NUTRIOME

NUTRIOME workshop1

NUTRIOME project introduction

Maastricht, May 27, 2024

Stine M. Ulven, coordinator

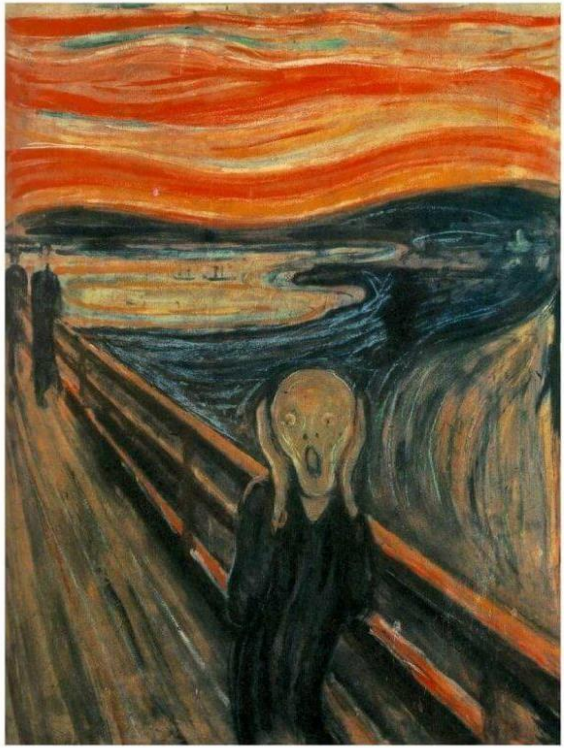
Funded by the European Union

Marie Skłodowska-Curie Actions

GAP-101119497

Welcome to NUTRIOME

- MSCA DN: 1.10 2023- 31.09 2027
- Total budget: 2 799 763 euro
- 9 partners and 6 associated partners
- 10 RDCs
- Ioanna Peppa (EU project officer)
- Stine Ulven (coordinator)
- Hege Berg Henriksen (project manager)



My group and my background

- Professor at Department of Nutrition, Institute of Basic Medical Sciences, UiO
- Group leader
  - Personalized nutrition and prevention of cardiometabolic diseases
    - 2 Reseachers
    - 1 post doc
    - 1 engineer
    - 3 PhD students
    - Scientific assistent
    - Co-supervising 3 PhD students and 1 postdoc

- Born in Oslo 1970
- High school 1989
- Cand scient 1995
  - Nutrition, UiO
- PhD 2000
  - Nutrition, UiO
- Post doc 2001-2004
  - Strasbourg/IGBMC
  - UiO/Department of Nutrition
- Associate professor 2004-2015
  - Oslo and Akershus University College of Applied sciences (HiOA)-head of center for controlled dietary intervention studies
- Professor, 2015-
- Vice-head of Department of Nutrition, 2019-2020
- Head of Department of Nutrition, 2021-

Nutrition and gene regulation

From: “Babette's Feast” by Karen Blixen

Nutrient	Compound	Transcription factor
Macronutrients		
Fats	Fatty acids Cholesterol	PPARs, SREBPs, LXR, HNF4, ChREBP SREBPs, LXRs, FXR
Carbohydrates	Glucose	USFs, SREBPs, ChREBP
Proteins	Amino acids	C/EBPs
Micronutrients		
Vitamins	Vitamin A Vitamin D Vitamin E	RAR, RXR VDR PXR
Minerals	Calcium Iron Zinc	Calcineurin/NF-ATs IRP1, IRP2 MTF1
Other food components		
	Flavonoids Xenobiotics	ER, NFκB, AP1 CAR, PXR

Müller and Kersten, Nature Genetic, vol 4, 2003

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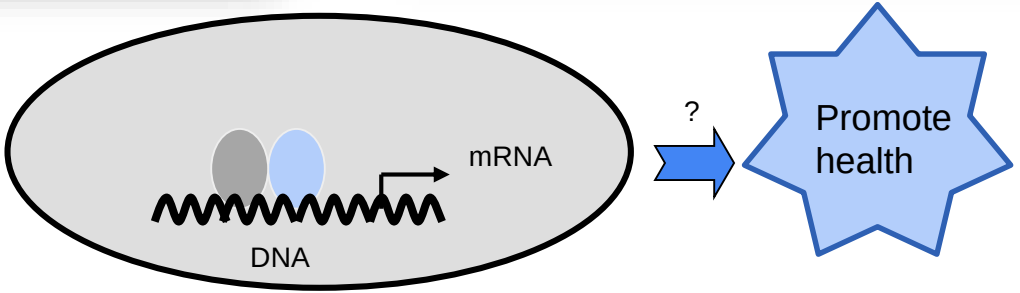


