



The Nutrition Academy

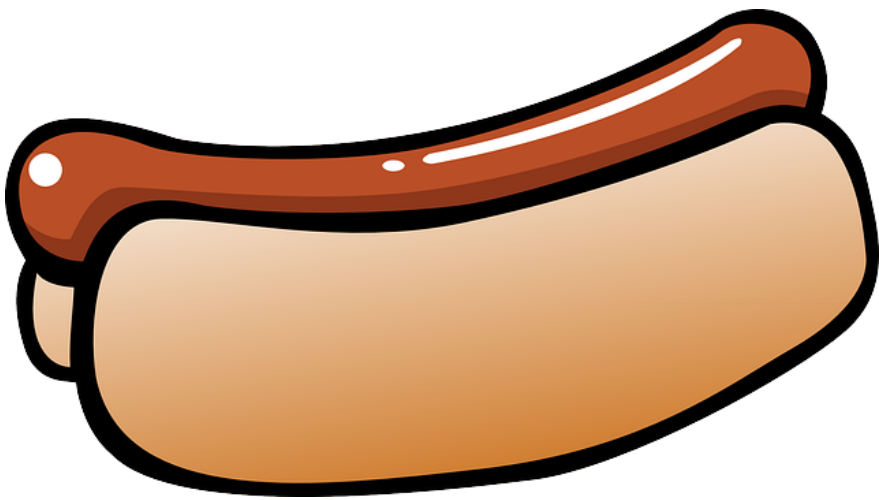
Fundamentals of Functional Nutrition Course

HISTORY OF NUTRITION TRENDS



Nutrition today

Lesson 4



Nutrition today

Nutrition in the 21st century

The twenty-first century has been described as the “triple crisis of malnutrition”, specifically over nutrition and obesity ^{3,4}, undernutrition and nutritional deficiencies ^{5,6}, and unsustainable food transformations which are closely connected to poor land management practices, economic growth, and urbanisation ^{7,8}.

In modern industrialised nations, we live in what has been described as a toxic food environment where calorie-dense foods are the norm ⁹. We have become familiar with packaging and brands but know little about the raw materials, the plants, or the processes that create the food product in the package.

We rely on fast food and convenience stores, and as a culture, we have almost severed our connection with nature and lost our understanding of what food is, where it comes from, and what its real purpose is ¹⁰. We buy and consume foods that have no recognisable connection to anything that would have historically been called food.

Our ancestors would certainly not identify products such as Hotdogs, Pop-Tarts, or soft drinks as food. Furthermore, they would never have imagined a world where food was stored in plastic or cardboard containers and meat came from animals that have been pumped full of hormones, antibiotics, and dangerous chemicals ¹¹. Joel Salatin

in his book ‘Folks, this ain’t normal’ ¹², argues that we are far removed from the simple, sustainable joy that comes from living close to the land and the people we love. He explains that “Chicken nuggets in the shape of Dino the dinosaur are not part of a chicken’s anatomy. You won’t find any muscle groups titled, Nuggets.”

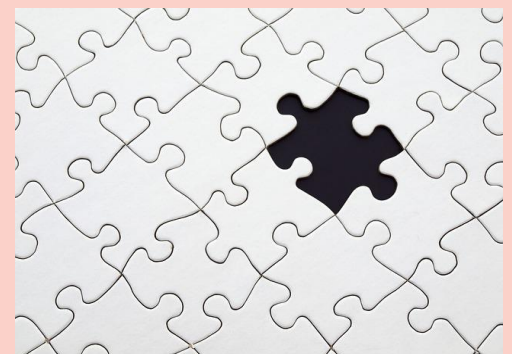
Over the past few hundred years, humanity’s footprint has accelerated to such an extent that we are now fundamentally changing the planet ¹³. Global population growth and the demand for increased food consumption will be an immense challenge for the global food system ¹⁴. A crucial question is how to meet this staggering demand for food and provide healthy diets that contribute to the health of global citizens, while not undermining our global resources and impacting humanity ^{14,15}.

Today the global nutrition situation is one of differences and inequalities. Presently, one billion people are hungry and two billion people do not have access to sufficient food ¹⁶. Meanwhile, two billion people are overweight and obese and have too much to eat ¹⁷.

