototypes of innovative products/advice

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				(based in Europe)	regimes to avoid weight gain/re-gain (including glycaemic index database)
DORIAN	Developmental Origins of Healthy & Unhealthy Ageing: The Role of Maternal Obesity	H		International (based in Europe)	FP7 funded 2012-2014. Basic mechanisms of early life development and ageing. Impacts of maternal obesity on ageing and degenerative pathologies in the offspring
DUTCH FFQ TOOL	Dutch FFQ-Tool	D		National (European country)	Example of national dietary collection tool. Dutch online FFQ
DYNAMO-HIA	EC DG Health & Consumers funded project. Dynamic Model for Health Impact Assessment	H		International (based in Europe)	Health policy assessment web tool. An instrument to assess the health impact of policies influencing health determinants
EARLY NUTRITION	Long-term effects of early nutrition on later health	ISH		International (based in Europe)	FP7 funded 2012-2017. RCT interventions, existing cohort studies, placenta biobank. Early nutrition programming effects on obesity risks.
EARNEST	Early Nutrition programming - long term efficacy/safety trials & integrated	DISH		International (based in Europe)	FP6 funded 2005-2010. Investigated early nutrition programming integrated knowledge from RCT, prospective observational studies and animal, cellular and molecular techniques

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	epidemiological, genetic, animal, consumer & economic research				
EASO	The European Association for the Study of obesity	SH		International (based in Europe)	Established 1986. Not-for-profit science/medicine professional membership association. Independent European scientific association. Promotes research into obesity, network of organisations.
<b>EATRIS</b>	<b>The European Advanced Translational Research Infrastructure in Medicine</b>	SH	X	<b>International (based in Europe)</b>	<b>Network of academic institutes providing cutting edge infrastructure and expertise along the translational value chain (translational research in medicine). Biomarkers Product Platform facilitates the validation and development of biomarkers for the prevention, diagnosis and prognostic assessment of disease. New functional markers and translational research in medicine (not nutrition specific)</b>
<b>EBI EMBL</b>	<b>The European Bioinformatics Institute Part of the European Molecular Biology Laboratory</b>	S	X	<b>International (based in Europe)</b>	<b>UK academic research institute. Part of European Molecular Biology Laboratory (EMBL). Provides and supports courses to teach the use of a range of free, open-source bioinformatics resources. Can be used by academics and researchers with an interest in improving the interface</b>

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					<b>between nutrition and bioinformatics and/or with an interest in -omics.</b>
ECNIS 1 & 2	Environmental cancer risk, nutrition & individual susceptibility	H		International (based in Europe)	FP6/7 funded 2005-2013. Network of Excellence on biomarkers of carcinogenesis. Diet and hereditary influence environmental cancer risk. Integrating European environmental carcinogenesis research. ECNIS2 continued the integrative and co-ordinating of ECNIS to create a virtual research centre
<b>ECRIN-ERIC</b>	<b>European Clinical Research Infrastructure Network</b>	<b>ISH</b>	<b>X</b>	<b>International (based in Europe)</b>	<b>Operations and support to multinational clinical trials. Database of existing clinical research centres in translational-interventional and epidemiology domains across Europe.</b>
EFCOVAL	European food consumption validation	I		International (based in Europe)	FP6 funded 2006-2010. Develop and validate a trans-European food consumption method & food matching guidelines (including GloboDiet, formerly EPIC-SOFT) to be used for estimating the intake of foods, nutrients and hazardous chemicals. Computerised dietary collection tool and recommendations

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EFSA	European Food Safety Authority	ISH		International (based in Europe)	EFSA Comprehensive Food Consumption Database information on food consumption across the EU (including Concise European Food Consumption Database and EXPOCHI: Individual food consumption data and exposure assessment studies for children). EU menu project (harmonising data collection on food consumption across Europe), classified according to FoodEx2 (food classification and description for exposure assessment). EFSA macro/micro-nutrients and energy DRV. GloboDiet 24hr recall method. EU Menu (including PANCAKE: Pilot study for the Assessment of Nutrient intake and food Consumption Among Kids in Europe)
<b>ELIXIR</b>	<b>European Life-science Infrastructure for Biological Information</b>	<b>S</b>	<b>X</b>	<b>International (based in Europe)</b>	<b>Infrastructure for biological information in Europe to support life science research and translation to medicine and environment, the bio-industries and society. Database and data collection tools.</b>
EMIF	European Medical Information Framework	SH		International (based in Europe)	European Innovative Medicines Initiative Joint Undertaking, EFPIA (European Federation of Pharmaceutical Industries and Associations') & FP7 project. Allows the re-use of existing health data. EMIF platform addresses issues critical to the use of

