

The Nutrition Society Spring Meeting was held at Abertay University, Scotland on 1–2 April 2019

## Editorial

### Conference on ‘Inter-individual differences in the nutrition response: from research to recommendations’

## Inter-individual differences in the nutrition response: from research to recommendations

The 2019 Nutrition Society Spring Conference, which convened in Dundee, focused on the challenges presented by inter-individual differences in the responses to nutrition and in conducting nutritional research. The programme brought together national and international experts to discuss the collective evidence on inter-individual nutritional responses and impacts on health. Speakers and delegates from across the UK, Europe and the USA debated new methods of conducting research in nutrition and discussed the development of appropriate dietary interventions to maintain health and prevent disease in diverse populations. Symposium 1 focused on the effects of ethnicity on nutrient availability and type 2 diabetes and cardio-metabolic disease. Symposium 2 explored sex differences in nutrient availability and health and metabolism. The final symposium examined genetic and phenotypic variation, nutrition and health. The meeting ended with a panel discussion about how we take research to recommendations and concluded with a need to consider inter-individual differences in planning, conducting and analysing nutritional research.

#### Nutrition response: Inter-individual differences: Research: Recommendations: 2019 Nutrition Society Spring Conference

Nutrition plays a fundamental role in maintaining health and preventing disease. However, it is now clear that the effects of nutrition on health differ in individuals of different ethnicities, genetics and sex. This is likely due to differences between individuals in food intake regulation and also in the absorption, distribution, metabolism and excretion of nutrients. In acknowledgement of this variation in the nutritional response, the Nutrition Society Spring Conference 2019, hosted at Abertay University in Dundee, attracted scientists, nutrition educators, health care professionals, clinicians, food industry partners, and students from the UK, Ireland, Europe, USA and Russia. Over two days, experts and delegates explored and debated the main factors underlying inter-individual differences that contribute to the development of new and innovative methodologies to optimise the delivery of health benefits of nutrition in these diverse populations. These short sessions delivered the latest research outputs in nutrition and fostered interaction between delegates.

Dr Janice Drew (University of Aberdeen, UK) opened the conference with a thought provoking introduction on the heterogeneous nutritional response: the folly of the group mean. Dr Drew discussed the potential confound of using the group mean to interpret a group of diverse individuals, when the nutrition response is

heterogeneous, and how this may mask critical knowledge about the mechanisms and determinants of the nutrition response. The challenges of compiling groups (in which to make comparisons, for example, based on sex, age, ethnicity and genetic diversity) and in interpreting the group mean were explored using examples from human subjects, *in vivo* and *in vitro* models. Advances in understanding and tackling the inter-individual variation in the nutrition response are essential to facilitate the development and implementation of effective dietary guidance and policy for individuals and populations<sup>(1)</sup>.

The first plenary lecture was given by Dr Sarah Berry (King's College London, UK) who addressed the determinants of inter-individual differences in postprandial metabolic responses. Using the example of the Personalised Responses to Dietary Composition Trial, a multi-centre dietary intervention which predicts the metabolic response to foods by deriving algorithms, Dr Berry illustrated how knowledge of integrated multiple regulatory systems is crucial to understanding inter-individual differences within a healthy and diverse population<sup>(2)</sup>.

Symposium 1 focused on the effects of ethnicity on nutrient availability and disease. Dr Louise Goff (King's College London, UK) commenced discussions on ethnic differences in the pathophysiology of type 2