Nutrition today

Challenges for the 21st century

This LESSON 4 of **Module 1** will focus on nutritional challenges associated with ameliorating many of the western lifestyle diseases of the 21st century. However, it is important to recognise that achieving health, wellbeing, and longevity through nutrition is not always possible for many nations. There are major scientific and political concerns with global food insecurity, undernutrition, and hunger, and whilst part of the world’s population starves, the other part suffers from obesity and associated complications (disease) ¹. The World Health Organization has identified the following nutritional challenges for malnutrition in the 21st century ².



Malnutrition includes the terms undernutrition (wasting, stunting, underweight), inadequate vitamins or minerals, overweight, obesity, and disease that is diet-related (non-communicable disease).

1. In 2020, approximately 149 million children under 5 years of age were stunted, and 45.4 million were wasted.
2. Undernutrition contributes to approximately 45% of deaths among children under 5 years of age. These mostly occur in low- and middle-income countries. At the same time, in these same countries, rates of childhood overweight and obesity are rising.
3. Nearly 2 billion adults are overweight or obese, while 462 million are underweight.
4. Thirty-nine million children under the age of 5 were overweight or obese in 2020.



Orange juice fortified with calcium

Functional foods

Nutraceuticals

It is predicted that **functional foods**, will become more common in the coming years. It is thought that functional foods will benefit human health beyond the effects of nutrients alone; however, few are convincing in human health claims partly because human responses to these foods are variable.

Though several definitions have been given for functional foods the general opinion is that they are any healthy foods similar in appearance to conventional foods, consumed as part of a usual diet, and claimed to have physiological benefits like disease-preventing properties beyond the basic function of supplying nutrients ¹⁸.

Recently, the European Union (EU) has defined functional foods as

“foods that have been satisfactorily demonstrated “to affect beneficially one or more target functions of the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and wellbeing or reduction of the risk to diseases” ¹⁹. **Table 1** shows some of the other different terms associated with functional foods.

The main issue associated with functional foods (nutraceuticals) that have been fortified is the lack of substantial clinical data showing their efficacy, and therefore this prevents the labelling of these products from claiming any health benefits ²⁰. However, a growing market demand exists for these functional foods although legislation on their safety is lacking ²⁰.

Functional foods

Also called nutraceuticals

Functional foods: are novel foods and substances related to the concept of optimal nutrition. This term was first introduced in Japan in the 1980's and refers to processed foods containing ingredients that aid specific bodily functions in addition to being nutritious.

Some common examples of functional foods include bakery products made with flaxseed oil, and eggs containing marine omega-3 fatty acids.



Raspberries are rich in antioxidants and therefore are



Functional Foods

Bread can be fortified with calcium therefore are Functional Foods

Table 1: Different terms associated with functional foods.

Term	Function
Bioactive compounds	Naturally occurring compounds present in, or derived from a plant, animal, or marine source, exert the desirable health benefit.
Dietary supplements	Supplement to the diet in which the active component is added to the food or it can be consumed in pill, powder, or liquid form but they do not replace the complete meal.
Functional ingredients	Fractions or extracts containing bioactive compounds.
Medical foods	Formulated foods to be consumed or administered externally under the supervision of a physician, and are intended for the specific dietary management of a disease or condition
Natural health products	Homeopathic preparations, traditional medicines, minerals or trace elements, vitamins, amino acids, essential fatty acids, or other botanical, animal, or microorganism-derived substances.
Nutraceutical	Any substance, food (or part of), that provides medical or health benefits.

Nutricosmetics: There is now a growing interest in products and ingredients that act as nutritional supplements for skin and nail care, and natural hair beauty. Nutricosmetics are the latest trend in the beauty industry and have gained millions of followers because it fits well with modern culture ²¹.



Personalised nutrition

Genome mapping

The complete mapping of the human genome sequence in 2000 raised the possibility of individualised medicine, including personalised nutrition ^{22,23}. Since then, an entirely new field has emerged: **nutrigenomics**, the integration of genomic science with nutrition ²⁴.

Nutrigenomics initially referred to the study of the effects of nutrients on the activation of an individual's genes. More recently, this definition encompasses nutritional factors that protect the genome from damage. Ultimately, nutrigenomics is the study of dietary components on the genome, the **proteome**, and the **metabolome**.