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					large datasets (e.g., health data from Electronic Healthcare Record databases) including semantic interoperability , ethics, data privacy, development of an IT platform
ENCR	European Network of Cancer Registries	H		International (based in Europe)	Hosted by EC Joint Research Council. Harmonisation of cancer registries, defines data collection standards, provides training for cancer registry personnel and disseminates info on incidence and mortality from cancer in Europe. Can be used to link cohort studies
**ENPADASI (including dbNP)	JPI HDHL joint action knowledge hub European Nutritional Phenotype Assessment and Data Sharing Initiative (including Nutritional Phenotype Database: The Phenotype Data Infrastructure)	ISH		International (based in Europe)	Began 2014 and brought together research centres and scientists from JPI Member Countries to carry out joint trans-multi-disciplinary activities. This initiative offers open access tools for future mechanistic, intervention and epidemiological studies providing the highest level of standardisation of all phenotypic information of study subjects with regard to diet, physical activity levels and all biological, clinical and physiological measurements that define human body responses in health and disease states. The dbNP is an open source application suite to store biological studies - central module stores study design and links to measurement/data platforms

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ENERGY PROJECT	European energy balance research to prevent excessive weight gain among youth	DH		International (based in Europe)	FP7 funded 2009-2012. School-based and family-involved energy-balance health behaviour intervention for 10-12 year olds
ENGAGE	European Network for Genetic & Genomic Epidemiology	H		International (based in Europe)	FP7 funded 2008-2012. Translate molecular epidemiology information into future advances in clinical medicine through the integration of existing large-scale genetic and phenotypic data. Meta-analysis of genetic and phenotypic datasets/tools for data sharing and harmonisation. Interactions of genes, environment and lifestyle factors on disease risk
ENNS	Étude nationale nutrition santé	DISH		National (European country)	French national study on nutrition and health (ENNS). Food consumption, nutritional status and physical activity survey in metropolitan France of 3-17 years and 18-74 years.
EORTC	European Organisation for Research & Treatment of Cancer	H		International (based in Europe)	Network co-ordinating scientific and operational infrastructure dedicated to investigator driven clinical trials and translational research. State-of-the-art treatments, development and testing of new cancer agents minimising laboratory discovery to therapeutic patient benefit delay.
EPIC	European Prospective	DISH		International	Prospective cohort (N=500,000, 23 centres, 10 countries). Study

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	Investigation into Cancer, Chronic Diseases, Nutrition & Lifestyle			(based in Europe)	resources include dietary collection tools e.g., GloboDiet 24-hour recall, FFQ. Food classification system. Cohort central biobank held at IARC. Cancer endpoint data.
ESPEN ASBL	European Society for Clinical Nutrition & Metabolism ASBL	ISH		International (based in Europe)	Network. ESPEN guidelines are developed by the European Society for Clinical Nutrition and Metabolism and provide guidelines for Parenteral and Enteral Nutrition or, more broadly, Clinical Nutrition and Metabolism.
<b>ESS-ERIC</b>	<b>European Social Survey</b>	<b>D</b>	<b>X</b>	<b>International (based in Europe)</b>	<b>Academically driven cross-national survey every 2 years since 2001. Social structure, conditions and attitudes in Europe (e.g., democracy). Not food specific.</b>
ETHERPATHS	Characterisation & modelling of dietary effects mediated by gut microbiota on lipid metabolism	H		International (based in Europe)	FP7 funded 2009-2013. Developing systems biology tools to facilitate dietary intervention studies aiming to modulate lipid homeostasis. Mechanistic studies regarding diet-microbiota interaction for the lipid metabolism.
EU PLATFORM DIET, PHYSICAL ACTIVITY & HEALTH	EU Platform on Diet, Physical Activity & Health	H		International (based in Europe)	E-platform forum for European-level organisations, ranging from the food industry to consumer protection NGOs, willing to commit to tackling current trends in diet and physical activity (e.g., consumer information/labelling, education, promotion)

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EUROCARE 1, 2 & 3	European Cancer Registry Study on Cancer Patients' Survival & Care	H		International (based in Europe)	FP2 & 4 funded 1990-2001. International collaborative study on the survival of cancer patients in Europe. Cancer prevalence, cancer survival time trends and patterns of care of cancer patients across Europe (not nutrition specific)
EUROCODE & EUROPEAN-FOOD GROUPS	Eurocode (formerly EuroFood) and European-Food groups	I		International (based in Europe)	The Eurocode system (first called EUROFOOD) was a result of the FLAIR and EU COST Action 99 projects. Intended to be a total food coding system with three components: Eurocode-1 (product codes), Eurocode-2 (classifications system) and Eurocode 2 descriptor system
EUROCOURSE ERA-NET	Europe against Cancer: Optimisation of the Use of Registries for Scientific Excellence in research	H		International (based in Europe)	FP7 funded 2009-2012. Improvement in and harmonisation of cancer registries across Europe. Program owners' and researchers' networking, information exchange and benchmarking of best practice.
EURODIAB	Epidemiology, aetiology and public health aspects of diabetes mellitus	H		International (based in Europe)	FP2, 3 & 4 funded 1988-2001. Eurodiab original cohort with a 5-year follow-up (cross sectional survey of 3250 people with IDDM (insulin-dependent diabetes mellitus) in 29 centres in Europe funded by the EC in 1989-91). Clinical, biological and questionnaire data (including dietary intake) collected on 1,880 participants (survivors and siblings of original participants who

