ILSI EUROPE SESSION PROGRAMME

Brain imaging and human nutrition: Which measures to use in intervention studies?

TUESDAY, 23 APRIL 2013, 10:30-12:30
EXPERIMENTAL BIOLOGY
ROOM: BALLROOM EAST
BOSTON, USA

ORGANISED BY THE NUTRITION AND MENTAL PERFORMANCE TASK FORCE IN COLLABORATION WITH THE AMERICAN SOCIETY FOR NUTRITION

American Society for Nutrition
Excellence in Nutrition Research and Practice
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Founded in 1978, the International Life Sciences Institute (ILSI) is a non-profit, worldwide foundation that seeks to improve the well-being of the general public through the advancement of science. Its goal is to further the understanding of scientific issues relating to nutrition, food safety, toxicology, risk assessment, and the environment. ILSI is recognised around the world for the quality of the research it supports, the global conferences and workshops it sponsors, the educational projects it initiates, and the publications it produces. ILSI is headquartered in Washington, DC. It is affiliated with the World Health Organization (WHO) as a non-governmental organisation and has special consultative status with the Food and Agriculture Organization (FAO) of the United Nations.

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Background

Throughout the lifespan the brain is a highly metabolically active organ that utilizes a relatively large proportion of total nutrient and energy intake. Furthermore, the development and repair of neural tissue depends on the proper intake of essential structural nutrients, minerals and vitamins. Therefore what we eat, or refrain from eating, may have an important impact on cognitive abilities and mental performance. Two of the key areas where diet is thought to play an important role are on optimizing neurodevelopment in children and preventing neurodegeneration and cognitive decline during aging. From early development to aging, brain imaging can detect structural, functional and metabolic changes in humans and modifications due to altered nutrition or to additional nutritional supplementation. Inclusion of imaging measures in clinical studies can increase understanding regarding modification of brain macro- and microstructure, metabolism and electrophysiology linked to functional endpoints, and may provide early sensitive measures of long-term effects. In this session, the utility of existing brain imaging technologies to assess the effects of nutritional intervention in humans is described. Examples of current research demonstrating the use of these markers are reviewed. Participants have an opportunity to explore the rationale and applicability of measures proposed through a panel discussion.

Purpose

Attendees of this session will:

- Obtain a basic understanding of brain imaging techniques, including what can be measured and how measurements are interpreted.
- Be able to describe the utility of brain imaging markers for nutrition research.
- Be able to incorporate brain imaging techniques into the design of nutrition intervention studies.

For more information
Please contact: Marie E. Latulippe, mlatulippe@ilsieurope.be
Information about the Nutrition and Mental Performance Task Force is accessible at: http://www.ilsi.org/Europe/Pages/TF_NutritionandMental.aspx
SPEAKERS SESSION

Chair: S. Sizonenko (Hôpital des Enfants, CH)
Co-Chair: J. Sijben (Nutricia Advanced Medical Nutrition, NL)

10:30-10:40 Linking brain imaging with the field of nutrition research
   J. Sijben

10:40-11:10 Understanding brain imaging and translating outcomes:
   Structural and functional MRI techniques
   S. Sizonenko

11:10-11:40 Applying structural magnetic resonance brain imaging in
   nutrition studies: Uses and limitations
   K. Walhovd

11:40-12:10 Understanding brain imaging and translating outcomes:
   PET-FDG, fMRI, EEG and MEG
   C. Babiloni

12:10-12:30 Panel Discussion
Despite great progress in the fields of neuroscience, neuropsychology and nutritional science in terms of understanding the relationship between brain function and nutrition, certain hurdles hamper progress in this field. In particular, research assessing the long-term relationships between nutrient intakes and brain function, as well as human data regarding mechanisms of action, are hindered by practical feasibility or methodological constraints. The emerging field of brain imaging provides novel opportunities to address some of these needs. Inclusion of brain imaging biomarkers as endpoints in interventions may provide study outcomes that supplement clinical or cognitive measures as endpoints. Particularly, brain imaging biomarkers might provide more sensitive outcome measures and improve our understanding of mechanisms of action in hypothesis-driven human intervention studies.