diabetes, with a focus on African–Caribbean populations. Type 2 diabetes is a major global public health concern, with WHO estimates of 422 million adults living with diabetes in 2014<sup>(3)</sup>. Critically, type 2 diabetes presents an increased risk for multiple co-morbidities, which in turn significantly reduce the quality of life and life expectancy. Ethnic inequalities in type 2 diabetes exist, with this disease placing a significant burden on ethnic minorities. For example, the prevalence of type 2 diabetes is approximately three times higher and the mean age of onset is 10–12 years earlier in black African–Caribbean compared with white European communities. Current thinking from research conducted in large epidemiological studies suggests that black African–Caribbean populations have a distinct hypertensive phenotype in the absence of dyslipidaemia and central obesity. The development of hyperglycaemia in these populations may be independent of body fat accumulation and due to  $\beta$ -cell dysfunction<sup>(4)</sup>. Further insight into those distinct biological mechanisms and processes that underlie the development of type 2 diabetes in black populations could enhance strategies for both prevention and treatment. Dr Vimal Karani (University of Reading, UK) discussed the importance of using a nutrigenetics approach to study the impact of genetic and dietary factors on cardio-metabolic traits in ethnic groups. This approach illustrates the complex nature of gene–diet interactions but enables the opportunity for a review of diet guidelines for optimising nutrition for individuals from diverse ethnic groups. Findings from the Gene–Nutrient Interactions Collaboration, a large-scale collaborative project investigating diet–gene interactions on cardio-metabolic outcomes, were used to illustrate how personalised nutrition could be used effectively to promote health and reduce risk of cardio-metabolic disease<sup>(5)</sup>. South Asian populations in Europe represent another group at an increased risk of dietary related diseases, particularly type 2 diabetes. The final presentation in the first symposium was delivered by Dr Carlos Cellis (University of Glasgow, UK), who discussed research from an evaluation of the effectiveness of current dietary strategies used to prevent type 2 diabetes in South Asians, in order to develop novel and targeted preventative strategies in these populations.

Sex differences in nutrient availability and health were the focus of symposium 2. Professor Lorraine Brennan (University College Dublin, Ireland) explored the impact of sex differences on the metabolome, and differential sex responses to dietary interventions. In particular, Professor Brennan discussed the influence of the menstrual cycle on the metabolome, with a view to understanding the variation both within and between individuals in order to enhance precision nutrition outcomes for women<sup>(6)</sup>. Discussion points included how we might deliver newly developed nutrition advice for women at a public health level. Professor Bettina Mittendorfer (Washington University, St Louis, USA) spoke on the physiological underpinnings for differences in metabolic disease risk in men and women, with reference to the cardio-metabolic disease. Insights into sex-related differences in key aspects of metabolism involved

in cardio-metabolic disease were reviewed. Findings support the importance of sex as a biological variable in interpreting data and designing research studies. However, it was noted that the mechanisms responsible for these differences in metabolism and the clinical implications require further study<sup>(7)</sup>. The final speaker of day 1 was Dr Caroline Childs (University of Southampton, UK), who discussed the important role that sex hormones have on fatty acid metabolism. The type and quantity of dietary fatty acids are important for human health, specifically CVD. The presentation encompassed an update of fatty acid metabolism research that has emerged over the past decade across *in vitro*, animal and human subjects' studies, identifying the mechanisms underlying the interaction between sex hormones and the synthesis of long-chain fatty acids. The example of recommended intakes of fatty acids for pregnant women was discussed, and how there is a disparity between recommendations and risk perception from fish consumption and limited knowledge of other sources of these fatty acids. Dr Childs emphasised how improved understanding of sex differences in fatty acids metabolism and interactions with pregnancy could shape future research and improve dietary recommendations at a policy level<sup>(8)</sup>.

Plant-based foods have significant beneficial effects on human health. Day 2 commenced with the second plenary lecture from Dr Christine Morand (INRA, France) and a discussion on inter-individual variation in response to consumption of plant food bio-actives. The presentation addressed how heterogeneity in absorption, metabolism and biological responsiveness of specific plant foods or bio-active compounds may mask the health benefit of these plant food rich diets in certain sub-populations. Population recommendations may not be sufficient for all individuals. Thus, identifying markers of inter-individual variability is crucial for implementing tailored recommendations to promote health and reduce chronic disease risk<sup>(9)</sup>.

The final symposium of the conference addressed the topic of genotypic and phenotypic variation, nutrition and health. Associate Professor Eileen Gibney (University College Dublin, Ireland) continued the theme of personalised nutrition and discussed genetic and phenotypic variation in response to dietary intervention. The example of Food4me examined whether personalised nutrition provides a greater, more appropriate sustained change in dietary behaviour than standard healthy eating advice delivered at a population level. Interestingly, findings suggested that greater improvement in dietary behaviour was found with personalised nutrition, but that the level of personalisation and/or how it was delivered had no effect<sup>(10)</sup>. A greater understanding of those factors influencing the impact of knowledge on dietary related behaviour change is warranted.

