UNC | NUTRITION RESEARCH INSTITUTE

VIRTUAL INTERNSHIP PROGRAM

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500 Laureate Way
Kannapolis, NC 28081
704-250-5000 | uncnri.org

VIP

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VIRTUAL INTERNSHIP PROGRAM

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What is VIP?

Our Virtual Internship Program is offered to high school students (those entering 9th grade through recent graduates entering their freshman year of college in the fall of 2025). This four-week program provides opportunities to learn from NRI principal investigators, participate in group mentoring sessions, and complete an independent nutrition research paper and presentation.

To successfully complete the program, students must attend all scheduled lectures and mentoring sessions. This year, the program featured six sessions across four weeks, lasting at least one hour each.

Leading these sessions were:
Deborah Tate, PhD, *NRI Interim Director, Professor of Nutrition and Health Behavior*
Jenna Baker, *VIP Coordinator*
Carsyn Patton, *VIP Coordinator*
Sandra Mooney, PhD, *VIP Coordinator, Associate Professor of Nutrition*
Melody Burke, *Assistant Director, Office of Undergraduate Admissions*
Ximena Bustamante-Marin, PhD, *Assistant Professor of Nutrition*
Carol Cheatham, PhD, *Associate Professor*
Ryan Dayvault, *Associate Director of Operations and Planning*
Walter Friday, *Research Specialist, Trujillo and Saini Labs*
Sabrina Molina, *Assistant Laboratory Manager, Sumner Lab*
Hannah Petry, *Graduate Research Assistant, Mooney Lab*
Julian Robles, *Research Technician, Goode Lab*

In the fourth week, students presented their posters to their peers and NRI scientists and staff. You're invited to read over their posters in this booklet.

Disclaimer
This journal is a student-created publication and the content within may not be entirely accurate. The articles and opinions expressed here do not reflect the official research, views, or positions of the UNC Nutrition Research Institute (NRI). Readers are encouraged to consult verified sources for accurate information.

“As a trailblazer in precision nutrition research, the UNC Nutrition Research Institute investigates the intricate interplay between nutrients, lifestyle behaviors, environmental influences, genetic and other biological factors. We’re dedicated to unraveling the mysteries of nutritional diversity among individuals.”

- Deborah Tate, PhD,
NRI Interim Director, Professor of Nutrition and Health Behavior

ABOUT THE NRI

The UNC Nutrition Research Institute is an internationally recognized center that conducts innovative basic and translational science studying how individual differences in requirements and responses to diet affect our individual nutritional needs. We believe that our advances in nutrition science are leading to successes in preventing or mitigating the negative effects of chronic diseases and aging and in improving human development, even prior to conception.

MISSION

To understand how nutrition affects individual health through our leadership in precision nutrition research, establishing how differences in our genes, bacteria, metabolism, and environment shape our individual disease risk.

VISION

To use scientific discovery to ensure optimal health through individualized nutrition.

GUIDING SCIENTIFIC PREMISE

Each of us is metabolically unique. The NRI is dedicated to answering the question of how these differences affect an individual’s health, and, in so doing, update the current but outdated paradigm of a singular dietary guideline with specific nutritional recommendations and actionsby which an individual can improve his or her health and quality of life.

Learn more at: UNCNRI.org

Caffeine

Student Name: Sarah Stanley Lawrence

Student Name: Kay Kim

NUTRIENT INTRODUCTION

Caffeine is a natural stimulant most commonly found in coffee, tea, and cacao plants. It works by stimulating the brain and central nervous system, helping you stay alert and prevent the onset of tiredness. Caffeine is classified as a psychoactive drug, and it's the most widely consumed one in the world. The word “caffeine” comes from the German word Kaffein, which was derived from the word Kaffee (meaning “coffee”). The chemical name for caffeine is 1,3,7-trimethylxanthine, but it's most widely known simply as caffeine. Though not a nutrient your body requires to survive, caffeine can impact your health by affecting alertness, heart rate, and metabolism. It's often added to foods, drinks, and medications for these effects.

WHY IT’S IMPORTANT

Caffeine is a natural stimulant that blocks adenosine, a chemical that causes sleepiness, helping people feel more alert and focused. It can also boost mood, energy, and metabolism by increasing dopamine and adrenaline. In moderate amounts, caffeine may improve mental and physical performance and lower the risk of diseases like Parkinson’s, Alzheimer’s, and type 2 diabetes. Coffee and tea also provide antioxidants that support health. However, too much caffeine can lead to anxiety, insomnia, rapid heartbeat, and digestive issues. Some people may develop dependence or have caffeine sensitivity, causing strong reactions even in small amounts.

