

RESEARCH AREA 3

DIET-RELATED CHRONIC DISEASES

JOINT ACTION:

Nutrition and Cognitive Function (NutriCog)



The main objective of the **NutriCog Joint Action was to support innovative, transnational research projects addressing important questions relating to the interplay between nutrition and cognitive function.**

The influence of dietary patterns on cognitive functions and vice versa the effects of central nervous system nutrient signaling and cognitive processes on food intake, dietary patterns and eating behavior were relevant for this call, concentrating on prevention rather than progression of disease.

This knowledge should be used as the basis for dietary preventive strategies and

recommendations to guide individuals and populations towards health promoting dietary habits. Five research consortia focussing on a broad range of different research questions were funded. Projects started in the first half of 2016, with an envisaged total budget of 5,7 M€ and finished between December 2019 and April 2021.

AMBROSIAC **A Menu for Brain Responses Opposing Stress-Induced Alterations in Cognition**

WHAT

The consortium investigated the interrelations between diet, stress and cognition across the lifespan, using both preclinical and clinical approaches.

WHO

AMBROSIAC consisted of 6 partners from 6 countries (IE, FR, DE, IT, NL, UK) and received approximately 1.9M€. The project was coordinated by John Cryan (University College Cork, IE).

HOW

Partners combined findings from in vitro, preclinical and human intervention studies to examine the influence of nutrition on an increased susceptibility for stress-induced cognitive deficits from adulthood to old age, the impact of nutritional interventions on both cognition and stress-related parameters and molecular mechanisms by which nutrition can improve stress-induced cognitive vulnerabilities. In addition, the role of the microbiome was investigated and the changes in inflammatory, endocrine outputs and in gene expression.

MAIN OUTCOMES

The consortium identified that short-chain fatty acids, Ω -3 fatty acid-rich and docosahexanoic acid (DHA) rich supplementation have anti-inflammatory properties reversing stress-induced deficits in behaviour and cognitive performance. The beneficial effect on

cognitive behaviour, stress and weight reduction was furthermore associated with changes in specific gut bacteria composition. Identified individuals susceptible to cognitive decline or stress (e.g. those with higher cortisol levels) could be prophylactically treated with a diet positively modulating the microbiome resulting in reduced inflammatory markers, decreased cognitive impairments and thereby in healthier aging.

HIGHLIGHT

The partners initiated a large number of collaborations including Nutricia Danone, the JPI HDHL projects DEDIPAC, ENPADA-SI, the ERA-HDHL project HEALTHMARK as well as the Irish projects INFANTMET, SMARTFOOD, and TODDLERFOOD and the German Rhineland Study. Furthermore, they collaborated with the EC funded projects FibeBiotics and MyNewGut.

iCASE **Individualized Cognitive, Affective and Social Enhancement in nutritional interventions for longevity and well-being**

WHAT

The consortium investigated the role of food supplements affecting serotonin levels and examined effects on cognitive ageing processes, with social and affective cognition in particular.

WHO

iCASE consisted of 4 partners from 3 countries (DE, ES, NL*) and received approximately 1.0M€. The project coordinator was Peter Kirsch (Central

Institute of Mental Health, DE).

HOW

Using a multidisciplinary (psychology, genetics, neuroscience, nutrition) and translational approach, the consortium mainly investigated whether tryptophan supplementation positively influences moral judgements, the mentalization of social signals and how the mechanism of social behaviour was modulated by nutrition.

MAIN OUTCOMES

The partners demonstrated that the essential amino acid tryptophan compensates for age-related social cognitive problems, e.g. recognizing positive emotions and that especially elderly people can profit from a tryptophan-rich diet protecting against depression and increased social cognition.

HIGHLIGHT

For harmonization of methods and data sharing the consortium created a Matlab-based analyses pipeline for dietary data.

*The Dutch partner left the consortium during the runtime in April 2017.

D-CogPlast

Identification of dietary modulators of cognitive ageing and brain plasticity and proof of concept of efficacy for preventing/reversing cognitive decline

WHAT

The consortium examined the role of dietary bioactives affecting brain plasticity for cognitive ageing processes. Furthermore, different age groups were studied to investigate a sensitive population responsive to dietary interventions. In addition, exposure to stress and genetic predispositions was considered.

WHO

D-CogPlast consisted of 6 partners from 5 countries (UK, AT, FR, NL, ES) and received approximately 1.0M€. The project was coordinated by Sandrine Thuret (King's College London, UK).

HOW

D-CogPlast was a translational project across nutrition, epidemiology and neuroscience ranging from studies in rodents to human data. Innovative methods were employed, such as food metabolomics, in-vitro approaches to study brain plasticity in humans and cognitive ageing models in rodents.

MAIN OUTCOMES

The consortium identified several dietary bioactives that influence cognitive ageing in later life and specifically found a protective role of cocoa, fish and red wine. Moreover, they found that caffeine could accelerate cognitive ageing. One potential way to trigger this outcome was through reducing proliferation of hippocampal neural progenitor cells.

HIGHLIGHT

The consortium achieved a high scientific output. 18 project-related scientific articles were published so far.

MiTyrAge

Targeting the mitochondria-tyr kinase axis to prevent age-associated neuronal decline

WHAT

The consortium investigated the role of dietary components for mitochondrial function and cognitive decline with age.

FUNDING

MiTyrAge consisted of 4 partners from 3 countries (DE, IT, ES) and received

approximately 0.8M€. The project coordinator was Natascia Ventura (University Dusseldorf, DE).

HOW

A complementary set up of basic research approaches was used with a variety of model systems, such as in-vitro mechanistic studies in cells and in-vivo studies in worm and rodent models and combined with epidemiological research in humans to obtain new results on neuronal aging.

MAIN OUTCOMES

The results of the consortium indicated that flavonoids (like quercetin, abundant in the Mediterranean diet) mainly found in fruits and vegetables can help to delay age-associated neuronal decline and associated neuronal pathologies like Alzheimer's disease.

HIGHLIGHT

Partners of the MiTyrAge consortium received a 3 years FIRC (Future Institute Research Center) fellowship to investigate the significance of SRC-NRF2 connection in cancer.

SELENIUS

Selenium in early life to enhance neurodevelopment in unfavourable settings.

WHAT

The consortium investigated the role of selenium for brain plasticity in relation to other trace elements and nutrients. Oxidative stress and inflammation will be

studied as key processes connecting diet, peripheral tissues and brain development.

WHO

SELENIUS consisted of 6 research groups from 5 countries (IT, FR, DE, PL, UK) and received approximately 1.0M€. The project was coordinated by Luisa Minghetti (Istituto Superiore di Sanità, IT)

HOW

The effects of different diets on behavioural development, cognitive functions, synaptic plasticity, and inflammation were studied, using a variety of methods, such as ex-vivo and in-vivo designs, -omics approaches, assessments of inflammatory parameters in different target organs and epidemiological data from a human birth cohort study.

MAIN OUTCOMES

The partners provided evidence for a detrimental effect of suboptimal selenium intake on behavioural development in infants and the adverse influence of early exposure to lead (Pb) in the absence of optimal selenium intake. The results also underlined the positive effects of dietary selenium on neuroinflammation and neuroplasticity.

HIGHLIGHT

A new rodent model was developed by the SELENIUS consortium allowing to study the effect of selenium intake levels challenging the brain development and cognitive function without dramatically affecting reproduction and other vital functions.



More detailed information on the funded projects can be found at www.healthydietforhealthylife.eu or by using the hyperlinks behind the project's acronym.

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