Moving to a focus on the health and productivity of animals, Professor Jos Houdijk (SRUC, Roslin Institute, Edinburgh, UK) discussed the impact of genetic and nutritional sensitivity of gastrointestinal parasitism on production performance in rodent and ovine models. Professor Houdijk described the conflict between

protein supply and demand and how gastrointestinal nematode parasitism is responsive to nutrient demand. He also discussed genetic variation for gastrointestinal nematode parasitism to productivity, and disease resistance from between and within breed studies.

The final paper of the third symposium was delivered by Professor Bruce Griffin (University of Surrey, UK) who provided an insight into the metabolic origins of variation in serum LDL-cholesterol to saturated fat. The Reading Imperial Surrey Saturated fat Cholesterol Intervention, an on-going study in healthy men to establish the mechanisms involved in the variation in serum LDL-cholesterol response to dietary SFA, was reviewed. This study will use metabolomics to identify potential biomarkers of more complex metabolic traits. These will then be used to tailor dietary guidelines for hyper LDL-cholesterol-responsive individuals at most risk of atherosclerotic CVD.

The scientific programme concluded with a panel discussion about how we take research to recommendations which acknowledged that characterisation of inter-individual variation is a prerequisite to understanding the aetiological basis of the observed variability in responses to nutrition. Delegates and speakers agreed that the need to identify appropriate dietary interventions and advice to prevent non-communicable diseases is a significant challenge for nutrition research which requires fundamental changes in the way we design and report on nutrition research. Going forward, one important aspect of inter-individual variation that is less challenging and could be addressed in nutrition research is the use of sex as a biological variable in both the design of studies and interpretation of data.

Joanne E. Cecil<sup>1\*</sup> and Karen L. Barton<sup>2</sup>

<sup>1</sup>*School of Medicine, Medical & Biological Sciences, University of St Andrews, North Haugh, St Andrews KY16 9TF, UK*

<sup>2</sup>*Division of Engineering and Food Science, School of Applied Sciences, Abertay University, Kydd Building, Bell Street, Dundee DD1 1HG, UK*

\*Corresponding author: Joanne E. Cecil, email [jc100@st-andrews.ac.uk](mailto:jc100@st-andrews.ac.uk)

### Financial Support

Not applicable.

### Conflicts of Interest

None.

### References

1. Drew JE (2019) Challenges of the heterogeneous nutrition response: interpreting the group mean. *Proc Nutr Soc* [Epublication ahead of print version]
2. Berry S, Valdes A, Davies R *et al.* (2019) Predicting personal metabolic responses to food using multi-omics machine learning in over 1000 twins and singletons from the UK and US: the PREDICT I study (OR31-01-19). *Curr Dev Nutr* **3**(Supp 1), 1324.
3. World Health Organization (2016) *Global Report on Diabetes*. Geneva: World Health Organization.
4. Goff LM, Ladwa M, Hakim O *et al.* (2019) Ethnic distinctions in the pathophysiology of type 2 diabetes: a focus on black African-Caribbean populations. *Proc Nutr Soc* [Epublication ahead of print version]
5. Alsulami SS, Isgin-Atici K, Turan-Demirci B *et al.* (2019) Impact of fat mass and obesity associated (FTO) gene variants and lifestyle factors on obesity traits in a Turkish population. *Proc Nutr Soc* [Epublication ahead of print version]
6. Brennan L & Gibbons H (2019) Sex matters: a focus on the impact of biological sex on metabolomic profiles and dietary interventions. *Proc Nutr Soc* [Epublication ahead of print version]
7. Fappi A & Mittendorfer B (2019) Different physiological mechanisms underlie an adverse cardiovascular disease risk profile in men and women. *Proc Nutr Soc* [Epublication ahead of print version]
8. Childs CE (2019) Sex hormones and n-3 fatty acid metabolism. *Proc Nutr Soc* [Epublication ahead of print version]
9. Morand C, De Roos B, Conesa MTG (2019) Why inter-individual variation in response to consumption of plant food bioactives matters for future personalized nutrition. *Proc Nutr Soc* [Epublication ahead of print version]
10. Gibney ER (2019) Personalised nutrition – phenotypic and genetic variation in response to dietary intervention. *Proc Nutr Soc* [Epublication ahead of print version]