Nutrition

RESEARCH AREA OVERVIEW
Our research spans from fundamental mechanistic studies to bioavailability and bioefficacy studies in healthy participants and ‘at risk’ groups. We specialise in research in plant bioactives (flavonoids and isothiocyanates), fatty acids and nutrigenetics.

Key Research Interests include:

- Cardiovascular health and in particular vascular function as assessed by techniques such as FMD and MRI
- Cardio metabolic health with a focus on insulin sensitivity and non-alcoholic fatty liver disease (NAFLD)
- Cancer risk
- Dietary strategies for enhanced cognition and reduced Alzheimer’s Disease risk
- Plant bioactive metabolism
- APOE genotype, ageing and disease risk

Relevant Links
http://www.uea.ac.uk/medicine/department-of-nutrition/research

Current Research Opportunities

- Anti-cancer effect of isothiocyanates – Dr Yongping Bao
- The impact of n-3 fatty acids and APOE genotype on cardiovascular and cognitive health – Prof Anne Marie Minihane
- Dysregulation of calcium and Vitamin D metabolism and complications of pregnancy – Dr Inez Schoenmakers
- Molecular Nutrition of the Gut-Liver-Brain-Axis – Prof Michael Muller

Public Health Nutrition

- Nutritional epidemiology – Prof Ailsa Welch
- Dehydration in the elderly – Dr Lee Hooper
Anti-cancer effect of isothiocyanates

The main focus of Dr Bao’s team is to determine doses of ITCs that are optimal for health, and to investigate interactions with other nutrients in the modulation of key genes that affect cell proliferation, migration and invasion. The work will contribute to the advancement of knowledge regarding the benefits and risks of dietary bioactives.

Isothiocyanates (ITCs), derived from glucosinolates from cruciferous vegetables, possess chemo-preventive properties. ITCs have been shown to exert antioxidant effects by the induction of the NF-E2-related factor-2 (Nrf2) transcription factor, which activates the transcription of various antioxidant genes upon binding to the antioxidant response element (ARE) in their promoters. The Nrf2-ARE pathway is typically induced in response to oxidative stress, against which it initiates a major cellular defence mechanism. This protection is very important in preventing cancer. However, the overexpression of Nrf2 in cells that are already cancerous has the potential to promote their chemo resistance.

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The impact of n-3 fatty acids and APOE genotype on cardiovascular and cognitive health

The research group’s primary focus is investigating the independent and interactive impact of dietary components (in particular marine n-3 fatty acids and plant bioactives) and common gene variants on cardiovascular, cardio metabolic, and more recently cognitive health.

The majority of the work uses randomised controlled trials (RCTs) with the ‘human’ interventions complemented by cell and rodent studies and molecular biology approaches to inform the RCTs and investigate the mechanisms underlying gene*diet*health associations. It is hoped our work will contribute to the future personalisation/stratification of nutrition recommendations and therapeutics based on an individual’s genetic profile.

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Dysregulation of calcium and Vitamin D metabolism and complications of pregnancy

Abnormalities in calcium and vitamin D metabolism have been implicated in the development of pregnancy complications, particularly preeclampsia and pregnancy induced hypercalcemia. The mechanisms are poorly understood. Investigation of factors predictive of these complications may aid the development of markers for the early detection of women at risk.

The aim of this project is to investigate markers of calcium and vitamin D metabolism in women diagnosed with preeclampsia and gestational hypercalcemia and healthy controls in early and late pregnancy.

**Project**

Cases and controls were selected for 2 separate study components and were selected from a large multi-ethnic and population representative prospective cohort study in Sweden (GRAVID, n=2000) from which banked samples are available in early and late pregnancy (trimester 1 and 3; T1, T3).

1. Preeclampsia case-control study (N=69 pairs)
   1) Hypercalcemia case-control study (N=30 pairs)

Measurement of biochemical markers of calcium and vitamin D metabolism in women at T1 and 3 has been completed at the Bio-analytical research Facility at UEA.

The student will conduct statistical analyses of available data and link these to clinical features of preeclampsia and gestational hypercalcemia and other characteristics of study subjects. Measurement of additional markers is a possibility, subject to ethical approval and funding.

![Figure 1](image-url)

**Figure 1**: Study design of the GRAVID cohort study. Available data include medical and midwife recordings of blood pressure, clinical symptoms and birth outcomes from all ante-natal, perinatal and post-natal visits. Questionnaires recorded anthropometric, social economic and geographic data and dietary intakes of nutrients.

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Molecular Nutrition of the Gut-Liver-Brain Axis

Research in the Müller group is directed towards getting an in-depth understanding of the mechanisms underpinning the role of nutrition in controlling health. We will use the knowledge we acquire to develop efficient strategies to prevent diet-related conditions, which include liver disease, cancer and cardiovascular disease. These strategies may include probiotics, food bioactives, specific bile acids or drugs that target specifically the small intestine to improve health and prevent systemic diseases.

We are currently facing significant human health and societal challenges that are linked to our unhealthy food patterns and lifestyles. One of the organs playing a vital role in health maintenance is the intestine. In the small intestine, food is processed, further digested and selected components are efficiently absorbed. The largely indigestible remnants that pass the SI and enter the colon are partly fermented by the resident microbiota. Compromised functionality of the intestine has been linked to several metabolic complications.

The important role of nutrition for the intestine, the gut microbiota and the gut liver axis is increasingly recognised. However, to our knowledge, the exact mechanisms underlying the complex interaction of the food-microbiome-host system in the different highly specialized regions of the small and large intestine remain largely unknown.

Our research aims to define the specific role of the microbiota in the differential responses of the small intestine to diets with different dietary fibre content.

We are studying how diet-related changes in the small intestinal bile acid metabolism impact enterohepatic functions and the functionality of the liver. We will also define the role of small intestinal metabolism for the aging phenotype of the gut-liver-brain axis.

By targeting the small intestinal microbiota and its metabolism, we will characterise the reversibility of detrimental age-related changes in the gut-liver-brain axis.

Interdisciplinary expertise allows us to apply our molecular nutrition research to molecular biology techniques and in vivo studies using various mouse models a broad range of different methodologies like NGS, metabolomics (with a focus on bile acids), miRNA, Transcriptome, 16S microbiome analysis and the related systems biology-based data integration.

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Public Health Nutrition

Nutritional epidemiology

Ailsa’s research focuses on nutritional epidemiology to understand the relationship between diet and ageing, with a particular focus on nutrition, muscle loss, osteoporosis and fracture risk; this research feeds into prevention for public health.

Ailsa also researches the impact of and developing nutritional public health interventions. The research will be based on using datasets with detailed information on diet and disease risk factors (for instance the EPIC-Norfolk cohort study). It could also involve evaluating local public health interventions with the Norfolk County Council, with some contact with participants.

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Dehydration in the elderly

Lee Hooper is currently running a study in residential care homes assessing the diagnostic accuracy of signs of early dehydration, and is carrying out systematic reviews in the same area. This study will offer an introduction to dehydration in the elderly, a chance to experience research in a care home setting, and some training in systematic review and/or diagnostic accuracy methodology. Students may choose to participate in an on-going systematic review or secondary data analysis.

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