This field emerged in response to efforts to explain the human disease and the complexities that govern human health. Because the presence of a specific gene or a mutation in a gene mainly predicts a particular predisposition to a certain disease; whether that genetic potential will eventually manifest as a disease depends on complex interactions between the genome, environment, and behaviour ²⁵.

It is suggested that dietary components impact every step from gene to protein or metabolic product(s) ²⁶. Thus, nutrients can either alter the **expression** or the

The function of a gene or a specific mutation in the gene can alter the response of that gene to a nutrient. The daily ingestion, absorption, transport, assimilation, utilisation, and excretion of nutrients involve many proteins and enzymes, receptors, transporters, ion channels, and hormones. Variations in the genes that **encode** these proteins can alter both the amount of the protein produced and its efficacy leading to dysregulation of metabolism and nutritional status.

This complex field is further complicated by the growing recognition that nutrition, in addition to affecting gene regulation, can also influence **epigenetic** processes and thereby induce persistent changes in the way genes are regulated. A significant challenge for nutrigenomics will be developing a nutritional strategy considering the genetic diversity of human populations, the complexity of foods, culture, lifestyle, behavioural factors, and metabolic processes that lead to health or disease. **Note:** nutrigenomics, epigenetics, and the metabolome will be discussed in more detail in Module 12 of the Applied Functional Nutrition Course.



Mapping of the human genome: fitting the puzzle together

Proteome

The total of all proteins

Metabolome

The total of all metabolites

Expression

How much of a specific gene is made

Encode

Genes that contain the information to make a protein.

Epigenetics

DNA is the blueprint that contains all genes. When DNA is activated it makes a specific gene (**expression**) and this is called message RNA (mRNA). It contains the message to **encode** proteins. All of the proteins in the body are the **proteome**.

DNA can be modified by the environment and/or behaviour (**epigenetics**). This can cause some genes to be switched off or on.

Summary

The growing recognition that appropriate dietary behaviours and regular physical activity contributes to longer, healthier lives remain a challenge. In many developed societies, there is an emergence of diet-related disease, while in less developed nations many citizens suffer from extreme undernourishment. In this context, personalised medicine has emerged in response to efforts to explain the human disease and the complexities that govern human health. One such field is nutrigenomics, a branch of genetics that aims to understand the impact of nutrients on the human genome and their role in health and disease. Accordingly, one of the greatest challenges in nutrition will be in establishing these basic relationships and applying them to improving the health of all individuals, of all ages, with the most obvious goal of actively preventing disease.

