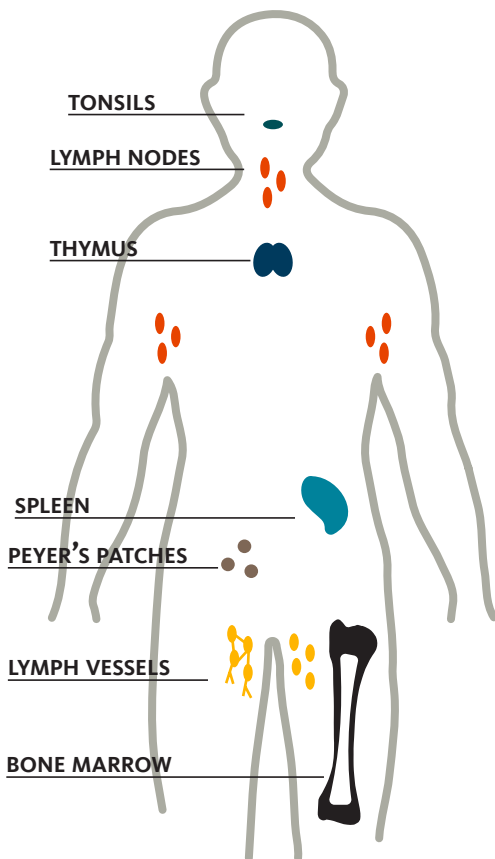


# NUTRITION AND THE IMMUNE SYSTEM

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

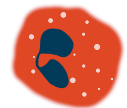
### THERE ARE SEVERAL TYPES OF WBCs



**NEUTROPHILS**  
Engulf and destroy



**MONOCYTES (MACROPHAGES)**  
Engulf and 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

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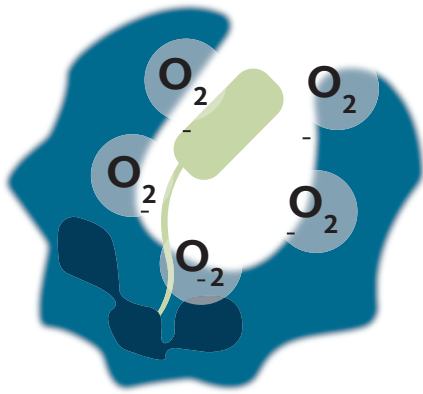
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# KEY FEATURES OF THE IMMUNE RESPONSE

## OXIDATIVE BURST



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

### Important nutrients

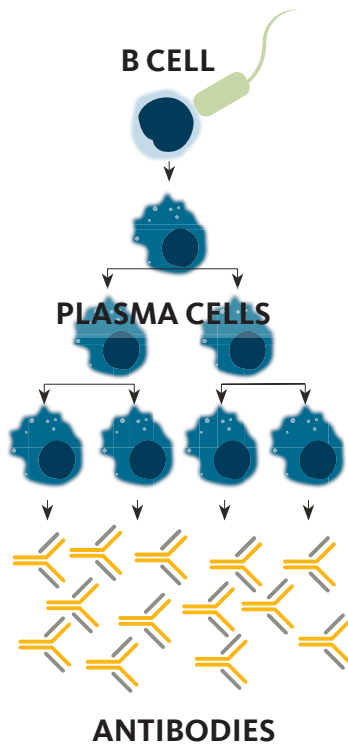


### Connection

Vitamin C  
Vitamin E  
Iron  
Zinc  
Copper  
Selenium

- 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

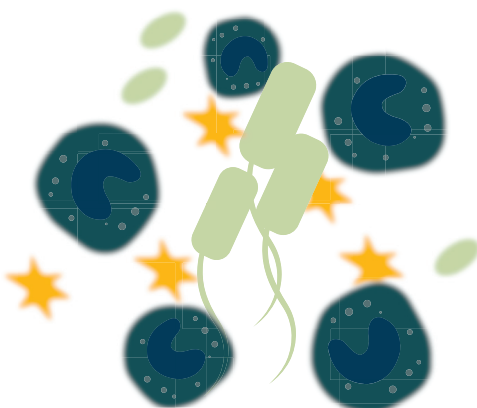


### Connection

Vitamin A  
Vitamin D  
Folate  
Vitamin B<sub>12</sub>  
Vitamin B<sub>6</sub>  
Iron  
Zinc

- 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



### Connection

EPA  
DHA

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

RDA = Recommended Dietary Allowance | RAE = retinol activity equivalents | DFE = dietary folate equivalents

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

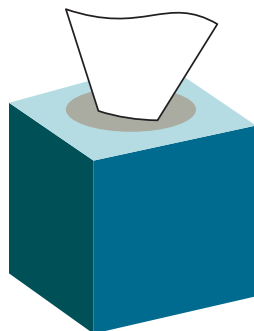
# FOR SOME NUTRIENTS, GETTING MORE THAN THE RDA MIGHT BE OF FURTHER BENEFIT

## VITAMIN C

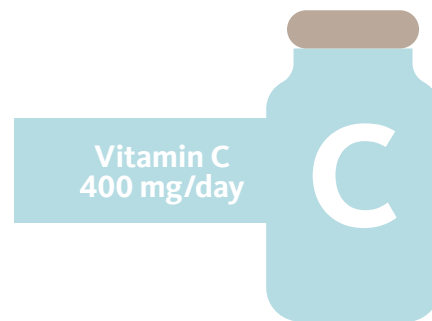
Routine supplementation with vitamin C (0.25 to 2 g/day) reduces the occurrence of the common cold in individuals undergoing heavy physical stress (marathon runners, skiers, and soldiers in subarctic conditions).



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/health-disease/immunity-in-brief](https://lpi.oregonstate.edu/mic/health-disease/immunity-in-brief)
- [lpi.oregonstate.edu/mic/health-disease/immunity](https://lpi.oregonstate.edu/mic/health-disease/immunity)