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					also have IDDM) in order to measure the impact of lifestyle, physiological and genetic factors on the onset and progression of diabetes
*EUROFIR AISBL FOOD COMPOSITION DATA INTERCHANGE PLATFORM	Eurofir AISBL Food Composition data interchange platform	DISH		International (based in Europe)	FP6 (FOODEXPLORER) & 7 (NEXUS) funded. International, member-based, non-profit association. Develops, publishes and exploits food composition information; promoting international co-operation and harmonisation of standards to improve data quality, storage and access. Includes eBASIS (Bioactive Substances in Food Information Systems) and FoodEXplorer (interface for searching food composition data). Provides food and supplement composition database and food classification linking system to aid studying the adequacy of European dietary intake
EUROSTAT EHIS	EUROSTAT-European Health Interview Survey	DIH		International (based in Europe)	Statistical office of the European Union. The European Health Interview Survey (EHIS) is carried out by EUROSTAT to obtain amongst other data on fruit and vegetable consumption in different population groups.
EURRECA	European micronutrient recommendations aligned	DISH		International (based in Europe)	FP6 funded 2007-2012. Dietary data collection and status marker best practice guidelines. Biomarker database (micronutrient

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					wiki). Nutrient calculation tool (NutPlan). DRV/NRV database (Nutrirequest)
FAIRSPEAK CBS	FairSpeak Group, Copenhagen Business School	D		National (European country)	Danish research group developing methods and tools for analysing consumer understanding of food labelling. Includes ability for eye tracking consumer behaviour research
FENL	Functional Electrical Neuroimaging Laboratory	D		National (European country)	Swiss laboratory for investigative neurophysiology. Research major sensory systems, multi-sensory processing, food perception electrical neuroimaging methods
FLABEL	Food Labelling to Advance Better Education for Life	D		International (based in Europe)	FP7 funded 2008-2012. Influence of food label nutrition information on consumer behaviour and food choice. Includes the use of eye tracking equipment.
FLAVIOLA	Targeted delivery of dietary flavanols for optimal human cell function: Effect on cardiovascular health	DIH		International (based in Europe)	FP7 funded 2009-2013. Impact of flavanols on CV health
FLICC	Front of pack food Labelling: Impact on Consumer Choice	D		National (European country)	UK MRC funded (partners UK and NZ) 2012-2014. Influence of front of pack labelling on consumer behaviour. Includes the use of Sensecam/Vicon Revue wearable camera equipment.

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FNIC	US Dept of Agriculture Food and Nutrition Information Centre	I		International (based outside Europe)	American national resource providing many links, including those to the 4 food and supplement composition database
FOLFIV	Impact of Folates in the Care of the Male Infertility	ISH		National (European country)	French large multi-centre randomised controlled 2xblind interventional study on the impact of folates on male infertility
FOOD & DRINK EUROPE	Food & Drink Europe	I		International (based in Europe)	Organisation representing European food and drink industry (food safety and science, nutrition and health, environmental sustainability and competitiveness). Provides reports on data and trends of the European food and drink industry online - estimate of nutrient intake
FOOD OUTLET CLASSIFICATION TOOL	Food Outlet Classification Tool	DH		National (European country)	UK NIHR (National Institute for Health Research) funded. Tool to describe types of food outlets. Derived from field observations and existing classification systems
FOOD4ME	Personalised nutrition: An integrated analysis of opportunities & challenges	DISH		International (based in Europe)	FP7 funded 2011-2015. Personalised nutrition and dietary data collection guidelines/tools
GIFTS	Genomic & lifestyle predictors of foetal outcome relevant to	H		International (based in Europe)	FP7 funded 2012-2015. European-South Asian collaborative intervention trials-based project targeting early life programming and looking at diet-gene interactions in the development of

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	diabetes and obesity & their relevance to prevention strategies in South Asian peoples				diabetes and obesity
*GLOBAL NUTRITION SURVEILLANCE INITIATIVE	IARC-WHO Global Nutrition Surveillance initiative (GloboDiet)	I		International (based in Europe)	EC funded projects (EuroDISH, PANCAKE, EMP-PANEU, JPI-DEDIPAC, BBMRI-LPC) developed the IARC-WHO Global Nutrition Surveillance initiative to collect standardised dietary data worldwide (in 25 countries) using the DEX international dietary assessment methodologies. Pursuing the development and implementation of a comprehensive e-research infrastructure to support the dissemination, maintenance, data access, sharing, and (pooled) analyses of the GloboDiet data across participating countries. GloboDiet (formerly EPIC-SOFT): a highly standardised 24-hour dietary recall programme used/validated in a number of European countries.
GRACE	Global Registry of Acute Coronary Events registry	H		International (based in Europe)	International ACS (Acute Coronary Syndrome) registry on-going. Largest multi-national registry tracking patient outcomes across full ACS spectrum
GUIDEA	Guidance for Dietary	I		International	ILSI (International Life Sciences Institute) Europe food intake

