Personalized Nutrition: Customizing Diets with Genetic Insights for Healthier Future

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Introduction

It is widely known that diet play a major role in the development of many diseases like heart disease, type II diabetes and cancer (Micha *et al.,* 2017). This emphasises the importance of personalizing dietary habits, as customize approaches may influence behaviour leading to improved health index. Personalized nutrition (PN) also known as "precision nutrition," "individualized nutrition," and "nutritional genomics" is a domain that harnesses an individual's distinct characteristics to create personalized dietary plans to prevent, manage and promotes overall health (Bush *et al.,* 2020). Personalized nutrition is associated with individual's nutrition, genetic makeup, phenotype such as body composition measurement, body mass index (BMI), physical activity levels, clinical indicators, gut microbiota and biochemical markers that evaluate nutritional status, alongside genomic data, to provide more personalized dietary recommendations (Singar *et al*., 2024). Personalized nutrition is based on the concept of genetic differences that how specific foods or nutrient levels of an individual's impacts the risk of developing diseases. The American Nutrition Association defines state that personalized nutrition consists of three interrelated components: the scientific principles and data supporting PN, professional education and training in PN and the implementation of PN in dietary guidance and therapeutic practices (Bush *et al.,* 2020). The main elements that analyse to design individual's personalised nutrition guidance are presented in fig.1.

Impact of dietary patterns on gut micro biota relationships

The microbial composition in gut can suddenly alter with the change in dietary habit just within 24 hours of food consumption. However, it can be returned to its original composition after discontinuous of that food in 48 hours (David *et al.,* 2014). It is also noted that the faecal micro biota composition to dietary fibre intake vary from person to person. Short-term dietary fibre consumption has resulted in increased microbial diversity, high levels of species such as *Prevotella* and *Coprococcus*, elevated the levels of corporate and vale rate and personalized changes in the fecal microbiota whereas the consumption of short-term resistant starches resulted in varying butyrate levels among different individuals (Yesilyurt *et al.,* 2022).

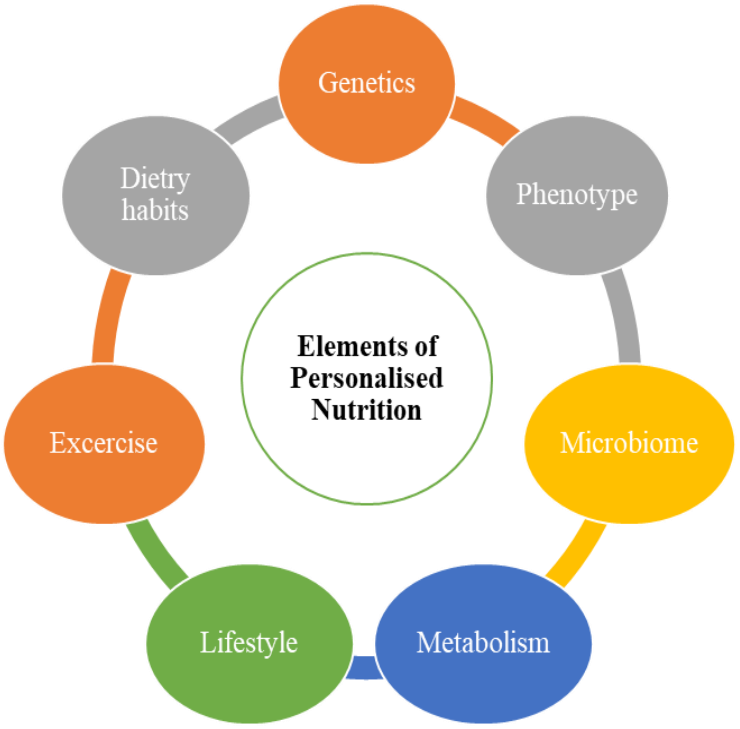

Fig. 1. Elements of Personalised Nutrition

Habitual diets have shown long-term effects on the composition of the gut microbiota.The Mediterranean diet, characterized by a high intake of olive oil, vegetables, fruits, legumes, oilseeds, and nuts along with moderate consumption of wine, fish, and dairy products, and low intake of meat and processed meats has been shown to improve obesity, lipid profiles and inflammation with an increase in *Lactobacillus, Bifidobacterium,* and *Prevotella* levels (Tosti *et al.,* 2018). Whereas, western-style diets, which are rich in animal-derived foods (saturated fats), eggs, refined carbohydrates, and total fats, while low in fruits, vegetables (fiber and micronutrients) and whole grains have been shown to decrease bacterial diversity and beneficial bacteria and reduction *Bifidobacterium* and *Eubacterium* species (Santos-Marcos *et al.,* 2019).

