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A Review on Individual Based Nutrition and Role of Genetic

Ni Putu Yenny Kendarini[1], Prayuda[2], I Made Jawi[3]

[1]Graduate of Postgraduate Medical Study Programme, Faculty of Medicine, Udayana University, Denpasar, Bali
[2]Postgraduate Medical Study Programme, Faculty of Medicine Udayana University, Denpasar, Bali, Indonesia
[3]Department of Pharmacology, Faculty of Medicine, Udayana University, Denpasar, Bali

Corresponding Author: Ni Putu Yenny Kendarini

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ABSTRACT

Health is a result of interactions between genes and environmental factors. The environmental factors that most significantly influence human health are nutrition, diet and daily lifestyle. Individual-based nutrition is an approach that recommends nutrition for individuals based on individual genetic information. The relationship between nutrition and disease has been widely researched and contains significant relationships. The specific relationship between nutrition and disease are being studied further in the form of epidemiological studies. Environmental factors such as dietary nutrition and genetic may have important roles in phenotypic manifestations through the central dogma of biology. This review article explains how DNA and genotype influence each individual's specific nutritional needs and maintain good health throughout life.

Keywords: individual nutrition, nutrigenetic, nutrigenomic

INTRODUCTION

Nowadays nutrition or diet is very widely discussed, related to a person's physical appearance and health-illness status. As an illustration, there are two people who often eat together, with nearly same portions and menus, have similar lifestyles, but resulting in different outputs, which are obese and non-obese. They began to wonder why is this happened? There are also people with obesity who follow a diet program strictly, but not everyone who follows the diet program is successful reduce their weight. There are still many who experience failure, even with a combination of diet program and regular exercise, failure still occurs. It turns out that there are other factors for each individual that make the results of their efforts different, namely a person's genetics. Thus, a person's nutrition is closely related to genetic variations in that person. The perception that diet influences health has have been known and the relationship between nutrition and disease has been widely researched and there is a significant relationship, currently this relationship is being explored through modern epidemiological studies.

Nutrition and Nutritional Status

Nutrition is known has a important role in the occurrence of several diseases. Several studies focus on the possibility of developing individual-based nutrition based on individual genotypes to develop and improve the influence of diet on a person's health status.[1] Nutrition is a set of integrated processes that aim to ensure that cells, tissues, organs and the entire body obtain energy so that structure and function can continue normally. This condition can be achieved through food supply and the body's ability to convert substrates and cofactors necessary for metabolic processes.

Differences in eating patterns, metabolic activity, body composition and levels of energy and nutritional requirements are influenced by the physiological conditions of the body as well as different pathological conditions or diseases.[2]

When determining a healthy diet, it is important to take into account how the food will affect the body's growth and development, particularly the immune system. Nutritional status affects several physiological processes, including mucosal protection and integrity (in the respiratory and gastrointestinal systems), brain function, and immunological response. Additionally, immunological problems, chronic inflammation, frailty, sarcopenia, the aging process, and cognitive decline are all linked to poor nutrition. Resistance, susceptibility, and responsiveness to treatment may all be affected by a person's nutritional state. Body mass index is used to illustrate how obesity might affect a person's reaction to antiviral medication.[3]

It is well-known that proper nutrition, diet, and exercise may greatly benefit health and aid in the prevention and management of illness. A person's eventual resistance to illness is in large part determined by the kind of diet they have available to them throughout their formative years. Adult susceptibility to the development of chronic non-communicable illnesses is partially determined by dietary habits. Malnutrition and obesity, for instance, make people more susceptible to poor health by lowering their resistance to and ability to deal with stress caused by infectious, emotional, or social sources.[4] There are bioactive components in food including essential and non-essential nutrients which can actually regulate gene expression patterns in the individual. Changes in individual eating habits and lifestyles will make people more susceptible to diseases and disorders related to eating patterns. Rapid advances in molecular biology technology in the last few decades have been able to resolve the relationship between nutrition and disease at the individual level.[5]

