

1 **Conference on ‘Inter-individual differences in the nutrition response’**

2 **Inter-individual differences in the nutrition response: from research to**
3 **recommendations**

4 Abstract:

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

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

31 Dr Janice Drew (University of Aberdeen, UK) opened the conference with a thought provoking
32 introduction on the heterogeneous nutritional response – the folly of the group mean. Dr Drew
33 discussed the potential confound of using the group mean to interpret a group of diverse individuals,
34 when the nutrition response is heterogeneous, and how this may mask critical knowledge about the
35 mechanisms and determinants of the nutrition response. The challenges of compiling groups (in
36 which to make comparisons, for example based on sex, age, ethnicity and genetic diversity) and in
37 interpreting the group mean were explored using examples from human, in vivo and in vitro models.
38 Advances in understanding and tackling the inter-individual variation in the nutrition response are
39 essential to facilitate development and implementation of effective dietary guidance and policy for
40 individuals and populations⁽¹⁾.

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

47 Symposium 1 focussed on the effects of ethnicity on nutrient availability and disease. Dr Louise Goff
48 (King's College London, UK) commenced discussions on ethnic differences in the pathophysiology of
49 type 2 diabetes, with a focus on African-Caribbean populations. Type 2 diabetes is a major global
50 public health concern, with WHO estimates of 422 million adults living with diabetes in 2014⁽³⁾.
51 Critically, type 2 diabetes presents an increased risk for multiple co-morbidities, which in turn
52 significantly reduce quality of life and life expectancy. Ethnic inequalities in type 2 diabetes exist,
53 with this disease placing a significant burden on ethnic minorities. For example, the prevalence of
54 type 2 diabetes is approximately three times higher and the mean age of onset is 10-12 years earlier
55 in Black African-Caribbean compared with white European communities. Current thinking from
56 research conducted in large epidemiological studies suggests that Black African-Caribbean
57 populations have a distinct hypertensive phenotype in the absence of dyslipidaemia and central
58 obesity. The development of hyperglycaemia in these populations may be independent of body fat
59 accumulation and due to beta cell dysfunction⁽⁴⁾. Further insight into those distinct biological
60 mechanisms and processes that underlie the development of type 2 diabetes in black populations
61 could enhance strategies for both prevention and treatment. Dr Vimal Karani (University of Reading,
62 UK) discussed the importance of using a nutrigenetics approach to study the impact of genetic and
63 dietary factors on cardio-metabolic traits in ethnic groups. This approach illustrates the complex
64 nature of gene-diet interactions, but enables opportunity for review of diet guidelines for optimising
65 nutrition for individuals from diverse ethnic groups. Findings from the Gene-Nutrient Interactions
66 Collaboration (GeNulne), a large scale collaborative project investigating diet-gene interactions on
67 cardio-metabolic outcomes, were used to illustrate how personalised nutrition could be used
68 effectively to promote health and reduce risk of cardio-metabolic disease⁽⁵⁾. South Asian
69 populations in Europe represent another group at an increased risk of dietary related diseases,
70 particularly type 2 diabetes. The final presentation in the first symposium was delivered by Dr Carlos
71 Cellis (University of Glasgow, UK), who discussed research from an evaluation of the effectiveness of
72 current dietary strategies used to prevent type 2 diabetes in South Asians, in order to develop novel
73 and targeted preventative strategies in these populations.

74 Sex differences in nutrient availability and health were the focus of Symposium 2. Professor Lorraine
75 Brennan (University College Dublin, Ireland) explored the impact of sex differences on the
76 metabolome, and differential sex responses to dietary interventions. In particular, Professor
77 Brennan discussed the influence of the menstrual cycle on the metabolome, with a view to
78 understanding the variation both within and between individuals in order to enhance precision
79 nutrition outcomes for women⁽⁶⁾. Discussion points included how we might deliver newly developed
80 nutrition advice for women at a public health level. Professor Bettina Mittendorfer (Washington
81 University, St Louis, USA) spoke on the physiological underpinnings for differences in metabolic
82 disease risk in men and women, with reference to cardio-metabolic disease. Insights into sex-
83 related differences in key aspects of metabolism involved in cardiometabolic disease were reviewed.
84 Findings support the importance of sex as a biological variable (SABV) in interpreting data and

85 designing research studies. However, it was noted that the mechanisms responsible for these
86 differences in metabolism and the clinical implications require further study⁽⁷⁾. The final speaker of
87 Day 1 was Dr Caroline Childs (University of Southampton, UK), who discussed the important role that
88 sex hormones have on fatty acid metabolism. Type and quantity of dietary fatty acids are important
89 for human health, specifically cardio-vascular disease. The presentation encompassed an update of
90 fatty acid metabolism research that has emerged over the last decade across in vitro, animal and
91 human studies, identifying the mechanisms underlying the interaction between sex hormones and
92 the synthesis of long chain fatty acids. The example of recommended intakes of fatty acids for
93 pregnant women was discussed, and how there is a disparity between recommendations and risk
94 perception from fish consumption and limited knowledge of other sources of these fatty acids. Dr
95 Childs emphasised how improved understanding of sex differences in fatty acids metabolism and
96 interactions with pregnancy could shape future research and improve dietary recommendations at a
97 policy level⁽⁸⁾.

98 Plant-based foods have significant beneficial effects on human health. Day 2 commenced with the
99 2nd plenary lecture from Dr Christine Morand (INRA, France) and a discussion on inter-individual
100 variation in response to consumption of plant food bio-actives. The presentation addressed how
101 heterogeneity in absorption, metabolism and biological responsiveness of specific plant foods or bio-
102 active compounds may mask the health benefit of these plant food rich diets in certain sub-
103 populations. Population recommendations may not be sufficient for all individuals. Thus, identifying
104 markers of inter-individual variability is crucial for implementing tailored recommendations to
105 promote health and reduce chronic disease risk⁽⁹⁾.

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

115 Moving to a focus on the health and productivity in animals, Professor Jos Houdijk (SRUC, Roslin
116 Institute, Edinburgh, UK) discussed the impact of genetic and nutritional sensitivity of
117 gastrointestinal parasitism to production performance in rodent and ovine models. Professor
118 Houdijk described the conflict between protein supply and demand and how gastrointestinal
119 nematode parasitism is responsive to nutrient demand. He also discussed genetic variation for
120 gastrointestinal nematode parasitism to productivity, and disease resistance from between and
121 within breed studies.

122 The final paper of the third symposium was delivered by Professor Bruce Griffin (University of
123 Surrey, UK) who provided an insight into the metabolic origins of variation in serum LDL cholesterol
124 to saturated fat. The Reading Imperial Surrey Saturated fat Cholesterol Intervention (RISSCI), an
125 ongoing study in healthy men to establish the mechanisms involved in the variation in serum LDL-C
126 response to dietary SFA, was reviewed. This study will use metabonomics to identify potential

127 biomarkers of more complex metabolic traits. These will then be used to tailor dietary guidelines for
128 hyper LDL-C-responsive individuals at most risk of atherosclerotic cardiovascular disease.

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

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