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Nutritional Genomics

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In nutrition, the diet is the sum of food consumed by a person or other organism. Dietary habits are the habitual decisions an individual or culture makes when choosing what foods to eat. Although humans are omnivores, each culture holds some food preferences and some food taboos. Individual dietary choices may be more or less healthy. Proper nutrition requires the proper ingestion and equally important, the absorption of vitamins, minerals and fuel in the form of carbohydrates, proteins and fats. Dietary habits and choices play a significant role in health and mortality. Throughout the 20th century, nutritional science focused on finding vitamins and minerals defining their use and preventing the deficiency diseases that they caused. In order to address the increasing incidence of these diet-related-diseases, the role of diet and nutrition has been and continues to be extensively studied.

Nutritional genomics is a science studying the relationship between human genome, nutrition and health. It can be divided into two disciplines:

Nutrigenomics:

Studies the effect of nutrients on health through altering genome, proteome, metabolome and the resulting changes in physiology.

Nutrigenetics:

Studies the effect of genetic variations on the interaction between diet and health with implications to susceptible subgroups.

97% of the genes known to be associated with human diseases result in *monogenic diseases, i.e.* a mutation in one gene is sufficient to cause the disease. Modifying the dietary intake can prevent some monogenic diseases. One example is phenylketouria a genetic disease characterized by a defective phenylalanine hydroxylase enzyme. In contrast, diseases currently in the world, e.g. obesity, cancer, diabetes and cardiovascular diseases, are *polygenic diseases, i.e.* they arise from the dysfunction in a cascade of genes and not from a single mutated gene. Dietary intervention to prevent the onset of such diseases is a complex and ambitious goal.

To prevent the development of disease, nutrition research is investigating how nutrition can optimize and maintain cellular, tissue, organ and whole body homeostasis. This requires understanding how nutrients act at the molecular level. The dietary constituents participate in the regulation of gene expression by modulating the activity of transcription factors or through the secretion of hormones that in turn interfere with a transcription factor. As a result, nutrition research has shifted from epidemiology and physiology to molecular biology and genetics and nutrigenomics was born.

Inter-individual differences in genetics or genetic variability, which have an effect on metabolism and on phenotypes were recognized early in nutrition research and such phenotypes were described. With the progress in genetics, biochemical disorders with a high nutritional relevance were linked to a genetic origin. Genetic disorders which cause pathological effects were described.

Nutrigenomics:

Nutrigenomics is the study of molecular relationships between nutrition and the response of genes, with the aim of extrapolating how such subtle changes can affect human health. Nutrigenomics focuses on the effect of nutrients on the genome, proteome and metabolome. By determining the mechanism of the effects of nutrients or the effects of a nutritional regime, Nutrigenomics tries to define the relationship between these specific nutrients and specific nutrient regimes (diets) on human health. Nutrigenomics has been associated with the idea of personalized nutrition based on genotype. While there is hope that nutrigenomics will ultimately enable such personalized dietary advice, it is a science still