Biography

Dr John Sijben studied at Wageningen University with specialisation in Physiology, Immunology, and Nutrition. In 2002 he obtained his PhD degree on research performed in Wageningen and UC Davis, California, on modulation of immune function with dietary polyunsaturated fatty acids. Since joining the research organisation of Nutricia, Danone since 2007, Baby and Medical Nutrition in 2001, he contributed to various research projects in Baby and Medical Nutrition as (senior) scientist and project leader, many on the role of fatty acids in immune- and brain function. His major interest is translation of science to innovative nutritional concepts in close collaboration with external scientific and medical advisors. This work has resulted in a large number of product innovations, international patent applications and scientific publications. Currently he is Research Manager in Disease Targeted Nutrition, and amongst others chair of the ILSI Europe Task Force on Nutrition and Mental Performance.
Understanding brain imaging and translating outcomes: Structural and functional MRI techniques

Stéphane Sizonenko, MD PhD
Children’s Hospital, Department of Child and Adolescent Medicine, Division of Child Development and Growth, Switzerland

This talk will focus on Magnetic Resonance Imaging (MRI) techniques and how they can be used in nutrition studies during early brain development. The advent of non-invasive MRI was a breakthrough to assess the human brain in vivo, greatly expanding the possibilities to investigate brain structure and function. Clinically, neuroradiologists usually interpret scans by visual inspection; however, in order to reveal more subtle features, other techniques have been developed that depend on different acquisition modalities with post-acquisition processing of the scans. Within the broad divisions of macro-, micro-structural, metabolic and functional imaging, a variety of techniques have emerged from magnetic resonance (MR) leading to multimodal assessment of the brain. Therefore, the combination of MRI as a multimodal tool with post-acquisition processing techniques provides powerful technology for the study of the effects of nutrition on brain development and ageing. Further it represent an excellent translational tool from animal to human research as the same techniques can be applied. These aspects will be presented and specific examples of nutrition studies in the perinatal period that have included MRI will be discussed.

Biography

Dr Sizonenko completed his medical qualifications with MD from the University of Geneva in 1994. He then trained in pediatrics, completing his FMH of Pediatrics and specialisations in neonatology and developmental pediatrics. From 1997 to 2001, as postdoctoral fellow at the Liggins Institute, Auckland University and in Neonatology in the Department of Pediatrics, he obtained his PhD in pediatrics in 2003 from his research on hypoxic-ischemic brain injury in the developing brain. Back in Geneva in 2001 as senior research fellow and consultant in the Division of Development and Growth of the Department of Child and Adolescent he developed his research in parallel to clinics in developmental pediatrics. He obtained his Privat Docent at the Faculty of Medicine of Geneva in 2009.

Dr Sizonenko’s research has been focused on the problem of developmental brain injury. These injuries still represent a challenging field of research, as not only the injury itself will alter brain tissue, but the subsequent brain development and function will be changed from the usual brain development pathways. Advanced magnetic resonance imaging (MRI) has given new and precise insight in preterm brain injury and altered development. In collaboration with the Centre for Biomedical Imaging at the Ecole Polytechnique in Lausanne, a MRI based multimodal approach has been applied to animal models of developmental brain injury with the aim of better delineating the changes seen in neuropathology and by translation in human imaging. Further, it has been used to test for neuroprotective strategies, including nutritional intervention. A key research focus is the development of therapeutic approaches to rescue injured brain cells but also to restore normal development and enhance cerebral plasticity. The use of MRI as a multimodal translational tool has given new insights into the process of CNS injury in preterm infants. Further this work has paved the way towards the possible development and assessment of neuroprotective treatments for extreme preterm infants and nutritional intervention are currently under investigation.
Applying structural magnetic resonance brain imaging in nutrition studies: Uses and limitations

Kristine B. Walhovd, PhD
Research Group for Lifespan Changes in Brain and Cognition, Department of Psychology, University of Oslo, Norway

