



## Personalized Nutrition: How to make it possible?

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Received 3 July 2019,  
Accepted 20 July 2019

Link to DOI:  
10.25220/WNJ.V03.i1.0001

Journal Website:  
[www.worldnutrijournal.org](http://www.worldnutrijournal.org)

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The advancing of economic and technology in the last 1–2 centuries that characterized by industrialization, urbanization, and globalization have changed human lifestyle worldwide. Abundance of food and the ease of getting it, the availability of calorie-dense processed foods, changes in dietary patterns, and sedentary lifestyles force the rapid accretion of the incidence of obesity and non-communicable diseases such as type 2 Diabetes mellitus, cardiovascular diseases (CVD), and cancer. Non-communicable diseases (NCDs) are the leading cause of death worldwide, and one of the major health challenges of the 21st century.<sup>1</sup> In 2016, NCDs were responsible for 71% (41 million) of the 57 million deaths which occurred globally. The major NCDs responsible for these deaths included cardiovascular, cancers, chronic respiratory diseases, and diabetes.<sup>2</sup> Many epidemiological, observational, and clinical studies have shown that nutrition, as the main environmental factor, plays a pivotal role in these high-cost degenerative diseases.

Current nutrient intake guidelines are based on population estimates of the nutrient intake

required to prevent malnourishment according to sex, age, and other physiological states such as pregnancy and lactation. People with metabolic risk factors or are identified to be have a high risk of NCDs typically get more specific advice based on pathophysiology of the disease. Then they are suggested to adopt one type of dietary patterns that claimed having better impact for health than others, and could prevent the morbidity of NCDs. However, this “one-size-fits-all” approach, was not succeeded on every person. It is known that individual responds differently to nutrients and the genetic factors play an important role in nutrient metabolism. Studying the interactions between nutrition and genetic provides a better insight into the variability in biological response to nutrients, and may explain the underlying inconsistent study results in the field of nutrition research. Study of diet-gene interactions has two approaches, i.e. how nutrition affects gene function (nutrigenomic), and how genetic variation affects nutritional response, food intake, and eating behaviors (nutrigenetic).

The sequencing of the human genome and identification of interactions between genes and nutrients transformed the concept of personalized nutrition. Personalized nutrition can be defined as an approach that uses information on individual characteristics to develop targeted nutritional advice, products, or services to assist people to achieve a lasting dietary change in behavior that is beneficial for health.<sup>3,4</sup> Ordovas et al<sup>3</sup> stated that

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“the overall goal of personalized nutrition is to preserve or increase health using genetic, phenotypic, medical, nutritional, and other relevant information about individuals to deliver more specific healthy eating guidance and other nutritional products and services.”

Motivating to change one’s dietary behavior is the greatest challenge for any nutrition interventions. Personalized nutrition is based on the concept that individualized nutritional advice, products, or services will be more effective than more conventional generic approaches. The Food4me study, an internet-based personalized nutrition randomized controlled trial that held at 6 country in Europe, showed that after a six-month intervention, an individual receives dietary recommendations on a personal basis is enough to positively affect his or her dietary behavior.<sup>5</sup> The effectiveness is higher, if the advice can be further personalized by providing detailed coaching on how each person can modify his/her existing food choices to improve his/her dietary habit.

The current evidence level of applying genomic information to tailor dietary recommendation is still at early stages, but the prospect of implementing nutrigenetics to the clinical practice is encouraging. Much qualified research, especially RCT, is needed before personalized nutrition can deliver the expected benefits.

It is very clear that industry captured the opportunities of personalized nutrition as a prospective and trendy business. Various companies are competing to be at the forefront of selling and getting profits from this kind of service. Some companies seek to sell personalized nutrition programs directly to consumers with claiming that the recommended diet is “the very best for you” or “based on the latest scientific research”. With an attractive approach and convincing explanation, people who might have not sufficient knowledge about the current evidence and the effectiveness of personalized nutrition are finally persuaded to join this program. With relatively quite expensive cost, then customers get written report about the most suitable diet for them based on their genes. Ideally, this personalized nutrition packages must be completed by the “after-sales” programs which provides consultation service with well-trained

health practitioners (doctors or nutritionists) who will explain how the diet will be carried out. Dietary behavior changes need some time to be adopted and people often struggle with temptation of “delicious but bad for health” menus around them. They often confuse about which food are good or bad for them while they are buying grocery or eating out. So, the program must also be completed with other tools or applications that they can access easily wherever they are.