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	Intake Exposure Assessment			(based in Europe)	methodology task force on-going initiative. Dietary data collection tool platform providing guidance on planning, conducting, reporting and interpreting exposure assessment
GUTSYSTEM	Dietary Polyphenols, Gut Microbes & Human Health: A Systems Biology Approach	H		International (based in Europe)	FP6 funded 2006-2010. Mechanistic study looking at host-microbiota-diet interactions
HABEAT	Determining factors & critical periods in food habit formation & breaking in early childhood: a multidisciplinary approach	D		International (based in Europe)	FP7 funded 2010-2014. Studies the formation of food habits and eating patterns in infants, toddlers and children up to 6 years to identify the key determinants of behavioural change. Involved birth cohort studies and experimental work.
HBSC	Health Behaviour in School-aged Children	DIH		International (based in Europe)	International alliance of researchers collaborating on a cross-national survey of school students. Collect data every four years on 11, 13 and 15 year-old boys' and girls' health and well-being, social environments and health behaviours. Began in 1982 with 3 countries. Adopted by WHO Europe in 1983. Now 43 countries across Europe and North America.

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HECTOR	Eating out: habits, determinants & recommendations for consumers & the European catering sector	DI		International (based in Europe)	FP6 funded 2006-2009. Eating out patterns database.
HEIDI WIKI	Health in Europe: Information and Data Interface	DIH		International (based in Europe)	HEIDI interactive application to compare information on health indicators (e.g., fruit and vegetable intake)
HEISB	Healthy Eating Indicator Shopping Basket Tool	DI		National (European country)	UK healthy eating indicator tool for determinants of food choice
HELENA	Healthy Lifestyle in Europe by Nutrition in Adolescence	DISH		International (based in Europe)	FP6 funded 2002-2006. Adolescent health behaviour and food consumption database. YANA-C (Young Adolescents' Nutrition Assessment on Computer) computerised 24hr recall. HELENA provided data about attitudes towards nutrition, and the main determinants of the food choice and preference, among male and female European adolescents.

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HMDB	Human Metabolome Database	ISH		International (based outside Europe)	Personal nutrition advice and nutrigenomics database. FooDB (Food component DataBase) is a resource/database with information on both macronutrients and micronutrients, including many of the constituents that give foods their flavour, colour, taste, texture and aroma. The database contains detailed information about small molecule metabolites found in the human body. It is intended to be used for applications in metabolomics, clinical chemistry, biomarker discovery and general education. HMDB designed to contain or link three kinds of data: 1) chemical data, 2) clinical data, and 3) molecular biology/biochemistry data
HOPE	Health promotion through obesity prevention across Europe: an integrated analysis to support European health policy	DH		International (based in Europe)	FP6 funded 2007-2009. Allows the meta-analysis of behavioural and environmental obesity determinants as well as intervention/policy effectiveness.
IARC	International Agency for the Research on Cancer	H		International (based in Europe)	Study of cancer aetiology and prevention

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IB DEPT REPRODUCTIVE BIOLOGY & MEDICINE	Instituto Bernabeu Department of Reproductive Biology & Medicine	ISH		National (European country)	Spanish research collaboration. Study semen quality, diet and male fertility
IDEFICS	Identification & prevention of dietary & lifestyle induced health effects in children & infants	IH		International (based in Europe)	FP6 funded 2006-2012. Large-scale cross sectional European study investigating diet, social determinants and lifestyle factors of 2-10-year-old children. Includes FFQ tool CEHQ-FFQ
IED, ETH ZURICH	Institute for Environmental Decisions, Eidgenössische Technische Hochschule Zürich	D		National (European country)	Study of consumer behaviour via eye tracker facilities. Research centre aim is to enhance the understanding of individual and organizational decision-making under conditions of uncertainty. It focuses on perception, acceptance, and behaviour related to new technologies, foods and the environment. One of its core topics is consumer decision-making in the domain of food products
IFAMILY	Investigating the determinants of food choice, lifestyle & health	DIH		International (based in Europe)	FP7 funded 2012-2016. Follow-up to IDEFICS continuing to track cohort as enter adolescence

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	in European children, adolescents & their parents				
INFOODS	International Network of Food Data Systems	I		International (based in Europe)	FAO supported. Began 1984. INFOODS is a worldwide network of food composition experts aiming to improve the quality, availability, reliability and use of food composition data. INFOODS provides a repository of food composition tables, databases and guidelines for describing foods & dietary assessment software tools
INFORMAS	International Network for Food and Obesity / Non- communicable Diseases Research, Monitoring & Action Support	DH		International (based in Europe)	Australian-led global network of public interest organisations and researchers. Provides government and food industry action monitoring system and database
INSTITUTE PAUL BOCUSE	Institute Paul Bocuse	D		National (European country)	French experimental restaurant & sensory laboratory facilities to study consumer behaviour
INTERACT	An examination of the interaction of genetic & lifestyle factors on the	H		International (based in Europe)	FP6 funded 2006-2011. Allows the study of type 2 diabetes aetiology and prevention (diet-gene interaction, targeted lifestyle prevention)

