

Role of Nutrition in Immunity

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Abstract

A balanced diet combined with healthy lifestyle factors like adequate sleep, low stress and exercise primes the body to fight infection and disease. Good nutrition supports the body throughout the life phases. The development of human body immune system is determined by the nutritional status. Nutrients are involved with the normal functioning of the immune system. Vitamin C, Vitamin D, Zinc, Selenium, Iron, and Protein have been identified as critical nutrients for the growth and function of immune cells. Deficit intake of one or more nutrients results in altered immune responses. This article highlights the importance of nutritional requirements to enhance the immune response.

Key Words: Nutrition; Balanced diet; Infection; Immune system.

Introduction

Adequate intake of macronutrients and micronutrient is vital to ensure a good supply of nutrients required for the development, maintenance and expression of the immune response.¹ Eating Pattern and habits decides body's capability to prevent, fight and recover from infections. Over nutrition and under nutrition may alter immune responses. Micronutrients such as zinc, selenium iron copper vitamins A, B-6, C, E, and folic acid have important influences on immune responses.² The development, maintenance and optimal functioning of immune cells is important to fight against infection at all stages of recovery. Even though in industrialized countries, the availability of healthy and nutritious food is feasible, factors such as social, economic, educational, ethnic and cultural backgrounds influence the diet pattern of

individuals which in turn has an adverse effect on their micronutrient status.³ Henceforth, Nutrition is a precarious determinant of immune response and is the most common cause of immune deficiency worldwide.

Nutritional Status the present scenario in India

According to the Global Nutrition Report 2020, India is also among the 88 countries that are likely to miss global nutrition targets by 2025. It indicates that rate of overweight and obesity continues to be rising, affecting almost a fifth of the adults, at 21.6% of women and 17.8% of men. Anemia is also highly prevalent in the country with one in two among women of reproductive age. 'The State of Food Security and Nutrition in the World, 2020' report states that 14 per cent of India's population are undernourished which accounts for 189.2 million people and 34.7 per cent of the children under five years are stunted. It further highlights that 20 per cent of children under the age of 5 suffer from wasting (meaning their weight is too low for their height) in India. The pandemic crisis has further worsened the nutritional status of the country among under-privileged population. The impact of poor nutritional status during infections among individuals is mediated by the effect of nutritional deficiencies on the immune defense mechanism.

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Relationship between Nutrition, Infection and Immune Response

Malnutrition makes a person more susceptible to infection, and chronic infection in turn contributes to malnutrition as a vicious cycle (Fig.1) depicts the relationship between malnutrition and infection.

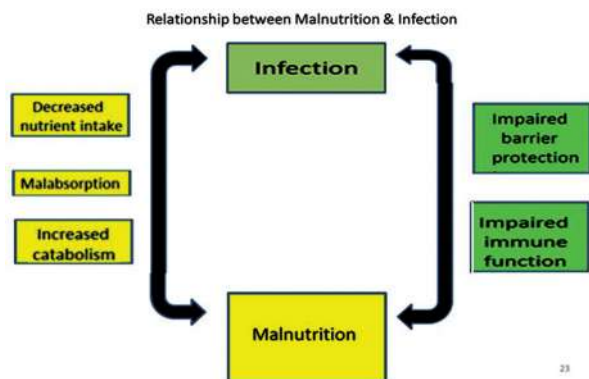


Fig. 1: Cycle depicting the relationship between Malnutrition and Infection.

Source: Malnutrition and Gastrointestinal and Respiratory Infections in Children: A Public Health Problem, 2011.

During infection, the immune response demands high energy expenditure. The infected individual will be subjected to diarrhoea, mal-absorption and loss of appetite which alters their nutrient intake thereby affecting the nutritional status.⁵ The altered nutritional status adversely affects the defense mechanism through hyper-metabolism, negative-nitrogen balance, increased gluco-neo-genesis and increased fat oxidation, which is modulated by hormones, cytokines and other pro-inflammatory mediators. An inadequate intake of nutrients lead to increased catabolism, weight loss, mucosal damage, invasion by pathogens, decreased immunity and impaired growth and development.

