NUTRITION AND THE IMMUNE SYSTEM

The immune system is constantly working to protect the body from infection, injury, and disease.

OVERVIEW OF THE IMMUNE SYSTEM

The immune system consists of various organs, tissues, and cells located throughout the body.

WHITE BLOOD CELLS (WBCs)

- The cells of the immune system
- Made inside bone marrow
- WBCs travel through the body inside lymph vessels, which are in close contact with the bloodstream

THERE ARE SEVERAL TYPES OF WBCs

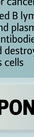
NEUTROPHILS
Engulf & destroy

MONOCYTES (MACROPHAGES)
Engulf & destroy

EOSINOPHILS
Fight parasitic infections

BASOPHILS
Release histamine

LYMPHOCYTES
Attack specific pathogens



PLASMA CELLS
Produce antibodies

The immune system provides three levels of defense against disease-causing organisms:

1 BARRIERS
Prevent entry
- Skin and mucus membranes
- Stomach acid and digestive enzymes
- Beneficial bacteria that live in the colon (the gut microbiota)

2 INNATE IMMUNITY
General defense

WBCs called neutrophils and macrophages engulf and destroy foreign invaders and damaged cells

3 ACQUIRED IMMUNITY
Specific defense
- WBCs called T lymphocytes (T cells) target and destroy infected or cancerous cells
- WBCs called B lymphocytes (B cells) and plasma cells produce antibodies that target and destroy infected or cancerous cells

KEY FEATURES OF THE IMMUNE RESPONSE

OXIDATIVE BURST

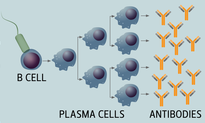
- Certain immune cells produce a concentrated burst of reactive oxygen species (ROS), damaging substances that help kill invading organisms

Important nutrients
- Vitamin C
- Vitamin E
- Iron
- Zinc
- Copper
- Selenium

Connection
- Prolonged and continuous exposure to ROS can lead to damage and disease
- The listed antioxidant nutrients protect immune cells and keep the oxidative burst in check

PROLIFERATION

- Refers to an increase in the number or amount of something
- The immune system is constantly producing cells, chemicals, and proteins to carry out its functions
- When it encounters a foreign invader, it ramps up production to respond as needed

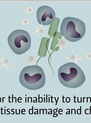


Important nutrients
- Vitamin A
- Vitamin D
- Folate
- Vitamin B_{12}
- Vitamin B_6
- Iron
- Zinc

Connection
- Proliferation requires energy, building blocks, and cofactors to produce the many cells and substances needed to mount an effective immune response
- The listed micronutrients have essential roles in the production and development of all new cells in the body, including immune cells

INFLAMMATION

- Isolates the injured or infected area
- Helps deliver immune cells, chemical messengers, and antibodies to sites of injury or infection



Important nutrients
- EPA
- DHA

Connection
- Inappropriate activation or the inability to turn off inflammation can lead to tissue damage and chronic disease
- EPA and DHA have anti-inflammatory activity that can help keep inflammation in check

NUTRIENTS THAT SUPPORT IMMUNE FUNCTION

NUTRIENT	RDA (adults)	GOOD SOURCES
EPA + DHA	No RDA Advised to consume two servings of oily fish/week	herring 3 oz, 1.8 g salmon 3 oz, 1.5 g sardines 3 oz, 1.2 g
Vitamin A*	Men: 900 µg/day Women: 700 µg/day	egg 1 large, 80 µg carrot** ½ cup raw, 534 µg sweet potato** ½ cup baked, 961 µg
Vitamin C*	Men: 90 mg/day Women: 75 mg/day	sweet red pepper 1 medium, 152 mg kiwifruit 1 medium, 91 mg strawberries 1 cup whole, 85 mg
Vitamin D*	19–70 years: 600 IU/day 71 years and older: 800 IU/day	pink salmon 3 oz, 370 IU sardines 3 oz, 164 IU fortified milk 1 serving, 120 IU sunshine
Vitamin E*	15 mg/day	almonds 1 oz, 7 mg sunflower oil 1 T, 6 mg avocado 1 whole, 2.7 mg
Folate	400 µg/day	lentils ½ cup cooked, 179 µg spinach ½ cup cooked, 131 µg enriched bread*** 1 slice, 84 µg
Vitamin B_{12}	2.4 µg/day	clams 3 oz, 84.1 µg mackerel 3 oz, 16.1 µg beef 3 oz, 6.9 µg
Vitamin B_6	19–50 years: 1.3 mg/day Men 51 years and older: 1.7 mg/day Women 51 years and older: 1.5 mg/day	salmon 3 oz, 0.5 mg turkey 3 oz, 0.7 mg potato with skin 1 medium, 0.7 mg
Zinc	Men: 11 mg/day Women: 8 mg/day	oysters 6 medium, 27–50 mg beef 3 oz, 4–6 mg yogurt 1 cup, 1.8 mg
Iron*	Men and women 51 years and older: 8 mg/day Women 19–50 years: 18 mg/day	beef 3 oz, 1.6 mg tuna 3 oz, 1.3 mg lentils ½ cup cooked, 3.3 mg
Copper	900 µg/day	oysters 6 medium, 2,397 µg cashew nuts 1 oz, 622 µg lentils 1 cup cooked, 497 µg
Selenium	55 µg/day	tuna 3 oz, 92 µg pork 3 oz, 32.5 µg whole-wheat bread 1 slice, 8.2 µg

RDA = Recommended Dietary Allowance | IU = International Units | g = grams | mg = milligrams | µg = micrograms oz = ounce(s) | T = tablespoon

**Underconsumed by eating the typical American diet. Iron underconsumed by adolescent females and pregnant women only*

***A source of provitamin A carotenoids*

****A source of folic acid, the synthetic form of folate*

For some nutrients, getting more than the RDA might be of further benefit

VITAMIN C

Routine supplementation with vitamin C (0.25 to 2 g/day) reduces the occurrence of the common cold in individuals undergoing heavy physical stress (marathon runners, skiers, and soldiers in subarctic conditions).

Routine supplementation with vitamin C slightly reduces the duration of the common cold.

The LPI recommends a daily intake of at least 400 mg of vitamin C for generally healthy adults.

VITAMIN D

Low vitamin D status is linked to a higher risk of upper respiratory tract infections and some autoimmune disorders.

Supplementation with vitamin D reduces the risk of acute respiratory tract infection.

The LPI recommends 2,000 IU (50 µg) of supplemental vitamin D daily for generally healthy adults.

SOURCES

- Micronutrient Information Center, lpi.oregonstate.edu/mic/micronutrients-health/immunity
- Textbook of Medical Physiology, 11th edition. Guyton and Hall
- Dietary Guidelines for Americans 2015–2020, Eighth edition, health.gov/dietaryguidelines/2015/guidelines/

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