HOW IT WORKS

Caffeine is absorbed quickly by the stomach and small intestine. Peak blood levels typically occur between 30 to 60 minutes after consumption. As caffeine has nearly 100% bioavailability, almost all of it enters the bloodstream. Caffeine circulates throughout the body, even crossing the blood-brain barrier to cause stimulating effects. Then, it is metabolized primarily by the enzyme CYP1A2 in the liver. Caffeine is converted into three main metabolites: paraxanthine, theobromine, and theophylline. Paraxanthine, the most abundant metabolite, contributes to feelings of alertness. These metabolites are eventually excreted in urine.

TOO MUCH/TOO LITTLE

Consuming too much caffeine, called caffeine toxicity, can cause symptoms like restlessness, anxiety, rapid heartbeat, insomnia, and digestive problems. Very high doses (over 400 mg per day) may lead to heart palpitations, high blood pressure, muscle tremors, or seizures. Long-term overuse can cause caffeine dependence, making it hard to function without it, and may worsen anxiety or heart issues. on the other hand, suddenly stopping caffeine after regular use can cause withdrawal symptoms such as headaches, fatigue, irritability, trouble concentrating, and low mood. These occur because the brain adjusts to caffeine’s effects, but symptoms usually fade within a few days. Since caffeine isn’t essential for the body, there’s no true deficiency.

FUN OR HISTORICAL FACTS

- It is believed that the stimulating effects of caffeine was discovered in Ethiopia in the third century AD.
- African warriors consumed coffee berries to prepare for battle.
- The earliest recorded use of caffeinated beverages is tea from Tang Dynasty China.
- All stable indigenous cultures that had access to caffeine-containing plants made foods or drinks from them.
- Over 1 billion people worldwide drink coffee everyday.
- 73% of Americans drink coffee everyday.
- Smoking increases caffeine metabolism.
- The estimated fatal oral dose of caffeine is 10-14 grams.

FOOD SOURCES

Coffee (80-100 mg in an 8-ounce cup of coffee)

Tea (25-50 mg in an 8-ounce cup of black tea)

Soft drinks (20-80 mg in a 12-ounce can)

Energy drinks (80-200 mg in a 12-ounce can)

Chocolate (70 mg in one dark chocolate bar)

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Caffeine

Student Name: Manaswini Ganta

Student Name: Ananya Gupta

NUTRIENT INTRODUCTION

Caffeine is a naturally occurring **stimulant** most commonly found distributed in coffee beans, tea leaves, cacao pods, and other vegetables. Its chemical name is **1,3,7-trimethylxanthine,** and it is a family of alkaloid chemicals with nitrogenous chemicals renowned for their physiological effects on the human body. It operates chiefly through the inhibition of the action of adenosine, a neurotransmitter responsible for sleep and relaxation, and thus increase alertness and ward off drowsiness temporarily. The word "caffeine" is derived from the German word **Kaffein** for "something found in coffee." Although often associated with beverages like coffee and energy drinks, caffeine is also found in medicine and supplements due to its energizing properties.

NEGATIVE EFFECTS

While caffeine is widely used, too much can lead to health problems, More then **400 mg** a day (about 4 cups of coffee) may cause headaches, insomnia, anxiety, rapid heartbeat, or muscle tremors. Additionally, high intake can contribute to bone loss an increased risk of **osteoporosis**. Consuming caffeine at unusual times often makes it harder to sleep, creating a hurtful cycle. Additionally, cutting back to quickly can lead to withdrawal symptoms such as fatigue and irritability. For **pregnant women**, as caffeine crosses into the placenta it can also affect the baby. It can cause an increase in a baby's heart rate and metabolism and can also cause slowed fetal growth and increased risk of miscarriage.

HOW IT WORKS

Caffeine is rapidly absorbed from the small intestine and stomach, typically reaching peak blood levels **30 to 60** minutes after consumption. It does not require digestion in the normal sense because it is a small water- and fat-soluble molecule that may pass through cell membranes rapidly. Caffeine is mostly processed in the **liver**, where it's changed into other substances that can also have mild effects on the body. Once absorbed, caffeine distributes throughout the body and passes through the blood-brain barrier into the brain, where it exerts its stimulating effects. Eventually, these substances are removed from the body **through urine.**

POSITIVE EFFECTS

When used moderately, caffeine can improve focus, energy, and performance. Doses between **200-400 mg** helps reduce tiredness and boost concentration. It is also know to improve endurance and reduce effort during exercise, especially at 3 to 6 mg per kg of body weight. Caffeine raises **adrenaline and endorphins,** which can lift mood and motivation. It also increases fat burning and calorie use by raising body temperature and helping the body use fat for fuel. Some studies show that regular caffeine use may lower the risk of **alzheimer's and dementia**. If used responsibly, caffeine can support both mental and physical performance.