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	incidence of type 2 diabetes				
INTERHEART STUDY	Interheart study	H		International (based outside Europe)	Canadian led global case-control study in 52 countries (2 European). Allows the of traditional and non-traditional risk factors for acute myocardial infarction (including nutrition)
INTERSALT STUDY	Intersalt study	H		International (based in Europe)	1985-1987. Study of sodium intake and blood pressure. Standardized, worldwide epidemiologic study of large sample size (n = 10079 men and women aged 20-59 y from 32 countries) that tested both within- and cross-population prior hypotheses on 24 hour sodium excretion and blood pressure
INTERSTROKE STUDY	Interstroke study	H		International (based outside Europe)	Canadian led global multi-centre case-control study built upon Interheart study. Looked at risk factors for stroke (including nutrition). 2 European countries involved
ISA	Investigation Study Assay	SH		International (based in Europe)	Open source available desktop software targeted to researchers that are involved in local management of experimental metadata from studies employing one or a combination of -omics and other technologies. Provides a data treatment and collection tool and new methodologies for alternative interpretations of the association between nutrition and health

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ISI	Image Sciences Institute	DH		National (European country)	Netherlands research institute studying applied research in medical image processing and acquisition. Lead projects within the scientific discipline of clinical and experimental neuroimaging such as 'Functional MRI of food-induced brain responses'
KIC	Knowledge & Innovation Communities	SH		International (based in Europe)	Independent but operational parts of the European Institute of Innovation and Technology. Consortium of 6 European countries to prepare applications under a particular KIC (e.g., Food4Future KIC). Food4future KIC relates to sustainable food supply chain, from farm to fork). Includes development of new food products (e.g., weight management)
LANGUAL	Lingua alimentaria	I		International (based in Europe)	LinguaL™ is a multilingual thesaurus system for food classification.
LIPGENE	Diet, genomics & the metabolic syndrome: An integrated nutrition, agro-food, social & economic analysis	ISH		International (based in Europe)	FP6 funded 2004-2009. Study the relationship between health (disease state or not, particular NCD) and nutrition/dietary patterns and determinants/health status
MAPP	MAPP Centre for Research on Customer	D		National (European)	Danish research centre, part of Aarhus University. Research dietary behaviour and food choice. Use of eye tracker equipment.

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	Relations in the Food Sector, Aarhus University			country)	
MAX PLANCK GESSELLSCHAFT	Max Planck Gesellschaft	D		National (European country)	German research organisation consisting of 82 research institutes. Institute for Human Cognitive and Brain Sciences studies eating behaviour with MR facilities
<b>METABOHUB</b>	<b>MetaboHUB</b>	<b>SH</b>	<b>X</b>	<b>International (based in Europe)</b>	<b>Originally a French project, MetaboHUB developed a distributed coordinated infrastructure for metabolomics dedicated to innovation, training and technology transfer across four sites (Bordeaux, Paris, Toulouse, Clermont-Ferrand). Tools and expertise are shared for basic/applied projects related to human health, nutrition, food production/quality, sustainable agriculture</b>
METACARDIS	Metagenomics in Cardiometabolic Diseases	ISH		International (based in Europe)	FP7 funded. Study the impact of changes in the gut microbiota on the onset and progression of cardio-metabolic diseases and their associated conditions e.g., validation of the gut microbiota targets and biomarkers; molecular phenotyping.
METAHIT	Metagenomics of the Human Intestinal Tract	SH		International (based in Europe)	FP7 funded. Associations between genes of the human intestinal microbiota with health and disease (inflammatory bowel disease

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					and obesity). Platform access to technology to investigate relationships between gut microbiota and diseases via sample bio-banking (SAMBO), quantitative metagenomics (METAQUANT) and functional metagenomics (METAFUN)
MONICA	Monitoring of trends & determinants in cardiovascular disease	H		International (based in Europe)	FP4 funded. International cohort study (10 million adults, 25-64 years) designed to measure 10-year trends in CVD mortality and morbidity in relation with daily living habits (smoking habits, blood pressure, serum cholesterol), health care, and major socioeconomic features. Collection of lifestyle data (smoking habits, blood pressure), anthropometric measures, blood samples (serum or plasma total and HDL cholesterol), CVD morbidity/mortality data.
MONITORING OF HUMAN EATING BEHAVIOUR IN A RESTAURANT	Monitoring of human eating behaviour in a restaurant	DI		National (European country)	Provides new methods for dietary data collection tools and technology for automated measurement of human behaviour
MORGAM	Monica Risk, Genetics, Archiving & Monograph	H		International (based in Europe)	Allows the study of genetic-environment interactions in CVD (nutrition a subsidiary component)