However, there are also providers which only sell genetic examination services and genetic based diet arrangements through the internet without providing consulting services. Consumers are then advised to consult how to apply the diet recommendations based on the reports he/she obtained from the provider to their personal physician. Unfortunately, not all health practitioner concerned and keep his/herself updated in the field of nutrigenetics or nutrigenomics. Thus, they might be do not have enough capability to direct their patient/clients to implement personalized nutrition. Furthermore, nutrigenetic and nutrigenomic science developed in the last 1–2 decades and these knowledges have not been included in every medical curricula yet, especially in developing countries.

It is premature to make health claims that personalized nutrition based on genotype is the best nutritional approach that can reduce the morbidity and mortality of NCDs as endpoint indicators, because there’s no scientific evidence yet. But many studies showed the effect of personalized nutrition on surrogate/intermediate endpoints as measurable and obtainable parameters that has been supported by strong evidence of its relationship to morbidity/mortality of NCDs. Livingstone et al<sup>6</sup> evaluate the efficacy of personalized nutrition intervention for improving consumption of Mediterranean diet. In this study, participants were randomly assigned to receive conventional dietary advice or personalized nutrition, and the MedDiet scores were calculated at baseline and 6 months interventions. The MedDiet score was converted from participant’s dietary intakes based on food-frequency questionnaire. The researchers conclude that higher MedDiet scores at baseline were associated with healthier lifestyles (higher physical activity level) and lower adiposity (lower body

mass index, BMI). After the intervention, MedDiet scores were greater in individuals who received personalized intervention than in controls, with the addition of DNA-based dietary advice showed the largest differences in MedDiet scores.

The future success of personalized nutrition will depend on the public knowledge about this approach. The review of Fallaize et al<sup>7</sup> regarding the public acceptance of nutrigenomic-based personalized nutrition assume that individuals with a heightened perceived susceptibility to disease, who has few risk factors, might be an ideal target group for nutrigenomic-based personalized nutrition. These people contribute significantly to disease events and are more willing to engage with personalized nutrition.

The role of technology in personalized nutrition is also essential and very important. Internet and mobile phone technology has become integral to our daily activities. Using the internet and mobile communications, consumers could have a choice of direct interfaces in any situation to support appropriate food choices.<sup>4</sup> Nutrition apps could be a powerful tool to support consumers to improve their dietary habits if it had a decision engine capable of providing personalized dietary advice. The eNutri is one of web app capable of delivering automated personalized dietary advice from participants' adherence to an 11-item modified US Alternative Healthy Eating Index (m-AHEI), which referred as Healthy Eating Score in the report, after they complete the online FFQ. This app will automatically select three dietary changes that the participant is recommended to consider based on the three m-AHEI components with the lowest score. This app has been evaluated by 32 nutritional experts, i.e. for the appropriateness, relevance, and suitability of advice given by using 2 pre-defined scenarios. A number of improvements to this app were suggested, such as including greater participant profiling (weight, lifestyle) and links to recipes and sources of further information.<sup>8</sup> As a supporting tool, this kind of service could be beneficial, but it couldn't be take over the role and importance of face-to-face consultation with capable health practitioner, especially in delivering more complex personalized nutrition advice based on dietary habits, lifestyle, health status, phenotype, and genotype.

As summary, to accelerate and make personalized nutrition possible, the following are several important things that must be considered:

1. Enhance qualified nutrigenomic/nutrigenetic research
2. Enhance multidisciplinary collaborations between basic and applied scientist, physicians, nutritionists, psychologists, pharmaceutical laboratories, information technologists (IT), and health educators to design a holistic personalized nutrition services. So customers will get the complete packages with maximal benefit.
3. Train the health practitioner about genomic medicine and include the genomic medicine in medical curriculum
4. Educate the general population on topics related with genetics and personalized medicine/nutrition
5. Use a non-invasive examination for genetic testing (saliva/cheek swab) to increase consumer acceptance
6. Adjust dietary recommendations completely based on unique individual characteristics, starting from genetics, phenotype, eating habits, food preferences, and stages of willingness to change.
7. Use any of technological advancing in the field of communication, to monitor and provide feedback to consumer (via internet or mobile apps).

#### **Conflict of Interest**

Authors declared no conflict of interest regarding this study.

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