FUN OR HISTORICAL FACTS

1. Once banned!
Caffeine-containing drinks were once banned in several places. For example, in the 16th century, Mecca banned coffee due to its stimulating effects. In Sweden, coffee was banned multiple times in the 18th century — even coffee cups were confiscated.
2. Found in over 60 plants
Caffeine occurs naturally in over 60 plant species, including kola nuts and guarana plants.
3. It's a natural pesticide
In plants, caffeine acts as a natural pesticide that can paralyze or kill insects feeding on the plant.

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Choline

"The brain nutrient"

Student Name: Sofiia Shyshkovtsova

Student Name: Prachi Desai

NUTRIENT INTRODUCTION

Choline is a water-soluble nutrient often grouped with the B-complex vitamins. The term "choline" comes from the Greek word "chole", meaning bile, because it was first isolated from bile in the 19th century

HOW IT WORKS

Absorbed in the small intestine via active and passive transport.
Metabolized in the liver into phosphatidylcholine and betaine
Converted into acetylcholine for nerve signaling.

Involved in methyl-group donation, crucial for gene expression and fetal development.

FUN OR HISTORICAL FACTS

Choline was officially recognized as an essential nutrient by the Institute of Medicine in 1998.

The discovery of choline's role in brain function led to increased research into its potential benefits for Alzheimer's disease and prenatal development.

Higher maternal choline intake during pregnancy is linked to better fetal brain development and improved memory performance in children.

WHY IT'S IMPORTANT

Choline is supports several critical bodily functions, including:
Brain development and neurotransmission (acetylcholine synthesis)
Liver function (fat metabolism and prevention of fatty liver)
DNA synthesis and repair (via methylation)
Muscle control and memory formation
Though the body can produce small amounts in the liver, dietary intake is necessary to meet health needs.

TOO MUCH/TOO LITTLE

Symptoms of choline deficiency:
memory loss, mood changes, tiredness, nerve damage, fatty liver deficiency neurological disorders, salivation, excessive sweating
Choline deficiency can be caused by many different factors such as poor diet, however it can also be caused by a deficiency of vitamin b12, because it's necessary for the recycling of folate

Toxicity (very rare):
Fishy body odor, vomiting, low blood pressure

FOOD SOURCES

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Alzheimer's Disease:
Animal models show that choline may protect against neurodegeneration, potentially delaying cognitive decline.

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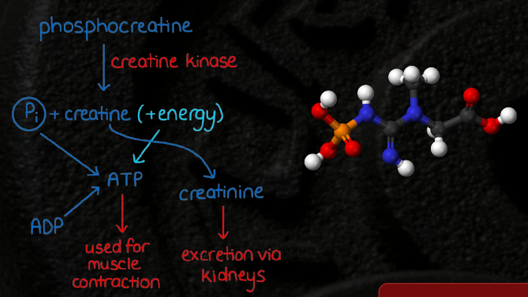
Creatine: Fueling Your Performance

By: Tanmay Sharma and Emi Dickman

Creatine. One of the most popular supplements known for its benefits in athletic performance and muscle growth. But, how many of you know how it actually works. We'll explore what creatine is, how it works in the body, its various uses, potential side effects, and specifically how it's utilized in gym settings.

What is Creatine?

Creatine is a naturally occurring organic compound found in muscle cells, primarily in skeletal muscle. It plays an important role in energy production, especially during high intensity activities like weightlifting or sprinting. Your body produces some creatine, and you also get it from certain foods, such as red meat and fish. As a supplement, it's typically consumed as creatine monohydrate.



How Does Creatine Function?

Creatine works by increasing the body's levels of phosphocreatine. Phosphocreatine helps to regenerate adenosine triphosphate (ATP). ATP is the primary measurable energy of the cell. During intense exercise, ATP is rapidly depleted. Without a quick way to replenish it, performance drops and fatigue sets in. By increasing phosphocreatine levels, creatine allows your body to produce more ATP, allowing you to sustain intense activities for longer periods and perform better. To put is simply, think of it as a quick energy reserve for your muscles.

Enhanced Strength & Power

Increases the ability to lift heavier weights and perform more powerful movements by enhancing muscle energy.

Improved Exercise Performance

Allows for more reps or sustained effort during high-intensity, short-duration activities such as heavy lifting and sprinting.

Cognitive Benefits

Emerging research suggests potential benefits for brain function, especially in tasks requiring quick thinking.