References

- 1 García-García, F. J., Monistrol-Mula, A., Cardellach, F. & Garrabou, G. Nutrition, Bioenergetics, and Metabolic Syndrome. *Nutrients* **12**, 2785 (2020). <https://doi.org:10.3390/nu12092785>
- 2 World Health Organisation. <https://www.who.int/news-room/fact-sheets/detail/malnutrition> Accessed 25 Jan 2022.
- 3 Caballero, B. Humans against Obesity: Who Will Win? *Adv Nutr* **10**, S4-S9 (2019). <https://doi.org:10.1093/advances/nmy055>
- 4 Lin, X. & Li, H. Obesity: Epidemiology, Pathophysiology, and Therapeutics. *Front Endocrinol (Lausanne)* **12**, 706978-706978 (2021). <https://doi.org:10.3389/fendo.2021.706978>
- 5 Bhutta, Z. A. *et al.* Severe childhood malnutrition. *Nat Rev Dis Primers* **3**, 17067-17067 (2017). <https://doi.org:10.1038/nrdp.2017.67>
- 6 Wells, J. C. *et al.* The double burden of malnutrition: aetiological pathways and consequences for health. *Lancet* **395**, 75-88 (2020). [https://doi.org:10.1016/s0140-6736\(19\)32472-9](https://doi.org:10.1016/s0140-6736(19)32472-9)
- 7 Sena, A. & Ebi, K. When Land Is Under Pressure Health Is Under Stress. *Int J Environ Res Public Health* **18**, 136 (2020). <https://doi.org:10.3390/ijerph18010136>
- 8 Hansen, A. Negotiating Unsustainable Food Transformations: Development, Middle Classes and Everyday Food Practices in Vietnam. *Eur J Dev Res*, 1-19 (2021). <https://doi.org:10.1057/s41287-021-00429-6>
- 9 Waynforth, D. Evolution, obesity, and why children so often choose the unhealthy eating option. *Medical Hypotheses* **74**, 934-936 (2010). <https://doi.org:http://dx.doi.org/10.1016/j.mehy.2009.11.018>
- 10 Rop, C. Biodiversity and the future of food. *Science Scope* **6**, 11 (2011).
- 11 Gedgaudas, N. T. *Primal body, primal mind: beyond the Paleo diet for total health and a longer life.* (Healing Arts Press, Vermont, ISBN:978-1-5947-413-3, 2009).
- 12 Salatin, J. *Folks, this ain't normal: a farmer's advice for happier hens, healthier people, and a better world.* (Hachette Book Group, New York. ISBN: 978-0-89296-820-6, 2011).
- 13 Myers, S. S. & Patz, J. A. Emerging Threats to Human Health from Global Environmental Change. *Annual Review of Environment and Resources* **34**, 223-252 (2009). <https://doi.org:10.1146/annurev.environ.033108.102650>
- 14 Lindgren, E. *et al.* Sustainable food systems-a health perspective. *Sustain Sci* **13**, 1505-1517 (2018). <https://doi.org:10.1007/s11625-018-0586-x>
- 15 Lutz, M. Healthy sustainable food patterns and systems: a planetary urgency. *Medwave* **21**, e8436 (2021). <https://doi.org:10.5867/medwave.2021.07.8436>
- 16 Hanieh, S., High, H. & Boulton, J. Nutrition Justice: Uncovering Invisible Pathways to Malnutrition. *Front Endocrinol (Lausanne)* **11**, 150-150 (2020). <https://doi.org:10.3389/fendo.2020.00150>
- 17 Perez-Escamilla, R. *et al.* Nutrition disparities and the global burden of malnutrition. *BMJ (Clinical research ed.)* **361**, k2252-k2252 (2018). <https://doi.org:10.1136/bmj.k2252>
- 18 Topolska, K., Florkiewicz, A. & Filipiak-Florkiewicz, A. Functional Food-Consumer Motivations and Expectations. *Int J Environ Res Public Health* **18** (2021). <https://doi.org:10.3390/ijerph18105327>
- 19 Jędrusek-Golińska, A. *et al.* Recent progress in the use of functional foods for older adults: A narrative review. *Comprehensive Reviews in Food Science and Food Safety* **19**, 835-856 (2020). <https://doi.org:https://doi.org/10.1111/1541-4337.12530>
- 20 Santini, A. & Novellino, E. Nutraceuticals - shedding light on the grey area between pharmaceuticals and food. *Expert Review of Clinical Pharmacology* **11**, 545-547 (2018). <https://doi.org:10.1080/17512433.2018.1464911>
- 21 Dini, I. & Laneri, S. Nutricosmetics: A brief overview. *Phytother Res* **33**, 3054-3063 (2019). <https://doi.org:10.1002/ptr.6494>
- 22 Zahn, L. M. The human genome. *Science* **373**, 1458-1459 (2021). <https://doi.org:10.1126/science.abm1359>
- 23 Kaput, J. Nutrigenomics research for personalized nutrition and medicine. *Current Opinion in Biotechnology* **19**, 110-120 (2008). <https://doi.org:http://dx.doi.org/10.1016/j.copbio.2008.02.005>
- 24 Loos, R. J. F. From nutrigenomics to personalizing diets: are we ready for precision medicine? *The American journal of clinical nutrition* **109**, 1-2 (2019). <https://doi.org:10.1093/ajcn/nqy364>
- 25 Mead, M. N. Nutrigenomics: The Genome-Food Interface. *Environmental Health Perspectives* **115**, A582-589 (2007).
- 26 Siddique, R. A., Tandon, M., Ambwani, T., Rai, S. N. & Atreja, S. K. Nutrigenomics: Nutrient-Gene Interactions. *Food Reviews International* **25**, 326-345 (2009). <https://doi.org:10.1080/87559120903155883>