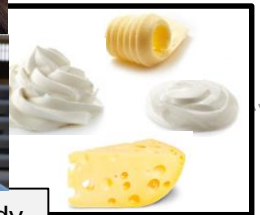
Personalized nutrition and prevention of cardiometabolic diseases

NUTRIOME

SYSDIET study

NOMA study

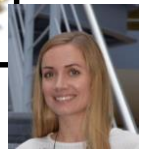
Modul study



DPP study

KF study

LA study



Epigenetic

DNA

Transcription

RNA

Translation

Transcription factor

miRNA

Post-translational modifications

Nutrients

Proteins

Metabolites

Data integration

qPCR, microarray, nanostring, RNAseq and pathway analyses

ELISA

Lipidomics, NMR metabolomics Untargeted metabolomics

Biological processes

Phenotype

Disease prevention

NUTRIOME Precision nutrition and postprandial immune response

9 Partners;

University of Oslo (UiO)
Polish Academy of Sciences in Olsztyn (IARFR)
Maastricht University (UM)
Deutsches Krebs-forschungszentrum (DKFZ)
University of Copenhagen (UC)
Wageningen University and Research (WU)
University of Oulu (UO)
Chalmers University of Technology (CUT)
University College of Dublin (UCD)

NUTRIOME Precision nutrition and postprandial immune response

6 Associated partners:

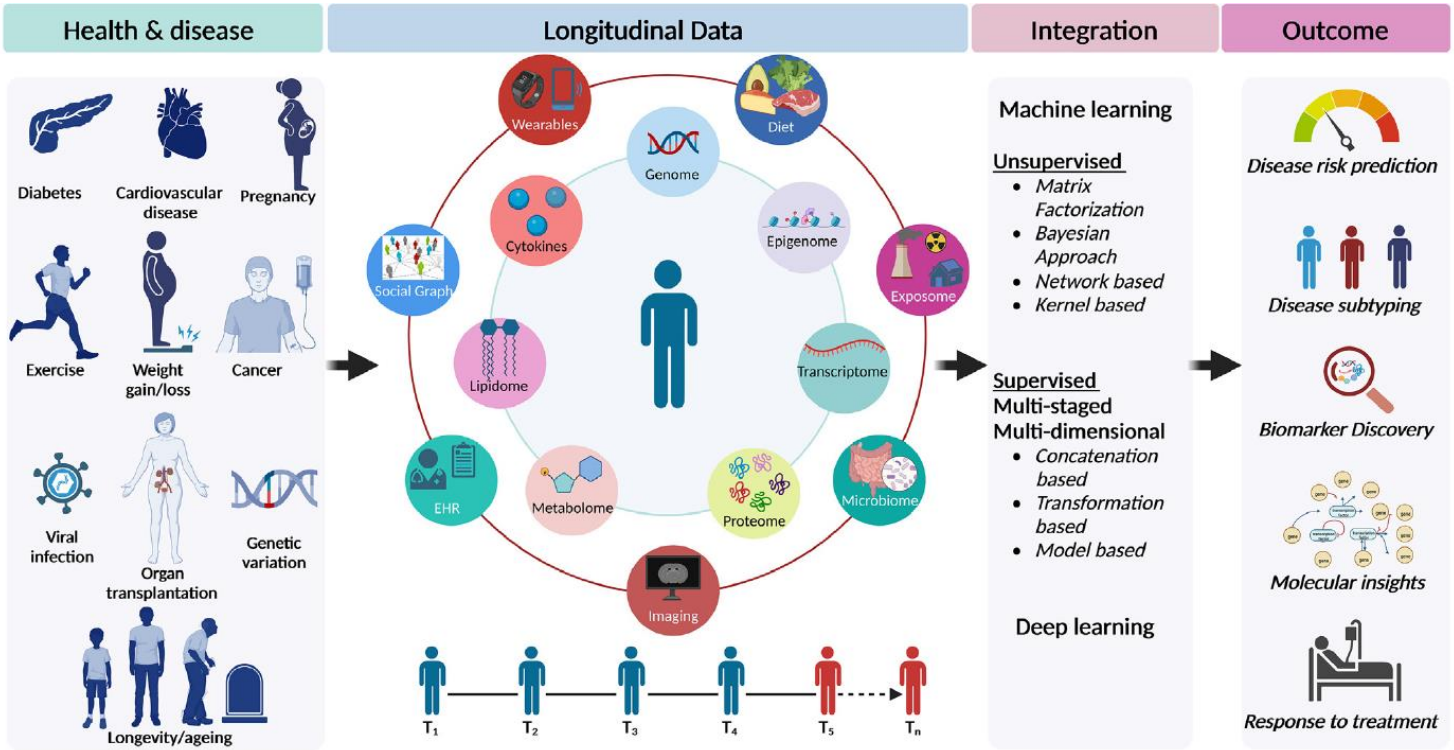
MS Omics APS:	Morten Danielsen, DK
Nortura SA:	Per Berg, NO
ZOE Ltd:	Sarah Berry, UK
Norilia AS:	Heidi Alvestad/Marianne Skov, NO
Capitainer AB:	Christopher Aulin, SE
Genzai:	Roy Lenders, NL