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NCBO	National Center for Biomedical Ontology	SH		National (European country)	Provides new methods to interpret nutrition and health associations. The goal of the National Center for Biomedical Ontology is to support biomedical researchers in their knowledge-intensive work, by providing online tools and a Web portal enabling them to access, review, and integrate disparate ontological resources in all aspects of biomedical investigation and clinical practice. A major focus of our work involves the use of biomedical ontologies to aid in the management and analysis of data derived from complex experiments
NESTLÉ RESEARCH CENTRE	Nestlé Research Centre	D		International (based in Europe)	Study consumer behaviour using EEG facilities. Research at the Nestlé Research Centre encompasses the nutritional value and sensory characteristics of products, commercial feasibility and food technology, along with consumer behaviour (via EEG)
NEUROSCIENCE & FOOD	Using Cognitive Neuroscience to Understand How Consumers Make & Maintain Healthy Food Choices	D		International (based in Europe)	FP6 funded 2007-2011. The project is an initiative by an industrial partner (Unilever) and two universities (University of Wales, Bangor, and Trinity College, Dublin) to generate a deeper understanding of the basic mechanisms underlying food liking and choice

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NHANES	National Health & Nutrition Examination study	DISH		International (based outside Europe)	Study health and nutritional status of American adults and children via national health survey assessment and food consumption database
NHS	Nurses' Health Study	IH		International (based outside Europe)	North American cohort which began in the 1970's - one of the largest and longest running investigations of factors influencing women's health (N=238,000). The Fertility Diet 8-year study examines the role of diet on fertility in >18,000 NHS women.
NU-AGE	New dietary strategies addressing the specific needs of the elderly population for healthy ageing in Europe	ISH		International (based in Europe)	FP7 funded 2011-2016. Study of dietary influence on ageing. Dietary pattern/nutrition intake/status database for elderly/at risk sub-populations
NUGENOB	Nutrient-gene interactions in human obesity	DISH		International (based in Europe)	FP5 funded 2001-2004. Obesity related major equipment/platforms and database. The NUGENOB database includes all data from the NUGENOB study. The data provides a thorough set of characteristics from 771 obese and 119 lean European subjects from 8 European cities e.g., habitual diet and life-style, family history of obesity etc. Provides ability to study interaction between nutrition and genetic variations in obesity

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NUGO	Nutrigenomics organisation	H		International (based in Europe)	FP6 funded. Facilitating best practice and technology development in nutrigenomics in Europe. Biobank storage/tools/SOP and dietary data collection tools
NUTRIMENTHE	Effect of diet on the mental performance of children	ISH		International (based in Europe)	FP6 funded 2008-2013. Interventional trial and meta-analysis. Studying the role of pre-natal, post-natal and childhood nutrition in later mental performance
NutriNet-Santé	NutriNet-Santé databank	DISH		National (European country)	Followed the SUVIMAX studies. Measures the adequacy of the dietary intake of French population (240,000 inscriptions, 120,000 inclusions, biobank with 12,000 blood samples). Conducted also in BE and CH. E-epidemiology based prospective ongoing cohort.
NUTRIOMICS	Effects of early programming on child's neurodevelopmental outcomes	IH		International (based in Europe)	FP7 funded 2013-2015. Intervention study. Multi-centred project. Short and long term study of the effects of early programming (maternal supplementation and maternal obesity) on child neurodevelopmental outcomes
NUTRITIONDAY	NutritionDay	IS		International (based in Europe)	Funded by ESPEN since 2007. Introduced Oncology NutritionDay from 2012. Database on adequacy of dietary intake and nutritional status of retirement home residents. Led by Austrian Society for Clinical Nutrition, ESPEN and the Medical

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					University of Vienna. Transverse study "a given day" to obtain prevalence of the under-nutrition, average food consumption and modalities of the care. Involves 18 European countries
OPEN FOOD FACTS	Open Food Facts	IS		International (based in Europe)	Food consumption/nutritional status tool. Food product information (photos, ingredients, nutrition facts etc.) is collected in a collaborative way and is made available to everyone and for all uses in a free and open database
OPUS	Optimal well-being, development and health for Danish children through a healthy New Nordic Diet	I		National (European country)	Example of nationally developed data collection tool. Danish web based dietary assessment software for 8-11 year old children
P <sup>3</sup> G	Public Population Project in Genomics	ISH		International (based in Europe)	Food consumption database repository of population based studies. Obiba is biobank harmonisation software/IT biobank solutions. P3G is a not-for-profit international consortium bringing together population based genomics studies. Datashaper provides flexible, structured, scientific approach & practical tools for harmonisation & pooling information between studies