A number of changes in brain and cognition take place across the lifespan. There are great individual differences. Changes can be influenced by a number of conditions, including nutrition. Brain imaging techniques have been applied to demonstrate the effect of dietary intake patterns and nutrition interventions on brain structure and function. Biomarkers of nutrient intake and related parameters, e.g. cholesterol, can also be linked to brain imaging data. One example of dietary components studied includes long-chain polyunsaturated fatty acids. In this presentation, imaging related to nutrition, including data using MR imaging and nutrition biomarkers, limitations of these techniques and potential future applications across the lifespan will be discussed. Preliminary data will be presented on MR imaging of longitudinal brain age changes in relation to nutrition, including data on cortical thinning in relation to blood markers of cholesterol and DHA.

Biography

Prof Walhovd’s current research is targeted at understanding the mechanisms underlying different types of change in brain and cognition, and whether and how we ourselves can initiate, enhance or slow them. Throughout life, our mental capacities and brains are under continuous alteration: Some changes are part of positive development, others are debilitating. Together with colleagues, Prof Walhovd is examining markers and mechanisms underlying changes in brain and cognitive behaviour throughout the lifespan in individuals from 4 to 90 years of age. In addition to studying normal cognition and brain-behaviour relationships throughout the human lifespan, Prof Walhovd is involved in patient studies, including Alzheimer disease and drug exposure in utero.
This talk will focus on relevant functional techniques for the study of the effects of food on human brain activity as revealed by electroencephalography (EEG), magnetoencephalography (MEG) functional magnetic resonance imaging (fMRI) and positron emission tomography (PET). The literature on these effects will be summarized. On the whole, quite a few studies demonstrate significant effects of nutrients on human brain function, especially by means of EEG and PET markers. However, some contrasting results were found possibly due to remarkable methodological differences among the studies. The research area will benefit from stronger standardization and harmonization of the nutritional interventions, the experimental conditions of EEG, MEG, fMRI and PET recordings, and the procedures to extract reliable EEG, MEG, fMRI and PET markers. To properly set up the recording time window to capture the acute effects of foods on brain function, critical considerations include the matrix in which an ingredient is provided (e.g., capsule, cold drink, hot drink, or meal) and the consequence of that matrix for absorption, distribution, and metabolism (also in the brain) of the ingredient concerned.

Biography
Prof Babiloni received a Ph.D. in Biomedical sciences at Aalborg University (Denmark), and is Associate Professor of Physiology at the University of Rome “La Sapienza” (Italy). He is an experienced neurophysiologist with a special interest in the study of functional and structural neuroimaging in the field of research lines on Cognitive neuroscience and Clinical Neurophysiology of cognitive processes. He has been developing advanced EEG tools for early diagnosis and prognosis of Alzheimer disease. He has published more than 190 papers recorded in PubMed on Neuroimaging, Neurophysiology and Clinical Neurophysiology.

Prof Babiloni is principal investigator (P.I.) of the Research Unit of the University of Foggia (Italy) in the IMI Joint undertaking 2008 project entitled “Prediction of cognitive properties of new drug candidates for neurodegenerative diseases in early clinical development” (“PharmaCog”;Partner 12), focused on the development of screening guidelines and diagnostic criteria and drug discovery for Alzheimer disease (AD). In the framework of PharmaCog, Prof Babiloni is the leader of the EEG data analysis modules across work packages dealing with human and animal models.

Prof Babiloni is also principal investigator of the Research Unit of the University of Foggia in the FP7-infrastructures-2010 ICT project entitled “Diagnostic enhancement of confidence by an international distributed environment” (“Decide”; Partner 7), focused on the development of a GRID-computing e-infrastructure for the storage and analysis of magnetic resonance, positron emission tomography, and EEG neuroimages for the instrumental evaluation of MCI and AD subjects. In the framework of “DECIDE”, Prof Babiloni is the leader of the EEG data analysis modules across work packages dealing with MCI and AD subjects.

Finally, Prof Babiloni is principal investigator of the Research Unit of the University of Rome “La Sapienza” in 4 projects granted by the Italian Ministry of Health and that of University on neuroimaging of Alzheimer’s disease.