Scientific Advisory Board:

Paul Frank, DK
Jose Ordovas, US
Elisabeth Rytter, SE

Goal: to increase competence in multi-omics and data-driven precision nutrition for better prevention strategies

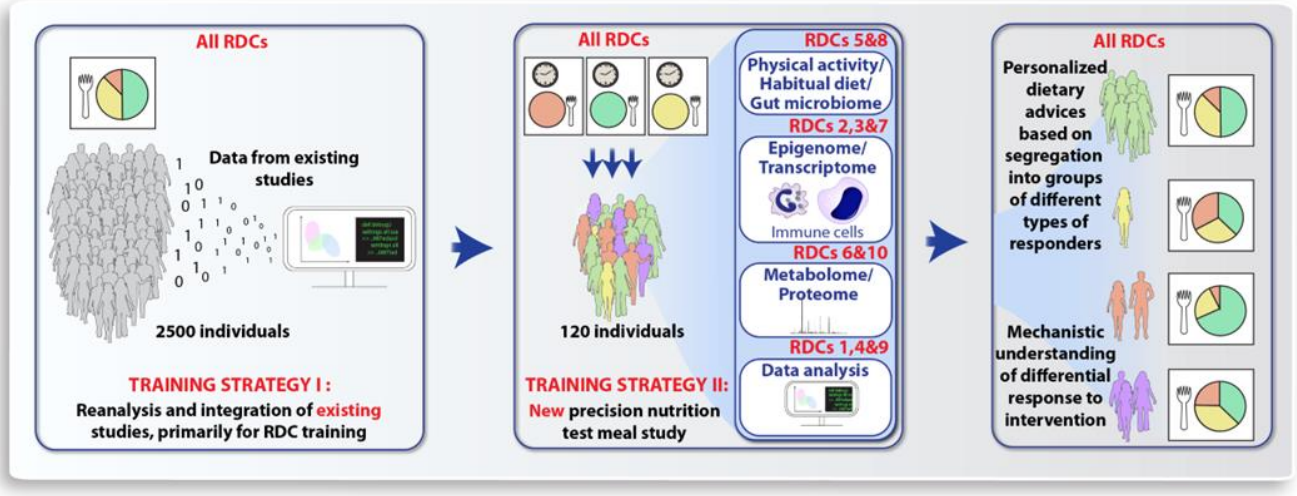
NUTRIOME



Babu and Snyder 2023

General concept of NUTRIOME

The focus of NUTRIOME is to train 10 Research Doctoral Candidates (RDCs) in data-driven precision nutrition using two complementary training strategies to learn how to handle and combine multi-omics data, to evaluate the response to foods and diets.



We will provide **multi-disciplinary training**:

i) are able to utilize, share and disseminate the growing pool of public available multi-omics data

ii) know the regulations and routine for collaborative data sharing in a FAIR manner

iii) are experts in analysing, integrating and interpreting increasingly complex data, including algorithm development

*iv) a*re able to design and conduct PN intervention studies

Overview of WP and WP leaders

WP No.	WP Title	Start Month	End month	Activity Type	Lead Beneficiary	Researcher involvement
1	Management, dissemination, communication and exploitation	M1	M48	Management, dissemination, communication and exploitation	**UiO**	1 elected RDC (management) All RDCs (communication)
2	Network training (courses, summer school and workshops)	M6	M48	Training	**WUR**	All RDCs
3	Proof-of-concept precision nutrition meal intervention study	M12	M24	Research and training	**CUT**	All RDCs
4	Transcriptome/epigenome/immune system	M24	M36	Research and training	**IAR&FR**	RDCs 2,3 & 7
5	Gut microbiome/ Metabolome	M24	M36	Research and training	**UCD**	RDCs 5, 6, 8, 10
6	Data management & analysis (including modelling and algorithm development)	M3	M48	Research and training	**UM**	RDCs 1, 4 & 9

Table 1.1: Ten RDC's projects within NUTRIOME. The composition of the RDC Supervisory Teams also reflect the planned secondments (blue: industry).