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PANAMA	Physical Activity & Nutrition: Advancing Measurement & Impact Assessment	DH		International (based in Europe)	FP7 funded 2011-2015. European, Australian & New Zealand collaborative project centred on the goal of improving knowledge about physical activity, diet and obesity and the impact of interventions aimed at improving population outcomes via: (a) exploiting, developing and validating new diet and activity measurement technologies; (b) using simulation models to quantify the impact of promising interventions on population health; and (c) integrating findings to create a portfolio of cost-effective policy and practice-relevant interventions
PHENOL EXPLORER	Phenol Explorer	I		International (based in Europe)	Food and supplement composition database (polyphenols).
PHILIIPS EXPERIENCELAB	Philips ExperienceLab	D		International (based in Europe)	Private company. Provides an observation research facility to study consumer behaviour
PHOEBE	Harmonising population-based biobanks & cohort studies to strengthen the foundation of European biomedical science in the post-genome era	H		International (based in Europe)	FP6 funded 2006-2009. Relevance in biobank harmonisation (identification of candidate biobanks and the establishment of optimal/complimentary protocols to assist harmonisation)

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PLANTLIBRA	Plant food supplements: Levels of intake, benefit & risk assessment	I		International (based in Europe)	FP7 funded 2010-2014. Meta-database containing new and existing data on plant food supplement consumption, risks/benefits, biological activity of constituents/ contaminants
PRO CHILDREN	Promoting & sustaining health through increased vegetable & fruit consumption among European school children	DIH		International (based in Europe)	FP5 funded 2002-2006. Food consumption database and dietary data collection tool. Project to evaluate and promote fruit and vegetable consumption in young adolescents (11-13 years-old)
PURE	The Prospective Urban Rural Epidemiology	H		International (based outside Europe)	Canadian-led global cohort study to examine societal/ biological influences on obesity/chronic health conditions, such as heart disease, diabetes and cancer. N=>150,000, 17 countries (2 European).
SCRAN24	Secondary school Computerised Recall & Analysis of Nutrition	I		National (European country)	Example of nationally developed dietary data collection tool. UK self-completed recall.
<b>SHARE-ERIC</b>	<b>Survey of Health, Ageing &amp; Retirement in Europe- ERIC</b>	<b>H</b>	<b>X</b>	<b>International (based in Europe)</b>	<b>ERIC RI. FP6 project SHARE I3 (2006-2008). FP7 RI projects: SHARE-PREP (2008-2009), SHARE-LEAP (2009-2010), SHARE-M4 (2011-2014). RI on ageing. Study on health, ageing and retirement. No dietary information. Database provided baseline for health status in elderly in</b>

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					<b>Europe</b>
SPOTLIGHT	Sustainable prevention of obesity through integrated strategies	DH		International (based in Europe)	FP7 funded 2012-2016. Defining factors needed to establish effective health promotion strategies; provides a new perspective on obesity prevention approaches e.g., individual, family, organisational, environmental contexts that can change behaviour, lifestyles and life skills to sustainably reduce obesogenic behaviours
SU.FOL.OM3	SU.FOL.OM3	DISH		National (European country)	French RCT on the effectiveness of nutrient supplementation in the prevention of CVDs; to test the efficacy of supplementation with folate, B-vitamins and/or omega-3 fatty acids on fatal and non-fatal cardiovascular events (N=>2500, 45-80 years with coronary/cerebral even in previous year.). Follow-up 5 years.
SU.VI.MAX 1 & 2	SU.VI.MAX 1 & 2	DISH		National (European country)	French intervention study/major equipment platform. A network of 80 centres studying population adequacy of dietary intake and nutritional status; and the role of antioxidants (supplementation) in the prevention of cancer, ischemic heart disease and total mortality.

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SUSFOOD ERA-NET	Sustainable Food	DI		International (based in Europe)	FP 7 funded 2011-2014. The ERA-NET scheme encourages the co-ordination and co-operation of national/regional programmes. SUSFOOD is designed to aid collaboration and co-ordination between research programmes on sustainable food production/ consumption. Includes a Meta Knowledge Base (MKB) for research programmes (European countries and beyond).
SYSDIET	Systems biology in controlled dietary interventions & cohort studies	ISH		International (based in Europe)	A project part of the Nordic Centre of Excellence programme on food, nutrition and health launched by NordForsk in 2007. A collaboration of 12 research groups across DK, FI, SE, NO to exploit nutritional systems biology tools in human dietary interventions, animal and cell culture studies. Includes an omics platform and identification of nutrition-related biomarkers for disease pathogenesis and dietary modification sensitivity
TI FOOD & NUTRITION	Top Institute Food & Nutrition	D		National (European country)	A public-private partnership of science, industry and government. Develop new psychological methods to predict food choice and sustained, long-term liking and desire for specific foods. Studies the neurobiology of food liking and food aversion with the use of fMRI equipment
TOBII TECHNOLOGY	Tobii Technology	D		International (based in Europe)	Private company world leader in eye-tracking/ gaze interaction. Allows the study of habitual and subconscious behaviour

