

Optimising nutrition: a cornerstone of health and longevity

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This article focuses on the critical importance of optimising nutrition for overall health and longevity. It explores the biological mechanisms of health, ageing, and disease, highlighting how nutrition can positively influence these processes. Current dietary recommendations are reviewed, focusing on personalised nutrition approaches to address individual needs. The article further discusses strategies for optimising nutrition, including weight reduction and specialised diets for specific populations like older adults and critically ill patients. By understanding the underlying mechanisms and implementing evidence-based practices, individuals can harness the power of nutrition to improve their health and well-being.

Keywords: nutrition, health, ageing, disease, diet, weight loss, older adults, critical illness

The biological mechanisms of health, ageing and disease

Depletion of health and development of disease does not just happen overnight, although there are exceptions like when there is trauma or acute infections.¹ There is also a very thin line between health and disease. That is because the onset of chronic disease can be the result of impaired, and ultimately the loss of adaptive processes and flexibility of mechanisms of our biological system, or in other words, our health.²

• **Growth and development**

Growth and development start from conception and can include genetic factors, hormonal factors, nutritional factors, environmental factors, neurological factors and physiological factors. It's important to note that these factors often interact and influence each other. For example, genetic predispositions can interact with environmental factors to increase the risk of certain diseases.³ A balanced diet, regular exercise, and adequate sleep are essential for optimal growth and development.⁴

• **Containment of perturbation**

This refers to the body's ability to maintain homeostasis, or internal balance, in the face of external stressors from the environment or internal disturbances. This ability is essential for health, as it allows the body to adapt to changes and prevent disease.⁵ Some mechanisms that contribute to containment of perturbation include the immune system, stress response system, homeostasis mechanism, cellular repair and regeneration, antioxidant system.⁵

Disruption of these mechanisms can lead to disease and illness. For example, a weakened immune system may make an individual more susceptible to infections. Dysregulation of the stress response can contribute to mental health disorders and chronic diseases. Impaired cellular repair and regeneration can accelerate ageing and increase the risk of cancer.⁶

• **Recycling and turnover**

To ensure health and vitality we need the biological processes of recycling and turnover. These processes involve the breakdown and rebuilding of tissues, the recycling of cellular components, and the elimination of waste products.⁷ They include cellular recycling, protein turnover, tissue repair and regeneration, nutrient recycling and waste elimination.

Disruptions in these processes can lead to various health problems. For example, impaired autophagy has been linked to neurodegenerative diseases, while defective protein turnover can contribute to cancer and other disorders.^{7,8} Understanding the biological factors that influence recycling and turnover, we can develop strategies to promote health and prevent disease. This may involve dietary interventions, exercise programmes, and the development of new therapies targeting specific cellular processes.⁹

• **Barrier function**

This is a crucial aspect of health, as it protects the body from external threats such as pathogens, toxins, and allergens. The body has multiple barrier systems, including the skin, mucosal surfaces, and the blood-brain barrier.⁸

With a clear comprehension of the biological factors that contribute to barrier function, we can develop strategies to protect the body from external threats and maintain overall health.^{10,11}

• **Socialisation**

Socialisation, the process of learning and internalising societal norms and values, is deeply intertwined with our biology. While it's a complex interplay of nature and nurture, biological factors play a crucial role in shaping our social behaviours and, consequently, our overall health.^{8,9} A supportive social environment can mitigate the negative effects of genetic predispositions and promote positive mental and physical health.⁹

Understanding the biological basis of socialisation can help us appreciate the importance of social connection for our well-being. By fostering positive social relationships and addressing potential biological factors that may hinder social interaction, we can improve our overall health and quality of life.⁹

- **Food intake**

Food intake is a complex biological process influenced by a variety of factors, including physiological, psychological, and environmental cues.¹² Here are some key biological factors that influence food intake: hormone regulation, neural mechanism, gut microbiome, genetic factors, environmental factors and psychological factors.

Disruptions in these biological factors can lead to eating disorders, obesity, and other health problems. For example, imbalances in hormones like leptin and ghrelin can contribute to overeating and weight gain. Additionally, genetic factors can predispose individuals to certain eating behaviours and metabolic disorders.¹³

A balanced diet, regular physical activity, and mindful eating habits can help to optimise our health and well-being.