NUTRIOME

Main supervisor	RDC	Individual project titles	Co-supervisors/ Secondments
Ulven (**UiO**)	1	Integrating transcriptomics and metabolomics data for understanding the role of habitual diet on individual's immune response after plant-based meals	Kutmon (**UM**), Dragsted (**UC**), **Genzai**
Ulven (**UiO**)	2	Relating the transcriptome with epigenomic changes of immune cells in response to plant-based meals	Carlberg (**IAR&FR**), Roche (**UCD**), **Nortura**
Carlberg (**IAR&FR**)	3	Personal genetic and epigenetic signatures of immune cells in context of plant-based meals	Ulven (**UiO**), Afman (**WUR**), **ZOE**
Coort (**UM**)	4	Applying biological network and pathways related to immune function to integrate and interpret multi-omics data from meal studies	Carlberg (**IAR&FR**), Skålhegg (**UiO**), **Genzai**
Elinav (**DKFZ**)	5	Applying data integration tools to dissect the role of gut microbiota on immunological responses of fish, meat and plant-based meals	Stientra (**WUR**), Coort (**UM**), **MS Omics**
Roager (**UC**)	6	Understanding the effect of fish, meat and plant-based meals on the plasma metabolome and the predictive value of circulating microbiota-derived metabolites in response/nonresponse to metabolic outcomes	Elinav (**DKFZ**),Landberg **(CUT), MS Omics**
Afman (**WUR**)	7	Dissecting individual's variation in metabolic responses of fish, meat and plant-based meals with emphasis on glucose and lipid metabolism	Roager (**UC**), Holven (**UiO**), **ZOE**
Herzig (**UO**)	8	Understanding the impact of physical activity on individual's immune response of fish, meat and plant-based meals with emphasis on circulating inflammatory markers and metabolites	Landberg (**CUT**), Brennan **(UCD)**, **Norilia**
Landberg (**CUT**)	9	Developing an algorithm for a personalised nutrition strategy based on results from the fish, meat and plant-based meals	Elinav (**DKFZ**), Herzig (**UO**), **Capitainer**
Brennan (**UCD**)	10	Understanding the variation in circulating metabolites and inflammatory outcomes of fish, meat and plant-based meals	Ulven (**UiO**), Herzig (**UO**), **Capitainer**

Research objectives

- **RO1**: Design and perform a proof-of-concept precision nutrition meal study to understand the interaction between habitual diet, physical activity, gut microbiome and individual postprandial responses to reveal the factors that drive inter-personal variation in metabolic and immunological responses to the meals provided **(WP3**).
- **RO2**: Develop an algorithm to tailor diet toward maximising beneficial response of metabolic and immunological outcomes (**WP3**, **WP5 & WP6**).
- **RO3**: Identification of common and non-commonly regulated epigenomic target loci and genes (transcriptome) in primary peripheral blood mononuclear cells (PBMCs) in response to the different meals to understand underlying mechanisms of individual responses (**WP4**).
- **RO4**: Determining key biomarkers of habitual diet, physical activity, gut microbiota and metabolome that explain response/non-response in metabolic and immunological outcome variables (**WP5**).
- **RO5**: Building workflows in which multi-layered nutrition data will be accessed, combined and analysed to dissect the underlying mechanisms behind response/non-response to diet and develop specific algorithms to tailor diet toward specific groups of individuals (**WP6**).

Table 1.4: Main network-wide training events, conferences and contribution of beneficiaries and associated industry partners