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TORNADO	Molecular Targets Open for Regulation by the gut flora New Avenues for improved Diet to Optimize European health	H		International (based in Europe)	FP7 funded 2009-2013. Interaction with diet and gut microflora.
TOYBOX STUDY	Multifactorial evidence based approach using behavioural models in understanding & promoting fun, healthy food, play & policy for the prevention of obesity in early childhood	DI		International (based in Europe)	FP7 2010-2014. Project designed to develop and test an innovative and evidence-based obesity prevention programme for children aged 4-6 years (including dietary data collection tools)
UK BIOBANK	UK Biobank Ltd	DISH		National (European country)	UK national health resource and registered charity. Supported by Wellcome Trust, MRC, UK Department of Health, Scottish Government, Northwest Regional development agency, Welsh Assembly Government, British Heart Foundation, Diabetes UK. Long-term prospective study (cohort of 5000,000 40-69 year olds recruited from 2006-2010) to investigate the respective

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					contributions of genetic predisposition and environmental exposure (including nutrition, lifestyle, medications, etc.) to the development of disease
UNI OF COPENHAGEN	Department of Food Science, Uni of Copenhagen	D		National (European country)	The research group investigates how the neurophysiology and psychology of the senses are connected to different types of appetite and food behaviour. They use EEG and EGG. Multisense lab is for olfactory research, equipped with a 6-channel olfactometer.
UPPSALA UNI	Department of Neuroscience, Uppsala Uni	D		National (European country)	Swedish research facility surrounding the normal function of the nervous system. Research includes the regulation of appetite and food intake. MR facilities to study eating behaviour.
VITAKID	VITAKID	DISH		International (based in Europe)	Non-profit organisation to support health promotion of young children and a healthy balanced diet. Internet based knowledge and learning platform connecting nurseries/elementary schools with families (includes recommendations for meals at home, recipes, personalised nutrition coaching). Original programme developed by University of Witten/Herdecke.

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WAGENINGEN UNI	Wageningen Uni	D		National (European country)	Observation restaurant & sensory consumer research laboratory. Marketing group runs studies with eye-tracking equipment. Sensory science group runs studies on eating behaviour using olfactory/gustometry/brain imaging (fMRI) equipment.
WCRF	World Cancer Research Fund	H		International (based in Europe)	Global network of charities committed to preventing cancer. Fund research and provide information.
WEIGHT WATCHERS	Weight Watchers	DIH		International (based in Europe)	Example of commercial service providing dietary advice. Personalised nutrition advice
WELLCOME TRUST CENTRE FOR NEUROIMAGING	Wellcome Trust Centre for Neuroimaging	DH		National (European country)	UK National research facility at UCL. Wellcome Trust funding. Focused on neuroimaging modalities (fMRI, MEG, EEG) and classical behavioural tools to help investigate critical determinants of human decision making/behaviour
WHO Europe	World Health Organisation regional office for Europe	DISH		International (based in Europe)	Directing and co-ordinating authority for health, within the United Nations. NOPA (food consumption database/tool) was a 2008-2011 WHO & DG SANCO project, which is now run by WHO Europe. NOPA monitors progress on nutrition, diet, physical activity and obesity across European member states. VMNIS compiles national, sub-national and first administrative level data on vitamin and mineral nutritional status of

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					populations in member states (includes biomarkers).
WOLFSON BRAIN IMAGING CENTRE	Wolfson Brain Imaging Centre	DH		National (European country)	UK research facility for Addenbrooke's Hospital Neuro Clinical Care Unit. Research groups include The Stroke Research Group, Behavioural and Clinical Neuroscience Institute and Impaired Consciousness Research Group. PET MR facilities available to study eating behaviour.
WORLD OBESITY (FORMERLY IASO)	World Obesity (formerly International Association for the Study of Obesity)	H		International (based in Europe)	A not-for-profit organisation linking >50 organisations, representing 55 countries. Its mission is to improve global health by promoting the understanding of obesity and weight-related diseases through scientific research and dialogue, whilst encouraging the development of effective policies for their prevention and management.
<p>*EuroDISH case study 1. Pan-European Nutrition surveillance RI: Globodiet + Eurofir AISBL Food Composition data interchange platform</p> <p>**EuroDISH case study 2. Nutritional phenotype research infrastructure, formerly dbNP (Nutrition Phenotype database) and now part of ENPADASI</p> <p>CVD: Cardiovascular Disease; DRV/NRV: Dietary or Nutrient Reference Value; EC: European Commission; EEG: electroencephalogram); EGG: electrogastrogram; ERIC: European Research Infrastructure Consortium; EU: European Union; FAO: Food and Agriculture Organization of the United Nations; FFQ: Food Frequency Questionnaire; fMRI: Functional magnetic resonance imaging; FP#: EC framework programme funding stream; HDL: High Density Lipid; JPI-HDHL: Joint Programming Initiative-Healthy Diet Healthy Life; MERIL: Mapping of the European Research Infrastructure Landscape; MEG: Magnetoencephalography; MR: Magnetic Resonance; NCD: Non-communicable disease; NGO: Non-governmental Organisation; PET: Positron emission tomography; RCT: Randomised Controlled Trial; SOP: Standard Operating Procedures</p>					

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†Please note mapping was not exhaustive and this table represents a contraction of the types of food and health research infrastructure available in Europe.

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