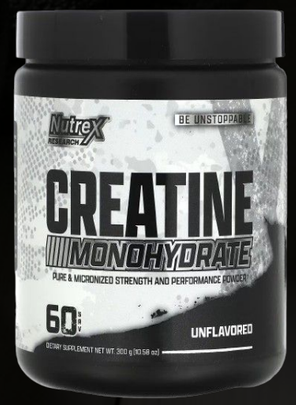
Potential Side Effects

Creatine is generally considered safe for healthy individuals when taken in normal portions. However, some common, mild, side effects can occur:

Water Retention: Creatine can cause muscles to need more water, leading to an increase in body weight, fuller muscles, puffiness, and bloating

Digestive Issues: Some people may experience an upset stomach, nausea, or diarrhea, especially if taken in large portions or on an empty stomach.

Muscle Cramps: While they are rare, some users reported muscle cramping, though this is often due to dehydration and not the creatine itself.



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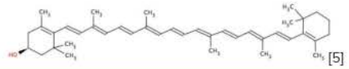
Cryptoxanthin

A 'hidden yellow' carotenoid with an important role in human health

NUTRIENT INTRODUCTION

Scientific name: β-Cryptoxanthin [1]

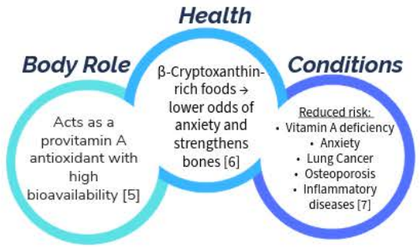
Name breakdown:
Crypto - hidden Xantho - yellow
Means "hidden yellow" [2]



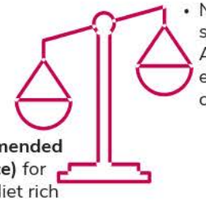
[5]

Cryptoxanthin is a carotenoid, naturally occurring plant pigment, that gives the plant a yellow, orange or red pigment [3]. Cryptoxanthin is a yellow pigment [4].

WHY IT'S IMPORTANT



TOO MUCH/TOO LITTLE

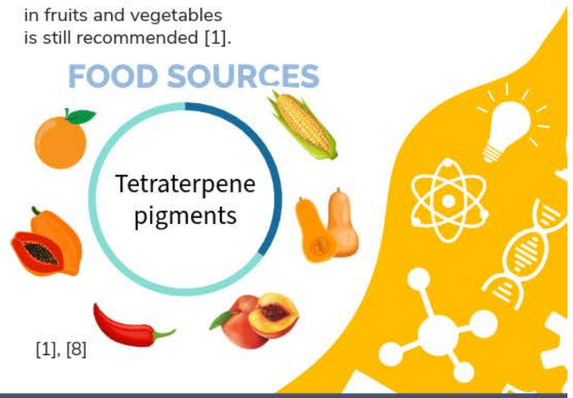


- No deficiency symptoms if vitamin A intake is adequate, even with **low** carotenoid intake [1].
- No RDA **(Recommended Dietary Allowance)** for carotenoids, but diet rich in fruits and vegetables is still recommended [1].

HOW IT WORKS

[5]

FOOD SOURCES



[1], [8]

FUN or HISTORICAL FACTS

1. β-Citraurin, the red-orange pigment in citrus peels, comes from β-cryptoxanthin and was first found in Sicilian oranges (1936) [9].
2. Cryptoxanthin is also found in egg yolks, butter, and cow's blood serum (the clear part) [10].
3. Over 600 carotenoids have been identified, all built from the same C40 isoprenoid skeleton.
4. Cryptoxanthin is structurally similar to beta-carotene, but it has an added hydroxyl group that gives it unique properties.

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Student Name: Anwita Wadekar

Student Name: Meghan Lanzi

Caffeine

Student Name: Sarah Stanley Lawrence

Student Name: Kay Kim

NUTRIENT INTRODUCTION

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TOO MUCH/TOO LITTLE

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FOOD SOURCES

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IRON

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NUTRIENT INTRODUCTION

Iron is a trace mineral, which means our bodies cannot produce it on their own, and we only need a little amount of it in our bodies. It is the only trace mineral to be required by the FDA to be listed on nutrition labels. This is because Iron deficiency is very common, and it may affect around 1 in 4 Americans [1]. Iron comes in 2 forms, heme (from animals) and non-heme (from plants and animals).