- **Repair and regeneration**

Repair and regeneration are essential processes that allow the body to heal and maintain its tissues. These processes involve a complex interplay of biological factors, including cellular signalling, gene expression, and immune responses.⁸

- **Integration on circuitries**

Integration of circuitries refers to the complex interactions between different neural networks in the brain. These networks are responsible for various cognitive functions, such as learning, memory, emotion, and decision-making. The efficient integration of these networks is crucial for optimal brain function and overall health.¹ Through gaining insight into the biological factors that influence the integration of circuitries, we can develop strategies to promote brain health and prevent cognitive decline.^{14,15}

- **Rhythmic oscillations**

Rhythmic oscillations, or biological rhythms, are cyclical patterns in physiological processes that occur over various time scales. These rhythms are essential for maintaining health and well-being.

Here are some key biological factors related to rhythmic oscillations: circadian rhythms, ultradian rhythms and infradian rhythms.^{16,17} Disruptions in rhythmic oscillations, often referred to as circadian rhythm disorders, can lead to various health problems, including:¹⁷

- Sleep disorders
- Metabolic disorders
- Mental health disorders
- Increased risk of chronic diseases

By exploring the biological factors that influence rhythmic oscillations, we can make lifestyle choices that promote optimal health and well-being.

- **Hermetic regulation and detoxification**

Hermetic regulation and detoxification are essential processes that maintain cellular and systemic health. These processes involve the body's ability to eliminate toxins, repair damaged cells, and maintain homeostasis.^{18,19}

- **Homeostatic regulation**

Homeostatic regulation is the body's ability to maintain a stable internal environment, despite external fluctuations.²⁰ This delicate balance is essential for optimal health and survival. Several biological factors contribute to this regulation.^{20,5}

- **Immune functions**

The immune system is a complex network of cells, tissues, and organs that work together to protect the body from infection and disease.^{21,22}

By understanding these biological systems one can implement dietary and lifestyle changes to contribute to optimal health.

Looking at the aging process, it is characterised by a decline in various biological functions, leading to increased susceptibility to chronic diseases. Several mechanisms have been identified, including:^{8,23}

- **Genomic instability:** DNA damage accumulates over time, contributing to cellular dysfunction and disease.
- **Telomere shortening:** Telomeres, protective caps on chromosomes, shorten with each cell division, limiting cellular lifespan.
- **Epigenetic alterations:** Changes in gene expression, influenced by environmental factors, can impact ageing and disease risk.
- **Loss of proteostasis:** The body's ability to maintain protein quality and function declines, leading to protein aggregation and cellular stress.²⁴
- **Deregulated nutrient sensing:** Disruptions in signalling pathways that regulate nutrient intake and metabolism contribute to metabolic disorders.
- **Mitochondrial dysfunction:** Impaired mitochondrial function reduces energy production and increases oxidative stress.
- **Cellular senescence:** Senescent cells, which no longer divide, accumulate and release inflammatory factors, contributing to ageing and age-related diseases.
- **Stem cell exhaustion:** Stem cells, responsible for tissue repair and regeneration, become less efficient with age.

Current nutritional recommendations

Current dietary guidelines emphasise the importance of consuming a variety of nutrient-dense foods in moderation, including fruits, vegetables, whole grains, lean proteins, and healthy fats.^{4,2}

Diet

A balanced diet that includes whole foods, lean proteins, healthy fats, and fibre can help you maintain a healthy weight, reduce the risk of chronic diseases, and support your overall well-being.^{25,26,11,27}

- Fruits, vegetables, whole grains, legumes, nuts, and seeds: These foods provide a variety of vitamins, minerals phytonutrients and antioxidants that support bodily functions.
- Lean proteins: Poultry, fish, beans, and tofu are all good sources of lean protein.
- Healthy fats: Avocados, nuts, and olive oil are all good sources of healthy fats.

- **Fiber**

Whole grains, legumes, fruits, and vegetables are all good sources of fibre, which helps with digestion, help managing certain chronic diseases and weight maintenance.

- **Hydration**

Staying hydrated is important for every bodily function, so you should aim to drink at least eight cups (two litres) of water daily. This amount can change depending on the weather outside, activity level, gender, age and chronic disease.

- **Exercise**

In addition to a healthy diet, exercise is also important for life expectancy. The World Health Organization's recommendation is between 150–240 minutes of moderate intense activity per week. Moderate intense exercise refers to your heart rate becoming elevated during your activity session.^{28,4,7}

- **Lifestyle**

The way we eat, what we eat and healthy behaviours are important for disease prevention and longevity. Lifestyle recommendations include achieving and maintaining a healthy body weight, including a healthy lipid profile, normal blood pressure, physical activity, and not smoking, to name a view.²⁹

- **Mindful eating**

Practices like intermittent fasting and the Valter Longo diet can help boost health and lifespan.