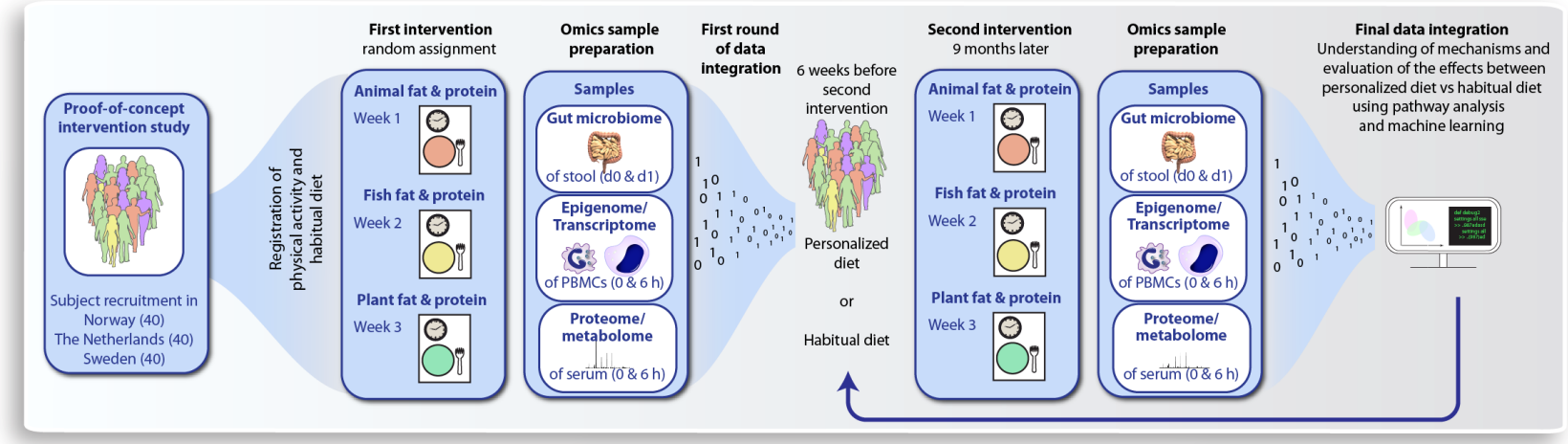
No	Main Training Events & Conferences	ECTS	Lead Institution	Action Month
1	**Workshop 1** on large-scale data handling and using tools to visualise multi-layered data from meal studies	2	**UM/IAR&FR**	7
2	**Workshop 2** on the proof-of-concept meal study design	1	**CUT/UCD**	10
3	**Workshop 3** on gut microbiota, diet, physical activity and immune response	1	**DKFZ/UO**	16
4	**Workshop 4** on advanced metabolomics to identify biomarkers of intake and health	1	**UCD/UC**	20
5	**Workshop 5** on conception to delivery of personalised nutrition advices including dietary guidelines policy	1	**ZOE/UiO**	26
6	**Summer school** on innovation and marketing, effective communication to consumers, press and stakeholders, and entrepreneurship in the field of precision nutrition	3	**UiO/CUT**	34
7	**Final conference** arranged as part of NuGO week 2027	1	**WUR/UC**	42

ECTS needs to be approved by the individual institutions

Training objectives

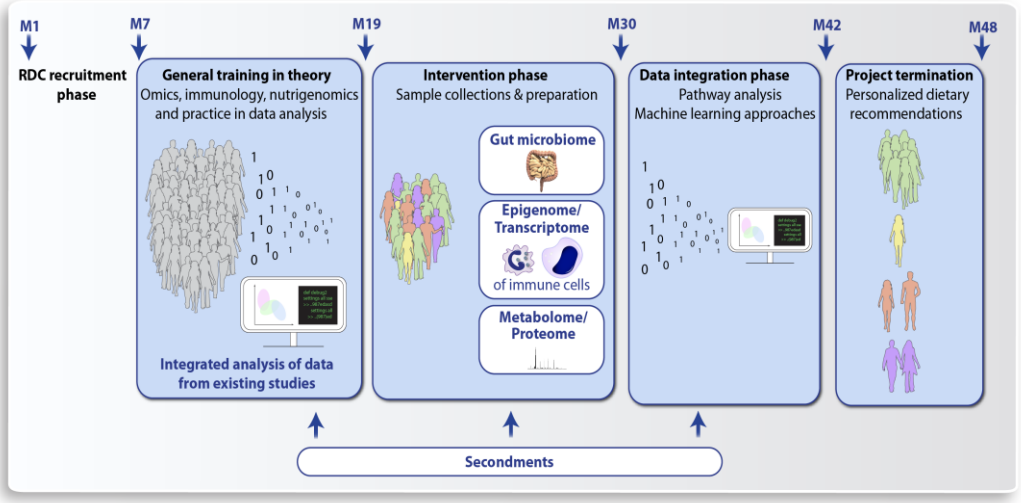
- **TO1:** Train in use, management, analysis and dissemination of open available data.
- **TO2:** To train and provide a doctoral degree of 10 RDCs who will demonstrate strong potential of becoming Europe's future scientific leaders in the **emerging field of data-driven precision nutrition**.
- **TO3:** To provide relevant **industrial knowledge** by giving the RDCs crucial insights into an industry-driven research culture.
- **TO4:** To provide relevant **policy knowledge** by giving the RDCs crucial insights into how policy makers can best implement delivery of personalised nutrition in Europe. The RDCs will be trained in communication and development of tailored dietary advice to the public and in the clinic based on algorithms (individual RDCs projects, workshops and summer school).
- **TO5:** To build **durable, sustainable inter-sectoral training and research platforms in the field of precision nutrition** between world-class academic and non-academic participants across Europe, in collaboration with the NuGO Network (www.nugo.org).
- **TO6:** To be trained to work multi-disciplinary and together on a common transnational project.