WHY IT'S IMPORTANT

Iron is necessary for proper growth and development of the body. It is responsible for the creation of oxygen-carrying proteins as well as some hormones. Iron is extremely important as its presence in the body allows for oxygen to be delivered to all of the cells in the body. The protein hemoglobin that is found in red blood cells contains iron and is responsible for carrying oxygen. As hemoglobin largely consists of iron, it is necessary to maintain proper iron intake in the body to prevent a shortage of hemoglobin. Similarly, the protein myoglobin carries oxygen to muscle cells to help them produce energy. Iron is also found in many enzymes that catalyze reactions in the body and is important to maintain a healthy immune system. [6]

HOW IT WORKS

IThe body recycles the iron from dead red blood cells and gets up to 90% of the body's required level of iron this way [3]. Iron is stored in various parts of the body including the muscles, liver, spleen, and bone marrow and is used to create hemoglobin and myoglobin. Iron is also necessary for carrying out many of the body's metabolic functions including DNA synthesis and electron transport [4]. Iron is unique from other minerals in that its usable amount in the body is determined by its absorption from food sources. Iron is absorbed in the small intestine where food is digested. In order for iron to be absorbed, it must be bound to a protein or be in the ferrous state where it is lacking 2 electrons. However, there are also foods that inhibit iron absorption due to other compounds they contain. Therefore, iron is often best absorbed along with Vitamin C. Iron is excreted through sweat, shedding skin or hair cells, and other unregulated processes [5].

TOO MUCH/TOO LITTLE

Iron deficiency may lead to anemia, which causes the lack of energy, dizziness, weak immune system, learning and concentration difficulties among children, headaches, or shortness of breath. People at-risk of anemia include those who frequently lose blood, runners, and people who have other medical conditions that cause them to have difficulty absorbing nutrients. Babies may also be at-risk if they don't eat the correct foods. Iron supplements are often available to prevent anemia and any degree of iron deficiency [2].

Too much iron, although rare, may cause nausea, vomiting, dizziness, or anorexia, which is an eating disorder characterized by a significantly reduced appetite and desire to eat food. Hemochromatosis may also lead to this condition as it is a genetic disorder that causes too much iron to be absorbed from the foods that are consumed [2].

FOOD SOURCES

Heme Iron Sources:
- Red Meats
- Seafood

Non-heme Iron Sources:
- Leafy Greens (spinach, kale)
- Legumes (lentils, beans)
- Whole Grains (rice, oats)

Heme iron comes from animal sources and contributes to nearly 10% of our iron as it is absorbed much faster than non-heme iron, which is from plant sources [2].

FUN or HISTORICAL FACTS

Thomas Sydenham first introduced iron as a way to treat anemia in the 17th century [7]

Cooking foods in cast iron pans can significantly increase their iron content [8]

Around 3500 B.C, Ancient Egyptians used iron powder to cure baldness [9]

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Student Names: Ahmed Rahman & Shivi Tripathi

Iron

How iron affects our bodies...

UNC | NUTRITION RESEARCH INSTITUTE

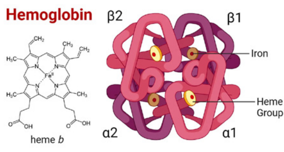
Student Name: Anusri Poreddy
Student Name: Anjana Ramanujam

NUTRIENT INTRODUCTION

Iron (commonly referred to as Fe on the periodic table) is a naturally occurring element essential to the human body for bodily functions, development, and growth.
How is iron found in our foods?
Iron is found in our veggies, as plants receive iron primarily from the soil through their roots systems, especially through the root hairs, in the form of ferric ions (Fe^+3), but these ferric ions are then converted by these plants into a more useful form, where this iron is utilized for cellular respiration and photosynthesis.

WHY IT'S IMPORTANT

Iron is utilized by our bodies to make hemoglobin, hormones, and myoglobin. Hemoglobin, a protein attached to our red blood cells (RBCs), carries oxygen from our lungs to our living cells through our arteries and carries carbon dioxide from our living cells to our lungs through our veins for it to exit into the environment, playing as a key element in respiration. Our iron content is primarily contained in hemoglobin, as approximately 2/3 of our iron supply is found here. Myoglobin is a oxygen-binding protein as well, but it is found in our muscle tissues. It delivers and stores oxygen as needed to act as an available supply of oxygen for muscle activities. Myoglobin also aids in neutralizing free radicals, specifically, harmful species of oxygen which tend to be reactive. Not only does iron contribute to the exchanging of carbon dioxide and oxygen between our bodies and the environment (respiration), but it also contributes to cellular respiration, a biochemical process which involves energy production with the help of catalysts. Catalysts, many of which contain iron, speed up chemical processes by binding to or consuming reactants and intermediates.



