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## NUTRITIONAL GENOMICS: THE FUTURE OF PERSONALISED NUTRITION



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### Lessons from the Food4Me project

Since the completion of the human genome sequence in 2003, the concept of personalised nutrition has arisen where individuals can receive tailored dietary advice based on their genetic makeup.<sup>1</sup> However, the definition of personalised nutrition is an evolving one and most recently, encompasses the idea of levels of personalised advice.<sup>2</sup>

Within this definition, Level 1 personalised nutrition is based on the assessment of the individual's dietary intake, Level 2 personalised advice is based on dietary intake and phenotypic measures, such as body weight and blood glucose, and Level 3 builds on from Level 2 with the inclusion of genotype information.<sup>3</sup>

From a clinical point of view, both Level 1 and Level 2 personalised nutrition advice are currently delivered by dietitians, but personalised nutrition based on genotype is not yet readily available to the population. Currently, genotype-based personalised health advice is predominantly delivered via direct-to-consumer testing (DTC) services. This is where the individual is sent the equipment to take a sample of DNA in their own home, usually by swabbing the inside of their cheek. The sample is then posted back to the company who will analyse it and notify the individual of the result via post, telephone or email. Previous research has shown that consumers do want genotype-based personalised nutrition and it is thought that personalised nutrition advice may be more motivating towards positive dietary and lifestyle changes compared with generic healthy eating advice.<sup>4,5</sup> However, there is also the

danger that knowledge of genotype risk may promote a more fatalistic attitude and reduced self-efficacy in terms of behaviour change. ([www.food4me.org](http://www.food4me.org)).

### FOOD4ME PROJECT - AN INTEGRATED ANALYSIS

The Food4Me project set out to investigate this concept of personalised nutrition and whether it was effective in motivating behaviour change.

Launched in 2011, Food4Me was a four-year FP7 project which aimed to examine all aspects of personalised nutrition including business models, consumer attitudes and ethical and legal issues. Within Food4Me, a six-month proof-of-principle (PoP) study was carried out to investigate the effect of varying levels of personalised nutrition advice on changes in diet and lifestyle compared with general healthy eating advice.<sup>6</sup> This was an internet-based intervention study across seven research centres in Europe (Ireland, UK, Germany, Greece, Netherlands, Spain and Poland) and was designed to emulate a personalised nutrition service. Over 1,600 individuals across Europe were randomised into one of four groups: control group receiving healthy eating advice; Level 1 group receiving personalised nutrition advice based on dietary intake; Level 2 group receiving personalised advice based on diet and phenotypic markers; and Level 3 group receiving the same as Level 2 as well as genotype information.

All information was self-collected and self-reported by the participants during the intervention. Prior to beginning the study, participants received a pack

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via post with the instructions and equipment required. Dietary intake was assessed using the online Food4Me food frequency questionnaire. Anthropometric information, such as body mass index (BMI) and waist circumference, were measured using weighing scales and measuring tape respectively. Blood biomarkers of health were measured via collection of dry blood cards by participants, similar to the Guthrie heel prick test used in babies.

Genotype information was collected using a cheek swab. Both dry blood spot cards and cheek swab samples were posted back to the research centres for analysis. Participants also wore a physical activity monitor and uploaded their data regularly to the website to collect information on their physical activity levels. Participants in Levels 1, 2 and 3 received regular personalised feedback reports via email based on the information collected. This dietary advice was developed using a series of decision tree algorithms to allow the delivery of systematic tailored advice. Within each report, participants were given three nutrient-related goals which were selected by a pre-defined ranking system, where those nutrients and metabolic markers that most warranted change, were prioritised. Participants were asked to focus on making changes to these three nutrients in the personalised reports in line with the patient-centred counselling models for facilitating behaviour change.<sup>7</sup>

#### KEY FINDINGS OF THE FOOD4ME PROJECT

The Food4Me project demonstrated that it is entirely possible to (i) collect phenotypic and food intake data remotely via the Internet and (ii) generate complex algorithms that enable effective personalised nutrition advice to be delivered

online to multiple European population groups.

Compared with control group participants who received non-personalised population-based advice, participants who received personalised dietary and lifestyle advice reported consuming significantly healthier diets after six-months.<sup>8</sup> Salt, saturated fat and red meat consumption were considerably lower and there was increased folate intake, in the personalised nutrition group. These findings were regardless of whether the personalisation was based on diet alone, phenotype or genotype, indicating that the use of genomic information to personalised lifestyle-based interventions may have little added value.<sup>8</sup> However, further research is required to corroborate these findings.

It is important to note that the individuals who were recruited to take part in Food4Me were generally healthy and free from disease. There is some evidence to suggest that genotype-based personalised nutrition advice may be more motivating for those who are already at a phenotypic or familial risk of disease and future work should investigate this hypothesis.<sup>9</sup>

Evidence from other studies have also shown that personalised or tailored nutrition at a dietary level can be more effective than generic dietary guidelines in promoting behaviour changes,<sup>10-12</sup> highlighting the potential for it to help improve the nutritional status of the population. Yet, how consumers will react to the concept remains another critical question. Many individuals may be reluctant to adopting personalised nutrition. However, such reservations have been found to relate more closely to insecurities regarding data protection and genetic privacy than the personalised nutrition advice itself.

Focus groups conducted within the Food4Me

project have established that transparent regulations regarding protection of data will need to be disclosed and enforced as the area grows, enabling consumers to develop trust with credible personalised nutrition providers. These focus group studies also highlighted the importance to the consumer that advice is tailored not only to current dietary intakes, but aligns with people's lifestyles and preferences, including those related to food choices, anonymity and motivational factors.<sup>13</sup>

Personalised nutrition advice on dietary intake information alone may not be sufficient in facilitating long-term changes in dietary behaviours, especially for different population groups. Many different factors influence eating habits and behaviours, such as beliefs, emotions, food preferences, financial resources, knowledge, time and food availability,<sup>14</sup> and expanding personalised nutrition advice to incorporate information relating to food preferences (e.g. likes and dislikes) and perceived barriers to change, could further enhance its efficacy in promoting sustained dietary changes.

FUTURE OF PERSONALISED NUTRITION IN DIETETIC PRACTICE

On a wide societal scale, personalised nutrition offers the potential to contribute towards improving health and reducing the widespread incidence of diet-related diseases, but can it reform current dietetic practice? Findings from the Food4Me project would suggest not. Current evidence suggests there is lack of added benefit of providing genotype-based personalised nutrition advice and practicing dietitians already analyse both individual dietary intake and limited phenotypic measurements, such as blood biochemistry, to create a tailored dietary plan usually delivered on a one-to-one basis.<sup>15</sup> Furthermore, the Academy of Nutrition and Dietetics has stated that the use of nutrigenetic testing to provide dietary advice is not ready for routine dietetics practice.<sup>16</sup>

It is clear that the emergence of advancing technologies and awareness in personalised health have heightened interest in the application of new technologies to assess dietary intake, and there is likely to be increasing use of these tools to generate personalised nutrition advice in the future.



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