Limiting the intake of unhealthy processed foods, sugary drinks, and unhealthy fats is also recommended. However, these general recommendations may not be sufficient for everyone, as individual needs vary based on factors such as age, sex, activity level, and underlying health conditions. Personalised nutrition is the next step in optimising nutrition and has had improved outcomes as it is more realistic and achievable for the individual.

Nutrition can be greatly improved with diet optimisation

Diet optimisation involves tailoring dietary intake to individual needs and goals. Including, age, gender, chronic disease profile, dietary preferences and cultural differences. This can be achieved through implementing some of the following strategies

(these strategies need to be discussed with your healthcare provider):^{30,26,28,31}

- **Personalised nutrition**

Using genetic testing, metabolic profiling, and other tools to identify specific nutritional requirements and tailor dietary recommendations accordingly.

- **Time-restricted eating**

Limiting the eating window to a specific period each day, which can improve metabolic health and reduce inflammation. This does not mean skipping breakfast; however, the strategy needs to be individualised for each person.

- **Ketogenic diet**

A high-fat, low-carbohydrate diet that can be beneficial for weight loss, metabolic health, and neurological disorders.³²

- **Mediterranean diet**

A plant-based diet rich in fruits, vegetables, whole grains, legumes, nuts, and olive oil, associated with reduced risk of heart disease, stroke, and certain types of cancer.³³

- **DASH diet**

A dietary approach to stop hypertension, emphasising fruits, vegetables, whole grains, and low-fat dairy products, and limiting sodium intake.³⁴

- **Managing fat intake**

Research recommends specific diet and lifestyle thresholds such as limiting saturated fat intake to < 7% of energy, cholesterol intake < 300 mg, and total fat intake between 25% and 35% of energy.²⁹

Strategies for optimising nutrition and weight reduction

Healthy weight loss and maintenance thereof can be challenging and if you look at the studies done on the success rate of weight loss, the percentages are low.

National Weight Control Registry members have lost an average of 33 kg and maintained the loss for more than five years. To maintain their weight loss, members report engaging in high levels of physical activity (\approx 1 h/d), eating a low-calorie, low-fat diet, eating breakfast regularly, self-monitoring weight, and maintaining a consistent eating pattern across weekdays and weekends.^{2,28,35}

There is a general perception that almost no one succeeds in long-term maintenance of weight loss. However, research has shown that approximately 20% of overweight individuals are successful at long-term weight loss when defined as losing at least 10% of initial body weight and maintaining the loss for at least one year.^{3,28,35}

These strategies include:

- **Mindful eating:** Paying attention to hunger and fullness cues, eating slowly, and savouring each bite.

- **Portion control:** Using smaller plates and measuring food portions to avoid overeating.
- **Regular meals and snacks:** Eating regular meals and snacks throughout the day to maintain blood sugar levels and prevent overeating. Include lean protein and high-fibre options in the meals and snacks.
- **Healthy food choices:** Prioritising whole, unprocessed foods and limiting processed snacks and sugary drinks.
- **Physical activity:** Engaging in regular physical activity to boost metabolism and burn calories.
- **Sleep:** Getting adequate sleep to regulate hormones that control hunger and satiety.
- **Stress management:** Practising stress-reduction techniques like meditation, yoga, or deep breathing to avoid emotional eating.

Optimising nutrition therapy to enhance mobility in critically ill patients

Malnutrition is common in critically ill patients and can impair recovery and functional outcomes. Optimising nutrition therapy is essential to support tissue repair, wound healing, and immune function. Strategies include:^{16,23,30}

- **Early nutritional assessment and intervention:** Identifying patients at risk of malnutrition and initiating early nutritional support.
- **Enteral nutrition:** Providing nutrients directly into the gastrointestinal tract via a tube, whenever possible.
- **Parenteral nutrition:** Providing nutrients intravenously for patients who cannot tolerate enteral feeding.
- **Individualised nutrition plans:** Tailoring nutrient intake to meet the specific needs of each patient.
- **Monitoring and adjustment:** Closely monitoring nutritional status and adjusting the feeding plan as needed.

Optimising nutrition in older people

Older adults have unique nutritional needs due to age-related changes in metabolism, appetite, and taste. Strategies for optimising nutrition in older people include:^{16,23,32,36}

- **Early identification of complications:** This requires encouraging regular screening/follow-up sessions at least annually or bi-annually with practitioners for early detection.
- **Addressing nutrient deficiencies:** Identifying and correcting deficiencies in vitamins, minerals, and protein.
- **Encouraging adequate fluid intake:** Preventing dehydration, which can lead to cognitive impairment and other health problems.
- **Promoting social dining:** Eating meals with others can enhance enjoyment and improve appetite.
- **Modifying dietary texture and consistency:** Adjusting food texture and consistency to accommodate changes in chewing and swallowing ability.
- **Addressing food insecurity:** Identifying and addressing barriers to accessing healthy foods.