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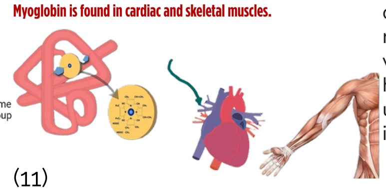

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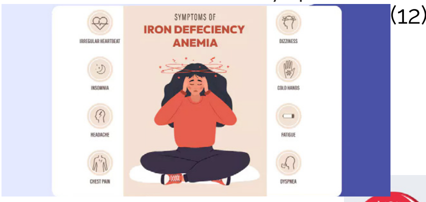
TOO MUCH/TOO LITTLE

Iron deficiency occurs when you do not consume sufficient amounts of iron through our diets. Iron deficiency commonly turns into iron deficiency anemia, which is most common in children born preterm; menstruating women, especially those experiencing mennorhagia; postpartum and pregnant women; those who frequently give their blood for donation; those with comorbidities which occur in bleeding, especially GI bleeding; and vegan and vegetarians, as iron found in plant sources is more difficult to process than iron found in animal sources. Some signs and symptoms of iron deficiency include apathy, arrhythmia and palpitations, dizziness, feeling cold frequently (commonly in extremities such as feet and hands), feelings of tiredness, irritability/mood swings, paleness and/or yellowing of skin, pica, etc. Iron toxicity occurs when we consume iron in excess to the recommended amount, which differs from one individual to another depending on age, diet, physical activity, sex, weight, and other characteristics specific to women, such as monthly bleeding (menstruation), lactation, and pregnancy (specific to the trimester). Iron toxicity may also occur due to an inherited condition called hemochromatosis, where iron is stored in excess in the body, potentially damaging several different bodily systems. Iron poisoning or toxicity may result in abdominal pain, diarrhea, drowsiness, irritability, vomiting, and vomiting blood. Severe iron poisoning or toxicity may result in a coma, high bpm, hyperventilation, low blood pressure, seizures, and unconsciousness. These are short-term symptoms. Long-term exposure to iron in excess can result in more severe symptoms.



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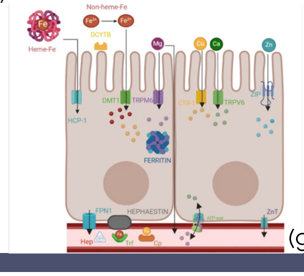
HOW IT WORKS

Iron absorption occurs through enterocytes, which are intestinal absorptive cells. Iron can be taken in through free ions or heme through certain pathways. Fe^3+ (ferric iron) ions are solubilized by hydrochloric acid in the stomach; this is needed in order for the ferric ions to enter the enterocytes. The non-heme iron uses the divalent metal transporter-1 (DMT1). Fe^3+ ions must be reduced to Fe^2+ (ferrous ions) before they can be transported into the enterocyte through the DMT1 pathway.



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FOOD SOURCES

There are two types of iron sources: heme iron sources and non-heme iron sources. Heme iron sources are processed with less effort than non-heme iron sources. Non-heme iron is better processed by our bodies when consumed with a proper source of Vitamin C. This is due to Vitamin C converting non-heme iron into a more processable version. Calcium when consumed along with iron can hinder proper iron absorption, as calcium competes with iron for absorption in the small intestine, so it is recommended to avoid consuming calcium-rich and iron-rich foods at the same time if you are iron-deficient.

Heme Iron Sources: poultry, red meat, seafood
Non-Heme Iron Sources: dried fruits, greens, legumes, nuts, seeds, whole grains

(13)

FUN or HISTORICAL FACTS

- Around 70% of the iron in the human body is found in the hemoglobin of red blood cells.
- For those suffering from both iron deficiency anemia and a form of IBD, iron supplements tend to further irritate the bowel due to aggravating inflammation and ulcers. Non-heme iron-rich foods tend to irritate to the bowel as well. This is difficult for those with IBD and iron-deficiency anemia who consume a vegan or vegetarian diet, as most heme iron sources are non-vegetarian. It is recommended for those with both active IBD and iron deficiency anemia to receive iron infusions (where iron supplements are given through a small catheter put into a vein) to prevent further damage to the bowels.

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Iron: The Element That Fuels Life

Add fact or question

Subtitle (If desired,

Student Name: Shloke Soni

Student Name: Robert Kirkley

NUTRIENT INTRODUCTION

Iron is a mineral that the body needs to make hemoglobin, a protein in red blood cells that carries oxygen throughout the body. It is also important for energy, growth, and healthy cells. The name "iron" comes from the Anglo-Saxon word “iren,” and its chemical symbol "Fe" comes from the Latin word “ferrum,” which means iron. This shows how long iron has been known and used by people.

WHY IT’S IMPORTANT

Provides oxygen to body

- Body uses oxygen for energy
- Helps produce hemoglobin & myoglobin
- Helps with brain health
- Maintains healthy hair
- Aids immunity

HOW IT WORKS

Ferric iron (Fe3+) is reduced to ferrous iron (Fe2+) by duodenal cytochrome B reductase (DcytB). In the intestines, Divalent Metal Transporter 1 (DMT1), a transport protein, allows the uptake of Fe2+ by enteroctyes. The iron is then stored as ferritin or transferred into the blood by ferroportin. In the blood iron is bound to transferrin and transported to bone marrow. Macrophages take iron in the reticulendothelial system for storage. Iron is regulated by hepcidin, a peptide expressed by the liver. Hepcidin binds to ferroportin to break it down and prevent iron from leaving cells and by inhibiting DMT1 transcriptions to reduce iron absorption. Most iron the body uses is recycled in the reticuloendothelial system and release into the system.