Overview of the design of the proof-of-concept precision nutrition meal intervention study



Multi-centre study: Gothenburg/CUT, Oslo/UiO, and Wageningen/WUR
All RDCs will take part via secondments

Timeline in NUTRIOME



Recruitment phase RDCs

K — M1 Oct 2023

W1 — M7 Apr 2024 — Maastricht — **UM/SC**

W2 / A1 — M12 Sept 2024 — Ghent — **CUT/RL**

W3 — **Meal study part 1** — M16 Jan 2025 — Digital — **DKFZ/EE**

W4 / A2 — M24 Sept 2025 — Dublin — **UCD/LB**

W5 — **Meal study part 2** — M26 Nov 2025 — Digital — **ZOE/SB**

S1 / A3 — M36 Sept 2026 — Olsztyn — **UiO/SU**

FC / A4 — M48 Sept 2027 — **WUR/LA**

Co-organised with NUGO?

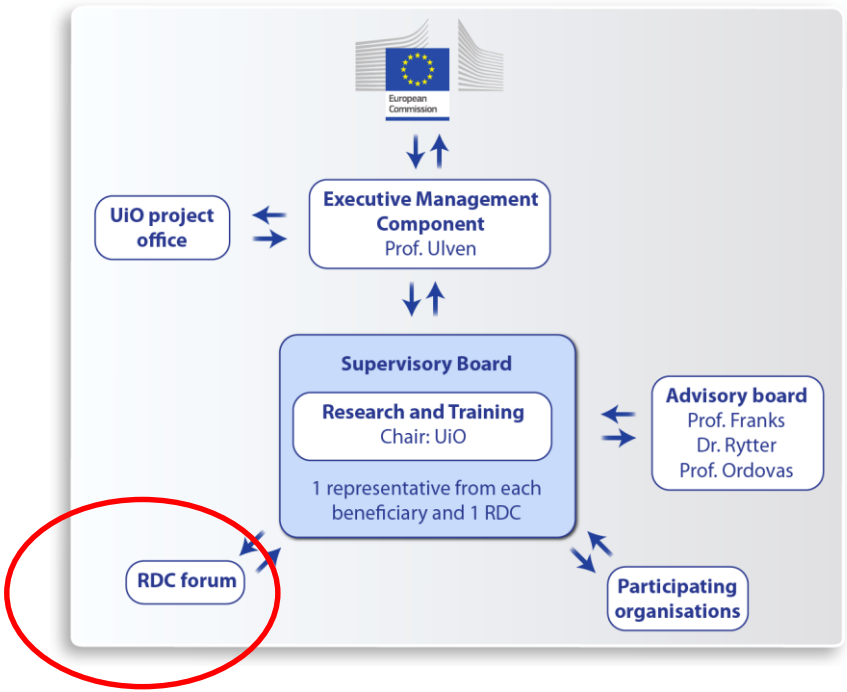
Co-organised with NUGO?

Co-organised with NUGO?

K=kick-off
W= workshop
A=annual meeting/SB meeting
S=summer school
FC= final conference

Research Doctoral Candidates (RDCs)

Organization and management structure



- **Supervisory board**
  - The highest decision-making body of NUTRIOME
  - The SB consists of 10 members: 9 representatives from all beneficiaries and one RDC representative, elected by his/her peers
  - The SB will have twice a year online or face-to-face meetings, arranged by the coordinator
- **Executive management component**
  - Coordinator and project manager will meet at least once a month
  - PM supports the project with the non-scientific and technical tasks, managing the website, compliance guidance of EU Regulations, communication and co-operation with the EC and the beneficiary organizations, legal issues, and distribution of the funds to the beneficiary organizations
- **RDC forum**
  - All RDCs are members of the RDC forum
  - Meet face-to-face at the occasions of network activities
- **Participating organisation/associated partners**
  - One person from each PO will be invited to the SB meetings
  - Do not have the possibility to vote, but can take part in the discussions, and raise questions to the SB
- **Advisory board**
  - The advisory board consists of three independent representatives
  - Will advise the SB with respect to the content of the training, to ensure and advance the quality of the training programme
  - One of the member of the advisory board will also act as appraiser for RDCs

Research Doctoral Candidates (RDCs)

Creation of RDC forum and election of RDC candidate in the SB

- All RDCs are members of the RDC forum.
- They meet face-to-face at the occasions of the NUTRIOME summer school and workshops and will be in contact *via* the closed Teams group.
- Be used to share acquired skills and reach out to each other when specific skills are needed.
- The RDC forum will discuss issues, such as project challenges and experience at the hosts, and during secondments, and ideas for topics in upcoming and future meetings and workshops.
- Will arrange together with the partners, 2 hours webinars throughout the project period on topics related to the network, where the RDCs can present their ongoing work.
- The RDC forum will have a yearly online meeting and elect the RDC representative in the SB, in combination with a webinar on a selected hop topic related to the NUTRIOME project.
- The RDC representative in the SB is responsible for arranging this meeting.
- The first yearly meeting will be arranged by the coordinator of NUTRIOME in order to establish the forum, and make sure that the first RDC representative is elected to the SB.