Conclusion

Optimising nutrition is a cornerstone of health and longevity. Through gaining insight into the biological hallmarks of aging and disease, implementing current dietary recommendations, and adopting personalised strategies, individuals can harness the power of nutrition to improve their health and well-being. It is essential to consult with healthcare professionals to develop personalised nutrition plans and address any underlying health conditions. By prioritising nutrition, we can enhance our quality of life and live longer, healthier lives.

References

1. Fraser HC, Kuan V, Johnen R, et al. Biological mechanisms of aging predict age-related disease co-occurrence in patients. *Aging Cell*. 2022;21(4). <https://doi.org/10.1111/accel.13524>.
2. Witkamp RF. Nutrition to optimise human health-how to obtain physiological substantiation? *MDPI AG Nutrients*. 2021;13. <https://doi.org/10.3390/nu13072155>.
3. Le Révérend BJD, Edelson LR, Loret C. Anatomical, functional, physiological and behavioural aspects of the development of mastication in early childhood. *British Journal of Nutrition*. 2014;111:403-14. <https://doi.org/10.1017/S0007114513002699>.
4. Yadav M. Diet, sleep and exercise: the keystones of healthy lifestyle for medical students. *J Nepal Med Assoc*. 2022;60(253):841-3. <https://doi.org/10.31729/jnma.7355>.
5. Puckett SLY. Physiology, Homeostasis. *Natl Libr Med Natl Cent Biotechnol Inf* [Internet]. 2023; Available from: <https://www.ncbi.nlm.nih.gov/books/NBK559138>.
6. Yegorov YE, Poznyak AV, Nikiforov NG, Sobenin IA, Orekhov AN. The link between chronic stress and accelerated aging. *MDPI AG Biomedicines*. 2020;8. <https://doi.org/10.3390/biomedicines8070198>.
7. Qiu Y, Fernández-García B, Lehmann HI, et al. Exercise sustains the hallmarks of health. *Journal of Sport and Health Science*. 2023;12:8-35. <https://doi.org/10.1016/j.jshs.2022.10.003>.
8. Nieto-Torres JL, Hansen M. Macroautophagy and aging: The impact of cellular recycling on health and longevity. *Mol Aspects Med*. 2021;82. <https://doi.org/10.1016/j.mam.2021.101020>.
9. Vigilant LG, Williamson J. The sociology of socialization. *21st Century Sociology*. 2012;1-143-1-152. <https://doi.org/10.4135/9781412939645.n13>.
10. Dao JYKH. Physiology, integument. *Natl Libr Med Natl Cent Biotechnol Inf* [Internet]. 2023; Available from: <https://www.ncbi.nlm.nih.gov/books/NBK554386/>.
11. Appleton KM, Hemingway A, Saulais L, et al. Increasing vegetable intakes: rationale and systematic review of published interventions. *European Journal of Nutrition*. 2016;55:869-96. <https://doi.org/10.1007/s00394-015-1130-8>.
12. Hopkins M, Beaulieu K, Gibbons C, et al. The control of food intake in humans. *Natl Libr Med Natl Cent Biotechnol Inf* [Internet]. 2022; Available from: <https://www.ncbi.nlm.nih.gov/books/NBK278931/>.
13. Klok MD, Jakobsdottir S, Drent ML. The role of leptin and ghrelin in the regulation of food intake and body weight in humans: a review. *Natl Libr Med Natl Cent Biotechnol Inf*. 2007;8(1):21-34. <https://doi.org/10.1111/j.1467-789X.2006.00270.x>.
14. Van De Sande MMH, Van Buul VJ, Brouns FJPH. Autism and nutrition: The role of the gut-brain axis. *Nutrition Research Reviews*. 2014;27:199-214. <https://doi.org/10.1017/S0954422414000110>.
15. Sporns O. Structure and function of complex brain networks. *Dialogues Clin Neurosci*. 2013;15(3):247-62. <https://doi.org/10.31887/DCNS.2013.15.3/osporns>.
16. Aburto NJ, Ziolkovska A, Hooper L, et al. Effect of lower sodium intake on health: Systematic review and meta-analyses. *Br Med J*. 2013;346. <https://doi.org/10.1136/bmj.f1326>.
17. Reddy S, Reddy V, Sharma S. Physiology, circadian rhythm. *Natl Libr Med Natl Cent Biotechnol Inf* [Internet]. 2023; Available from: <https://www.ncbi.nlm.nih.gov/books/NBK519507/>.
18. Forcina L, Franceschi C, Musarò A. The hormetic and hermetic role of IL-6. *Ageing Res Rev*. 2022;80. <https://doi.org/10.1016/j.arr.2022.101697>.