Nutrition and Disease in Humans

Conditions of nutritional disorders and cause the development of disease in humans. Eating disorders, obesity, and persistent illness are all possible outcomes of nutritional excess or shortage. illnesses that take a long time to manifest and return to normalcy are called chronic illnesses. Many chronic illnesses take years to develop, and it's difficult to determine whether or not a certain meal is a contributing factor in the onset of a given chronic condition.[3] Low density lipoprotein (LDL) levels are raised higher by a diet heavy in cholesterol than by one high in saturated fatty acids. However, people react differently to cholesterol in their diet.[6] After cardiovascular disease, cancer is the leading cause of death among persons aged 45 and over in most nations. Almost 30–40% of cancer cases may be averted by adopting suitable and sufficient dietary treatments, according to data from major cancer organizations worldwide. Obesity is associated with an increased risk of various cancers, including those of the colon, prostate, uterus, pancreas, and breasts.[7] High amounts of body fat cause a rise in estrogen, insulin, and other associated hormones, which may explain this illness. High alcohol intake is also involved in the growth and development of various types of cancer, especially cancer of the mouth, throat, liver and esophagus (alcohol has a synergistic effect with cigarettes).[8] Knowledge about various diseases based on a person's nutritional status, such as celiac disease which is caused by wheat protein gluten allergy, kwashiorkor due to protein deficiency, anemia which is caused by iron deficiency, stunting due to zinc deficiency, and osteoporosis due to lack of calcium in the bones and several other diseases which It is also influenced by a person's nutritional status. Selecting nutritious dietary options is crucial in preventing and treating illness. Recent studies have shown that this health issue is caused by both environmental and genetic factors working together. Molecular genetic analysis, polymorphism, the

discovery of qualitative trait loci (QTL), and genetic markers are all examples of genomic methods that have been studied to better understand the role that numerous genes play in illness development.[9]

Nutrition and Genetics

The arrangement of genome base pairs between humans has very high similarities (97-99%), this identical thing results in the basic processes of food metabolism in each human body being largely the same. This condition explains how healthy food consumption patterns and regular exercise have a good impact on the general population. However, the differences in genomes between humans about 1 to 3% can cause differences in response to certain types of food. Recently, molecular nutrition has shown promising results in the study of functional nutrition and its effect on human health, also known as nutrigenomics and nutrigenetics. The study of the effects of diet on the genome (the complete genetic structure, including epigenetic changes), the proteome (the total number of all proteins), and the metabolome (the total number of metabolites) is a relatively new branch of genomics known as nutrigenomics.[4,10] The field of nutrigenetics examines how changes in genes affect dietary reactions in different people. SNPs, or variations in a single nucleotide, are more common than mutations in a whole gene to account for these kinds of variances across people. This helps to explain why the same diet may elicit such a wide range of reactions in different people.[4] Following are four explanations that go to the heart of what genomic nutrition is all about. To begin, one must accept that nutrition is a substantial risk factor for certain illnesses in specific people. If you have cardiovascular disease, for instance, you should probably cut down on meals high in saturated fat. Second, the human genome is susceptible to changes in diet that affect gene structure or expression. S-Adenosylmethionine is a universal methyl donor throughout the DNA methylation process, and various dietary precursors-including folate, methionine, folate, betaine, vitamins B2, B6, and B12 - are required for its production. Third, the difference in health and sickness between people may be explained by their unique genetic makeup. Research on the role of certain genotypes and haplotypes in illness susceptibility has yielded interesting results. Finally, genes whose regulation is affected by dietary variables may have a role in the development of certain long-term illnesses.[4] Research understanding the specific genetic foundation and function of genes behind the development of this illness is crucial for developing effective treatments.[11]

The development of omics science aims to explore how genes interact with nutritional exposure in a person's body. This explains how DNA and genetic makeup influence each individual's specific nutritional needs and maintain individual health. Determining the type of diet that is tailored to each individual is very useful. Such as meeting nutritional needs based on an individual's genetic makeup. It is important to know the relationship between genetics, nutrition and health, because it will make it easier to evaluate individual nutritional needs based on an individual's genetic profile or what can be called a personalized diet and help in the management and prevention of chronic disease. Research in the field of genes and nutrition in health needs to be increased to understand the relationship between nutrition and health in order to benefit from the genome revolution.[12]

Human Nutrition

Human nutrition is a new science, so it began to be studied less than 100 years ago. In one culture, namely Asian-pre-Christian Greek Culture, the idea developed that food could cause disease or even maintain health. The initial treatment in both cultures is various types of food. As early as the 4th century BC, Hippocrates looked into the idea that a healthy diet may serve as the first medicine. A human diet was formed during the period of naturalization (400 SM to 1750 AD) that was crucial in the fight

against and treatment of various ailments. Now that we live in an age of analytical chemistry, we know exactly what goes into our food. While this was happening, the biological age was expanding our understanding of metabolic pathways and the importance of both micronutrients and macronutrients to human health. By the middle of the 20th century, scientists had begun to piece together the connections between the causes of various illnesses and the foods they ate. Individual differences in gene expression, protein synthesis, and metabolic and cellular processes are all affected by a person's dietary habits. The nutrition sector has benefited from the Human Gene Project's success.[1]