Importance of Micronutrient requirements in each stage of life

In every stage of human life immune response depends on adequate nutrition reserve in the body.⁶ Starting from infants, the breast milk provides various immunological components such as antibodies (e.g., antigen-specific IgA), anti-inflammatory cytokines, anti-microbial factors and critical micronutrients necessary to support neonatal development of immune system.⁷ Breastfed babies are less prone to infections and hospitalizations than formula-fed infants. Worldwide child hood micronutrient deficiencies includes Iron, Vitamin A, Iodine and Zinc deficiency are common.⁸ Young children have more crave for processed food than

fruits and green leafy vegetables which lead to poor micronutrient status. Need of essential micronutrients proliferates during adolescents and adult stage. It is essential to ensure that antioxidant levels (e.g., vitamins A, E, and C) and micronutrients that are components of antioxidant enzymes (e.g., zinc, copper, iron, and selenium) are sufficient in the dietary habits of adolescents and adults to combat the oxidative stress, which is induced by unhealthy lifestyle factors.⁹ The oxidative stress also impairs the immune system. Micronutrient deficiencies are also common among elderly people. Aging process makes the internal organs less efficient and immune-related organs like thymus or bone marrow produce less immune cells needed to fight off infections. Micronutrients such as Vitamins A, D, C, B2, and B12, Folic acid, Iron, Zinc and Selenium have immune modulatory and antioxidant property that influence the host to fight against infections.¹⁰ Adequate diet intake is important in each stage of life to ensure good immune system.

Nutritional requirements during Infection

Magnitude of infection recovery depends on the nutritional reserve of the individual. The nature and duration of the infection and the diet of the individual during the infection also imparts the recovery speed of the infected individual.

Carbohydrates: Energy and carbohydrate requirements during fever increases due to increased metabolic rate. The energy intake needs an increase by almost 50% depending on the severity of infection. Simple and easily digestible carbohydrates like rice, steamed foods, simple porridges, fruit juices, and nutritional supplements are recommended.

Protein: Protein helps in repair and replacement of tissues. Metabolic damage such as losing proteins during the infection increases the need for dietary protein. A high protein diet supplying about 1.25-1.5g protein per kg of body weight per day should be given to patients to recover from infections. Good quality protein can be obtained from fish, poultry, lean red meat, eggs, dairy products, nuts, dried beans, peas, lentils, and soy. Protein supplements may also help to meet the increased demand of proteins by the body during infection.

Vitamins and Minerals: Micronutrient requirements are increased during infections. Eating a variety of fruits and vegetables helps to meet the increased demands for immune response during infection. Vitamins like A, E and C are antioxidants that fight infection causing agents and to promote

faster recovery with quicker tissue regeneration. B-complex vitamins, especially vitamin B9 (folic acid), should be consumed in larger amounts. Zinc has antimicrobial and antibacterial properties which supports the immune system. Sodium and potassium loss due to electrolyte imbalance should be replaced by including more fluids such as soups, juices, and milk.¹¹

Important dietary sources of nutrients that support the immune system

World Health Organisation guidance on diet, especially during the current pandemic states that “good nutrition is crucial for health” (WHO, 2020). Providing a diet rich in vitamins and minerals (Table 1) supports optimal function of the immune system by providing antioxidants to slow damage of cells caused by free radicals.

Table 1: Dietary sources of Vitamins and Minerals.

Nutrient	Good dietary sources
Vitamin A	Milk and cheese, eggs, liver, oily fish, fortified cereals, dark orange foods-carrot, pumpkin, mango, papaya, peaches, green leafy vegetables such as spinach, broccoli
Vitamin B6	Fish, poultry, meat, eggs, whole grain cereals, fortified cereals, soya beans, green vegetables, green leafy vegetables and fruits such as bananas,
Vitamin B12	Fish, meat, shellfish, milk and cheese, eggs, fortified breakfast cereals,
Folate	Broccoli, green leafy vegetables such as spinach, kale, cabbage, peas, chick peas, kidney beans, fortified cereals
Vitamin C	Citrus fruits such as oranges and lemon, amla, guava, tomato, strawberries, blackcurrants, kiwi, broccoli,
Vitamin D	Oily fish, liver, eggs, fortified foods (spreads and some breakfast cereals)
Vitamin E	Nuts and seeds- Almonds, pea nuts, vegetable oils,
Zinc	Shellfish, crab, lean meat and poultry, cheese, chick peas, beans, yogurt.
Iron	Meat, liver, beans, nuts, dried fruit (eg, apricots), whole-grains (eg, brown rice), egg, fortified cereals, most dark green leafy vegetables (spinach, kale)
Copper	Shellfish, nuts, liver, some vegetables
Selenium	Fish, sea-foods, meat liver poultry cheese eggs, some nuts especially brazil nuts

Conclusion

The nature of infectious agents varies and so different dietary approaches are required to

support the immune system. Each nutrient has a diverse role in functioning of the immune system. Balanced nutrition can create an environment for the immune system to respond appropriately to overcome the challenges of infection thereby bringing about quick recovery of the infected individual.

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