19. Panda C, Komarnytsky S, Fleming MN, et al. Guided metabolic detoxification program supports Phase II detoxification enzymes and antioxidant balance in healthy participants. *Nutrients*. 2023;15(9). <https://doi.org/10.3390/nu15092209>.
20. Billman GE. Homeostasis: The underappreciated and far too often ignored central organizing principle of physiology. *Front Physiol*. 2020;11:1-12. <https://doi.org/10.3389/fphys.2020.00200>.
21. Vasudevan J, Divincenzo C, Feagins LA. Optimizing nutrition to enhance the treatment of patients with inflammatory bowel disease. *Gastroenterology & Hepatology*. 2022;18.
22. Ruemmele FM, Pigneur B, Garnier-Lengliné H. Enteral nutrition as treatment option for Crohn's disease: In kids only? In: *Nestle Nutrition Institute Workshop Series*. S. Karger AG; 2014. p. 115-23. <https://doi.org/10.1159/000360716>.
23. Fontana L, Hu FB. Optimal body weight for health and longevity: Bridging basic, clinical, and population research. *Aging Cell*. 2014;13:391-400. <https://doi.org/10.1111/accel.12207>.
24. Wen JH, He XH, Feng Z Sen, et al. Cellular protein aggregates: formation, biological effects, and ways of elimination. *Int J Mol Sci*. 2023;24(10). <https://doi.org/10.3390/ijms24108593>.
25. Oldewage-Theron W, Egal A. The effect of a combination of nutrition education, soy and vegetable gardening, and food preparation skill training interventions on dietary intake and diversity in women: a case study from Qwa-Qwa. *South African Journal of Clinical Nutrition*. 2015;28(3):113-120.
26. Despain D, Hoffman BL. Optimizing nutrition, diet, and lifestyle communication in GLP-1 medication therapy for weight management: A qualitative research study with registered dietitians. *Obes Pillars*. 2024;12. <https://doi.org/10.1016/j.obpill.2024.100143>.
27. Prins A. The nutritional management of a central venous incident. *S Afr Clin Nutr*. 2015;28(3):105-112.
28. Kramer H, Tuttle KR, Leehey D, et al. Obesity management in adults with CKD. *Am J Kidney Dis*. 2009;53(1):151-65. <https://doi.org/10.1053/j.ajkd.2008.10.003>.
29. Passarino G, De Rango F, Montesanto A. Human longevity: genetics or lifestyle? It takes two to tango. *Immun Ageing*. 2016;13(1):1-6. <https://doi.org/10.1186/s12979-016-0066-z>.
30. Singar S, Nagpal R, Arjmandi BH, Akhavan NS. Personalized nutrition: tailoring dietary recommendations through genetic insights. *Nutrients*. 2024;16(16):1-18. <https://doi.org/10.3390/nu16162673>.
31. Chi CL, Street WN, Robinson JG, Crawford MA. Individualized patient-centered lifestyle recommendations: An expert system for communicating patient specific cardiovascular risk information and prioritizing lifestyle options. *J Biomed Inform*. 2012;45(6):1164-74. <https://doi.org/10.1016/j.jbi.2012.07.011>.
32. Dowis K, Banga S. The potential health benefits of the ketogenic diet: A narrative review. *Nutrients*. 2021;13(5). <https://doi.org/10.3390/nu13051654>.
33. Aune D. Plant foods, antioxidant biomarkers, and the risk of cardiovascular disease, cancer, and mortality: A Review of the Evidence. *Adv Nutr*. 2019;10(1):S404-21. <https://doi.org/10.1093/advances/nmz042>.
34. Tyson CC, Nwankwo C, Lin PH, Svetkey LP. The dietary approaches to stop hypertension (dash) eating pattern in special populations. *Curr Hypertens Rep*. 2012;14(5):388-96. <https://doi.org/10.1007/s11906-012-0296-1>.
35. Kim EY. Definition, mechanisms and predictors of weight loss failure after bariatric surgery. *J Metab Bariatr Surg*. 2022;11(2):39. <https://doi.org/10.17476/jmbs.2022.11.2.39>.
36. Ahmed T, Haboubi N. Assessment and management of nutrition in older people and its importance to health. *Clin Interv Aging*. 2010;5:207-16. <https://doi.org/10.2147/CIA.S9664>.