NuGO is an Association of Universities and Research Institutes (n=29) focusing on the joint development of the research areas of molecular nutrition, personalised nutrition, nutrigenomics and nutritional systems biology.

‘European’ Nutrigenomics Organisation
https://www.nugo.org/

NuGO evolved from an EU Sixth Framework Network of Excellence that ended in 2010. The Association took over some of the Network's activities as well as developing new ones and has expanded activities globally.

NuGO Officers



CEO: Prof. **Michael Müller** (University of East Anglia, UK)
Executive Secretary: Prof. **Lydia Afman** (Wageningen University & Research, NL)
NuGO Secretariat: Dr. **Meike Bünger** (Wageningen University & Research, NL)

NuGO Management Board









NuGO's Mission:

Stimulating developments in molecular nutrition, precision nutrition, nutrigenomics, and nutritional systems biology and incorporating these aspects in nutrition and health research, conferences, workshops and training and by stimulating collaborative research projects

NuGO WEEK

Highlights recent advances in the field of nutrigenomics and molecular nutrition

20th Edition of NuGOweek, 2-5 September 2024, Ghent.

INTEGRATING NUTRITIONAL OMICS INTO A HEALTHY DIET

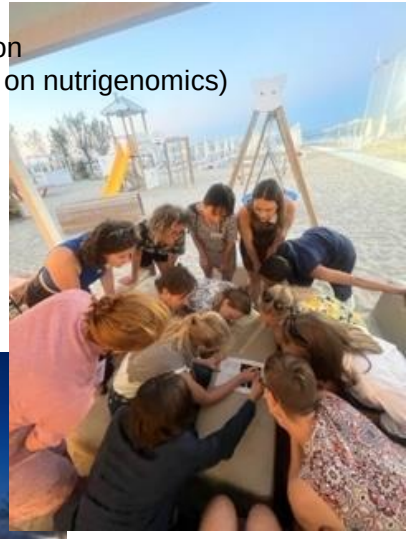
NuGOweek 2025, Dublin

NuGOweek 2026, Poland

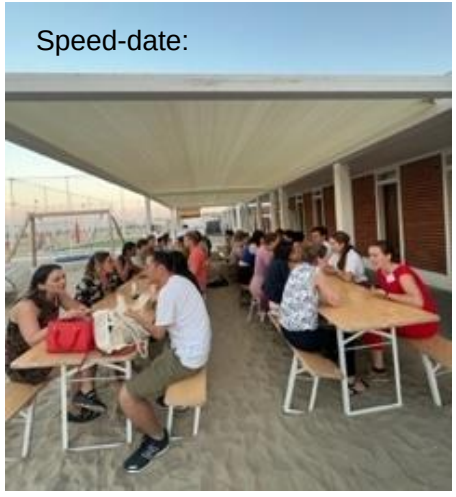
- **Bioinformatics Infrastructure**
- **Training, Workshops**
- **Travel grants**
- **Early Career Network**

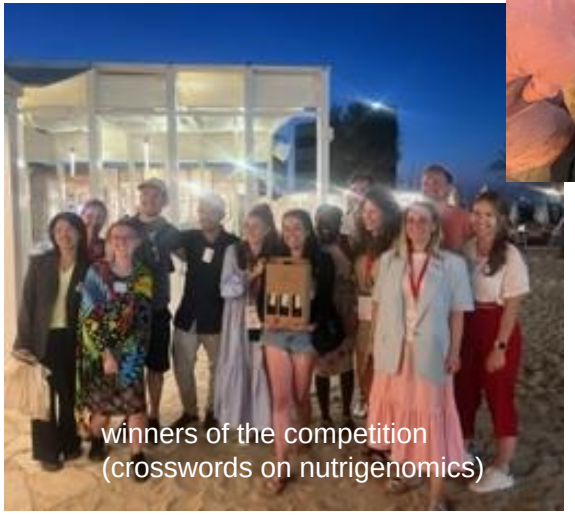
NuGO Week ECN Meet-Ups

<- competition
(crosswords on nutrigenomics)



Speed-date:





winners of the competition
(crosswords on nutrigenomics)

NuGO week 2024 postgraduate course/NUTRIOME WS2

NUTRIOME

NUTRITIONAL OMICS: from study design to integrative data analysis

Day 1: Saturday 31/08 PM
Introduction on (epi-)genomics, metagenomics, metabolomics/lipidomics

Day 2: Sunday 1/09 AM & PM
Introduction to metabotyping and machine learning, hands-on lab demo metabolomics/lipidomics workflows.

