Nutrition to support immune health

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The immune system ....
... is a cell and tissue system that protects the individual from harmful organisms (= pathogens)

- Bacteria
- Parasitic worms
- Viruses
- Fungi
A well functioning immune system is key to providing robust defence against pathogens
The four general functional features of the immune system

- **Exclusion barrier**
  - Skin, mucosal linings, acid pH of stomach, proteins in secretions …

- **Identification/recognition**
  - Generic via pattern recognition receptors; specific via “antigen receptors”

- **Elimination**
  - Phagocytosis and digestion; Direct destruction; Killing virally-infected cells

- **Memory**
The immune system involves many cell types – each has their own role

Barrier

Cellular components of innate and acquired immunity
Immune development, immune decline & "immune vulnerability"

Periods of immune vulnerability

Immune development:maturation

Immune decline ("Immunosenescence")
Weak immunity

= Poor defence against harmful organisms

= Infection
In 2020 weak immune systems were exposed as a major public health challenge!

COVID-19 mortality by week and region

European Centre for Disease Prevention and Control
34% of under-five deaths are from diarrhoeal disease and acute respiratory infections.

Sources:
Leading causes of death in low-income countries

1. Neonatal conditions
2. Lower respiratory infections
3. Ischaemic heart disease
4. Stroke
5. Diarrhoeal diseases
6. Malaria
7. Road injury
8. Tuberculosis
9. HIV/AIDS
10. Cirrhosis of the liver

Number of deaths

Many factors affect the immune response

How nutrients can support the immune system

- **Fuels** for energy generation
- **Building blocks** (e.g. amino acids for immunoglobulins, cytokines, new receptors, acute phase proteins)
- **Regulators** of molecular and cellular responses (e.g. zinc, vitamin A)
- **Substrates** for the synthesis of chemicals involved in the immune response (e.g. arginine and nitric oxide)
- **Specific anti-infection roles** (e.g. Zn)
- **Protection** of the host from oxidative and inflammatory stress (e.g. vitamin C, vitamin E, cysteine, Zn, Cu, Se, many phytochemicals)
- **Creating a diverse microbiota** (e.g. fibre, prebiotics, phytochemicals, ....)
Undernutrition
• Weakens immunity
• Predisposes to infection

Rivera et al. (1986) Nutr. Res. 6, 1161-1170
Sarcopenia and frailty
Frailty reduces response to influenza vaccination among older people

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Reprinted from Vaccine, Vol 29, X Yao et al., Frailty is associated with impairment of vaccine-induced antibody response and increase in post-vaccination influenza infection in community-dwelling older adults, pp 5015-5021, Copyright (2011), with permission from Elsevier.
Overnutrition
• Obesity impairs the activity of helper T cells, cytotoxic T cells, B cells and NK cells
• Obesity reduces antibody responses
• Obesity reduces IFN-γ production

• People with obesity are more susceptible to many infections
• People with obesity do not respond so well to some vaccinations

• 2009 H1N1 influenza pandemic: people with obesity showed delayed and weakened anti-viral responses to infection and poor recovery from disease

• People with obesity have a prolonged period of influenza virus shedding and show emergence of virulent minor strains

• Vaccinated individuals with obesity have twice the risk of influenza than healthy weight people, indicating poorer protection from vaccination
Micronutrients are vital to the immune system

Gombart et al. (2020) Nutrients 12, 236
Key nutrients that are involved in immune system support

Fat-soluble vitamins: A, D, E, (K)

Water-soluble vitamins: B6, B9 (folate), B12, C, ….

Minerals: Zn, Cu, Se, Fe …. 

Some amino acids: S-containing, glutamine, arginine, leucine, taurine, and some amino acid metabolites

Several fatty acids: Essential fatty acids, Omega-3 (EPA & DHA)
Optimal immune function

Optimal nutrient supply

Optimal nutrient status (& stores)

Optimal immune function

Good defence against pathogens
INADEQUATE nutrient supply

INADEQUATE nutrient status (& stores)

IMPAIRED immune function

IMPAIRED defence against pathogens

-> more infections; more severe infections; illness; death
Summary

• A well functioning immune system is required for effective defence against pathogenic organisms
  • Impaired immunity predisposes to infections
  • Impaired immunity weakens vaccine responses
• The immune system is weakened with obesity, frailty, malnutrition and micronutrient deficiencies
  • Weakened immunity is an under-recognised result of these factors
• Multiple nutrients (including a range of vitamins and minerals) play important roles in supporting the immune system and low intakes and status of these impair the immune response and make people more susceptible to infections – this situation can be prevented or reversed by repletion
• Nutritional approaches should be part of the approach to preventing infections, optimising vaccine responses and promoting recovery from infection
  • supplements may be necessary to achieve the required intakes of some of the key nutrients
Thank you!