TOO MUCH/TOO LITTLE

Too much iron is associated with organ damage such as liver cirrhosis, heart failure, diabetes, joint pain, and hormone problems, especially in people with hereditary hemochromatosis or those who receive frequent blood transfusions. Since the body cannot get rid of extra iron, it builds up over time and can cause serious health problems or early death if untreated. Too little iron is linked to iron deficiency anemia, which causes tiredness, dizziness, shortness of breath, and strain on the heart. In chronic kidney disease, low iron worsens anemia due to less erythropoietin and blood loss, and in inflammatory bowel disease, it results from bleeding and poor absorption and often needs IV treatment. Both too much and too little iron can lead to serious health issues and need proper diagnosis and treatment.

FUN OR HISTORICAL FACTS

Iron is one of the most important and abundant elements on Earth, used not only to build steel but also to help carry oxygen in your blood. Some of the oldest known iron used by humans came from meteorites, like ancient Egyptian beads made from space iron over 5,000 years ago. The red color of blood actually comes from iron bonding with oxygen, and Earth’s magnetic field is powered by iron in its liquid core. Mars looks red because of iron oxide, or rust, on its surface. There’s even a 1,600-year-old iron pillar in India that has barely rusted, showing how powerful and lasting this metal can be.

FOOD SOURCES

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AUTHORS

Aryan Saha, Shyla Tyagi

Nutrition Research Leucine

"Let food be thy medicine and medicine be thy food." - Hippocrates

01. Introduction

Leucine has found widespread use in the bodybuilding industry. Known for its function as an essential branched amino acid (BCAA's) and ability to bypass the liver, Leucine plays a crucial role in muscle growth and repair as it promotes protein synthesis and the building of muscle tissue. Its name was derived from its color as a white powder (or leukós in Greek for White). Being found in meat, dairy products, and legumes, Leucine, however, is also sold as a dietary supplement to build muscle mass and improve athletic performance.

02. Food Sources

Leucine is found in animal- and plant-based foods, as well as in supplements and legumes; however, its concentration varies, with animal sources having higher levels. Examples of these foods include beef, milk, lentils, brown rice, and sunflower seeds.

03. Intake

Intake requirements are not definite yet, but leucine intake should be above 35 mg/kg. A lack of leucine intake is associated with a worse quality of life, but high levels of leucine intake (<500 mg/kg) have caused increased insulin resistance, hyperammonemia, hypoglycemia, and pellagra.

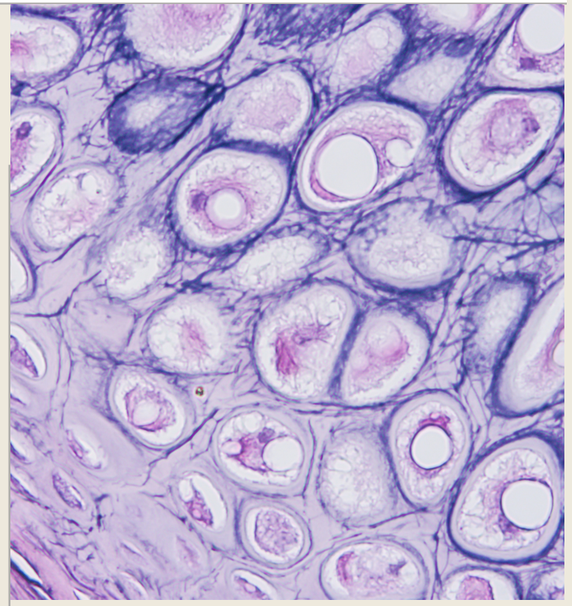
Still, those who have the following should talk to their doctor.

- **Maple Syrup Urine Disease**
- **Pregnant**
- **Diabetes**

**Older Adults should take higher amounts of leucine ~70 mg/kg to prevent muscle loss*

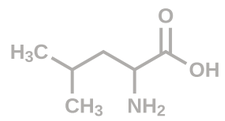
04. Digestion & Metabolism

Following the digestion of these foods, leucine is absorbed by L-type amino acid transporters in the small intestine. These proteins transport leucine into liver, muscle, or adipose tissue cells in exchange for intracellular glutamine. Once leucine enters the cell, it binds to sensing proteins that activate Rag GTPases, allowing for mTORC1's activation (MTORC1 signals the start of protein synthesis and cell growth). Next, leucine losses its amino group in the process of transamination, creating glutamate and α-ketoisocaproate (KIC). The glutamate is either converted to glutamine or used to generate alanine. Meanwhile, the resulting KIC is further metabolized in the mitochondria to produce acetoacetyl-CoA and acetoacetate for energy production. In liver tissue, however, KIC can be converted into HMG-CoA—for cholesterol or ketone synthesis—or HMB for muscle preservation.