Personalised nutrition in gut modulation

Advanced technologies such as genetics, epigenetics, metabolomics, nutrigenetics and nutrigenomics collects, store and analyses the individual level data and explores the human genome and diet interactions (Fig. 2). They have enhanced the capacity to personalized guidance on nutritional needs, diet and on overall nutrition of individuals. These studies examine how genetics, epigenetics and the microbiome impact the dietary responses their influence by dietary intake (Ordovas *et al.*, 2018 and Kaiser, 2021).

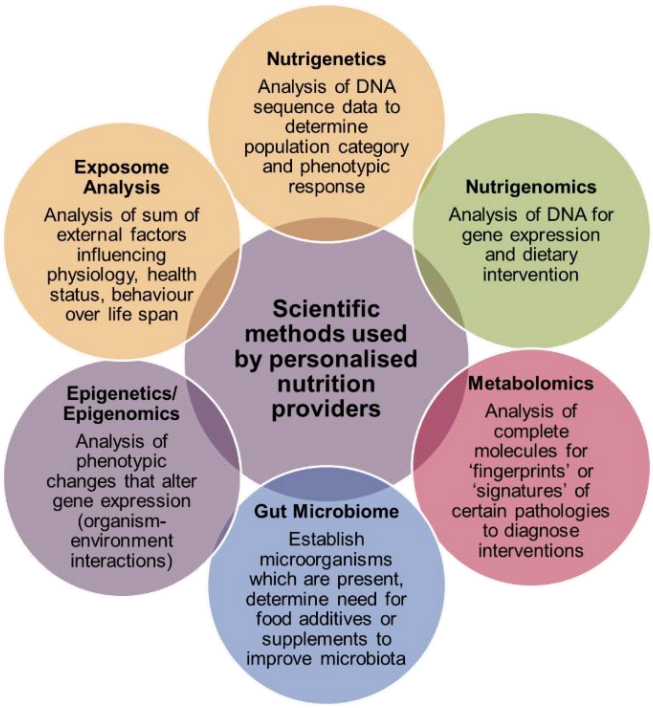

Fig. 2. Human genome and diet interactions (*Source:* Food Standard Agency, U.K)

Metabolic phenotype can be assessed using weight, blood pressure or fasting blood glucose, as well as more advanced data such as metabolomics, transcriptomics, and proteomics while key factors that contribute to human variation include the genome and micro biome (Bashiardes *et al.,* 2018). For personalized micro biome-based dietary guidance, the International Life Sciences Institute (Unites States) suggested 10 foundational principles for personalized dietary. (Yesilyurt *et al.,* 2022).

Foundational principles for personalized dietary

1. Define potential users and beneficiaries.
2. Use validated diagnostic methods and measures.
3. Maintain data quality and relevance.
4. Derive data-driven recommendations from validated models and algorithms.
5. Design PN studies around validated individual health or function needs and outcomes.
6. Provide rigorous scientific evidence for an effect on health or function.
7. Deliver user-friendly tools.
8. For healthy individuals, align with population-based recommendations.
9. Communicate transparently about potential effects.
10. Protect individual data privacy and act responsibly.

Conclusion

Studies have observed that gut microbiota interacts with body's systems through metabolites which are generated from undigested carbohydrates, proteins, fats or other nutrients. Due to individual variations in the gut microbiota caused by internal and external factors, personalized responses are triggered by the nutrients consumed through diet and the gut microbiota, changes under different environmental conditions. Based on their interaction modifying host microbiota through personalized nutrition presents a novel and promising therapeutic approach for both disease prevention and treatment.

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