Day 3: Monday 2/09 AM
Integrative/fused omics data analysis (incl. machine learning)

Day 1**: Saturday 31/08 PM**
Introduction on (epi-)genomics, metagenomics, metabolomics/lipidomics

The introductory lectures will concentrate on sample handling, covering various aspects such as most suited sample types, collection, storage, and processing, tailored to each technique. Following this, an overview of the relevant tools and techniques applicable to (epi-, meta-)genomics and lipidomics/metabolomics will be provided, highlighting the main advantages and challenges in their implementation. Further, the expected results and data output specific to nutritional research will be emphasized, both for each individual technique and in the collaborative realm of omics technologies. To conclude, the interactive session will engage participants in designing and discussing the experimental workflow setup and goals for the practical sessions scheduled on day 2 (1/09).

Timetable:

1 p.m.	Welcome + short workshop overview: tasks and goals (Lynn Vanhaecke)
1:30 p.m. – 2.10 p.m.	Introduction to (epi-)genomics (Carsten Carlberg)
2.10 p.m. – 2:50 p.m.	Introduction to metagenomics (Ugent presenter)
2:50 p.m. – 3:20 p.m.	Coffee break
3:20 p.m. – 4:20 p.m.	Introduction to metabolomics/lipidomics (Lieselot Hemeryck/Vera Plekhova)
4:20 p.m. – 5:00 p.m.	Interactive session on experimental setup/study design nutritional omics study (Stine Ulven/Lydia Afman/Ellen De Paepe)

Day 2: Sunday 1/09 AM & PM
Introduction to metabotyping and machine learning, hands-on lab demo metabolomics/lipidomics workflows.

The second day of the workshop will introduce concepts of metabotyping and machine learning for the analysis of omics data. This will be followed by hands-on laboratory training in metabolomics and lipidomics analytical workflows. Topics covered include sample preparation, instrumental setup, data acquisition, processing, and quality assurance/control. The data handling segment will focus on general data mining in preparation for the more in-depth discussions on data modeling and integration on the third day. To enhance learning, participants will engage in practical sessions in small groups.

Timetable:

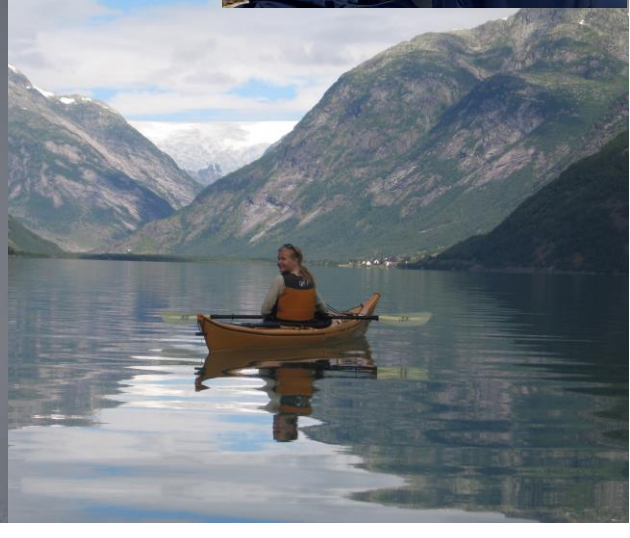
9:00 a.m. – 10:30 a.m. Metabotyping (lecture, Carl Brunius)
10:30 am. – 11:00 a.m. Coffee break
11:00 a.m. – 12:30 p.m. Introduction to machine learning (lecture, Mats Jirstrand)
12:30 p.m. – 1:30 p.m. Lunch
1:30 p.m. – 4:30 p.m. Hands-on training in metagenomics, metabolomics/lipidomics (LIMET team)
1:30 p.m. – 4:30 p.m. Training in single omics data processing (Michiel Adriaens, LIMET team), basic knowledge of R and/or Python required.

Day 3**: Monday 2/09 AM**
Metabotyping through integrative OMICs and ML

The third day of the workshop will extend on the data analysis training commenced on day 2 and expand on exercises in data analysis of metabolomics data, integrated with clinical- dietary and microbial data (16SrRNA-data). The aim is to derive metabotypes based on these data and investigate their association with dietary patterns and specific outcomes variables using machine-learning, correlation analyses and different visualization techniques.

Timetable:

8:00 a.m. – 8:45 a.m. The NUTRIOME-study- rationale, design and outlooks for precision nutrition (closed sessions for NUTRIOME students)
9:00 a.m. – 9:30 a.m. Introduction to the dataset and approaches to be used (Carl Brunius)
9:30 a.m. – 11:30 a.m. Workshop in groups (supervised by: Carl Brunius, Mats Jirstrand, Viktor Skantze and Mikael Wallman), required skills/software packs?
11:30 a.m. – 12:00 p.m. Summary and conclusions



NUTRIOME

Questions?