Nutrigenetics and Nutrigenomics

With the rapid development of nutritional science in the world, a new science or term was born, namely nutrigenetics and nutrigenomics, supported by a gene project that produces a human nutritional-genetic map in an area. This development ultimately gave a new diet concept, namely individual-based nutrition or personal diet (personalized food or nutrition).[13,14] Personal diet is part of personal lifestyle medicine or often known as personalized lifestyle medicine.[15] Personalized diets use information specific to each individual, based on science, which supports changes in a person's diet[16] to ultimately produce a benefit to the individual's health.[17]

Nutrigenetics is how an individual's genetics gives a certain response when given certain nutrients which ultimately has an effect on the body, can be a healt effect or a disease effect. The health effect referred to that it can reduce the risk of a disease occurring and can even cure a disease, while the disease effect referred to is that it can become a risk factor for disease, for example obesity.[14,18] Several examples of the nutrigenetic concept are contained in the table below.

Table 1. Gene polymorphism and nutrients in individual-based nutrition[1]

Gen	Activities	Disease	Nutrition
FTO	Hunger Energy balance Muscle mass storage	Obesity	Mediterranean food
IL-6	Inflammation	Complex Chronic Disease, Cardio Vascular Disease, obesity	Mediterranean food, polyphenols, dried fruit
MCR4	Leptin pathway	Obesity	Mediterranean food
MTHFR	Homocysteine Metabolism	Cardio Vascular Disease, Chronic Degenerative Disease, obesity, sarcopenia	Folate, cobalamin, protein
TNFα	Inflammation	Complex Chronic Disease, Cardio Vascular Disease, obesity	Mediterranean food, polyphenols, dried fruit
GSTM1	Oxidative stress	Non-small cell breast cancer	Antioxidant compounds
MnSOD	Oxidative stress	Breast cancer	Antioxidant compounds
HMGCR	Fat and carbohydrate metabolism	Chronic Degenerative Disease	Mediterranean food
IL-1β	Fat and carbohydrate metabolism	Chronic Degenerative Disease	Ω 3 Long chains, PUFAs (polyunsaturated fatty acids)
NFkB	Inflammation, proliferation, angiogenesis	Chronic Degenerative Disease, cancer	Ω 3, Ω 6, PUFAs

Nutrigenomics is when certain nutrients are given to a person, then the substances or ingredients in these nutrients will interact in the body and have an effect on the individual's genetics which ultimately causes a response in the body, in the form of health or disease.[1,4,18,19] One example is a well-known diet program from America, namely Bodykey NUTRILITE, where the macronutrients contained in it will have an effect on patients with gene SNPs locus FABP2 (rs1799883), PPARG (rs1801282), ADRB2 (rs1042713), ADRB2 (rs1042714), ADRB3 (rs4994). In those who do not have polymorphisms at these loci, it is likely that they will not provide maximum or expected results for weight loss.[20] Likewise in the case of type 2 diabetes mellitus, where there are more than 100 genetic loci identified in connection with the disease, so the

recommended diet is also very complex.[21] Several examples of nutrigenomics to further strengthen the concept can be seen in the table below.

Table 2. Nutrient activities and their effects[1]

Nutrients	Activities	Effects
Folic acid (B9)	Methionine synthase cofactor Availability of the methyl group for DNA methylation	Homocysteine detoxification, Epigenetic regulation
Cobalamin (B12)	Inhibits DNTMS	Anti-cancer
Pyridoxine (B6)	Reduces serum triglyceride levels Anti-inflammatory	Normalizes blood pressure Stabilizes atherosclerotic plaque
Selenium	*Metal Transcription Factor 1*	Anti-cancer
Ω3 and 6	Expression on p21 Inhibits the pathway from G2 to M in the cell cycle	Anti-cancer
α-linoleic acid	Inhibits histone deacetylase Inhibits Sp1/Sp3 Activates p21waf1/cip1	Anti-cancer
Zinc Isothiocyanates	Reduces fatty acid biosynthesis and triglyceride production Fatty acid oxidation levels	Prevents CVD and CDDs Prevents skeletal muscle damage
	Antioxidant	Prevents CVD and CDDs Anti-cancer
Butyric acid	Inhibits the stimulation of inflammatory cytokines, cell adhesion molecules and iNOS-dependent	Prevents CVD and CDDs Anti-cancer
Mediterranean Diet (fiber, vitamins, antioxidants, polyphenols, Ω3-6, olive oil, fish oil, PUFAs, minerals)	Producing SCFA	Intestinal mucosal integrity

CONCLUSION

Thus, it can be concluded that a personal diet is individually-tailored. Just like someone who wants to have clothes made by a tailor, even though they are identical twins with the same weight, it is not certain that the measurements of every corner of their body will be the same, such as arm circumference, waist circumference and so on, there must be a difference. Thus, personal diet is not necessarily the same as other people's and it is more deeply influenced by a person's genetics.

Declaration by Authors

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