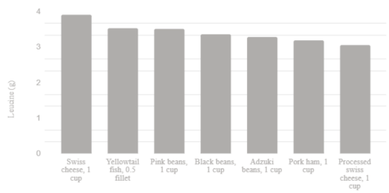


05. Importance

Leucine helps the body form fat cells, control inflammation, support muscles, adjust insulin resistance, make proteins, and use energy. Due to its ability to activate mTORC1 and other pathways, this essential amino acid has been found to reduce muscle loss and control glucose levels. It is important to consume a balanced amount of leucine, because it impacts the hypothalamus, activates appetite-suppressing neurons, and prevents age-related muscle loss. For these reasons, leucine is therapeutically used as a dietary supplement to improve muscle strength and is a promising intervention for diabetes, sarcopenia, and obesity.



The chemical structure of Leucine



Graph of Leucine Content of Household Foods
(USDA National Nutrient Database-Leucine)

06. Conclusion

Leucine is an essential amino acid responsible for cellular growth and survival. It has found use in the bodybuilding industry and as nutrition steategy against obesity and sarcopenia. However, variability in individuals' health status, study designs, genetics, and populations complicate leucine's effects. While leucine has a promising future, more research is needed to clarify optimal strategies for its use.

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Lycopene

Made By: Kavish Gupta & Komal Yavagal

NUTRIENT INTRODUCTION

Lycopene is a red pigment belonging to the carotenoid family of plant compounds.

It gives tomatoes, watermelon, pink grapefruit and other fruits/vegetables their red color (*Arballo et al. 2021*).

WHY IT'S IMPORTANT

Antioxidant Protection: Lycopene is a very strong antioxidant. Its structure allows it to quench reactive oxygen; this helps protect cell membranes and DNA from oxidative damage.

Heart Health: Research links higher lycopene intake to lower risk of cardiovascular disease. Lycopene helps prevent LDL cholesterol oxidation, reducing plaque formation in arteries; basically, more lycopene in blood tends to support healthier hearts and blood vessels.

Cancer Prevention: Lycopene may slow the growth of certain cancer cells. Laboratory and epidemiological studies suggest diets high in lycopene are associated with reduced risk of prostate, lung, stomach and breast cancers *(Przybylska and Tokarczyk 2022)*.

HOW IT WORKS

Digestion & Release: Chewing & stomach digestion break down the plant foods to release lycopene. Stomach acids and enzymes help free lycopene, which then mixes with fats in the stomach.

Absorption: After mixing with dietary fat (oil, avocado, etc.) and bile salts, tiny droplets (micelles) are formed in the small intestine. These micelles deliver lycopene into intestinal cells (enterocytes).

Transport & Metabolism: Inside enterocytes, lycopene is packed into chylomicrons (fat particles) and sent into the lymphatic system and then the bloodstream *(Arballo et al. 2021)*.

FOOD SOURCES

Tomatoes & Tomato Products: All tomato-based foods are extremely rich in lycopene – fresh tomatoes, tomato paste, sauce, ketchup and juice.

Red Fruits: Watermelon, pink grapefruit and red/pink guava contain significant lycopene.

Other Sources: Papaya and apricots have moderate amounts. Some processed vegetable juices and soups also contain lycopene *(USDA Agricultural Research Service 2018).*

TOO MUCH/TOO LITTLE

Deficiency: No deficiency disease is linked to low lycopene. However, not eating enough carotenoid-rich fruits and vegetables means missing out on antioxidant protection, thus making cells more vulnerable to damage over time.

Excess: As of now, adverse effects are reported at normal dietary levels, and health agencies have not established an upper limit.

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Nature's Red Shield

Lycopene as a phytonutrient

Student Name: Harshini Keshavamurthy

Student Name: Rishidharan Jayakumar

NUTRIENT INTRODUCTION

- Lycopene is a natural chemical that gives red fruits and vegetables their bright red color (like tomatoes and watermelon).
- It's a phytonutrient, which means it's a plant-based nutrient that helps protect our health.
- The name comes from the tomato's scientific name: Solanum lycopersicum.
- Lycopene is part of the carotenoid family, like beta-carotene (found in carrots), but it doesn't turn into vitamin A.

HOW IT WORKS

- Lycopene is fat-soluble, so your body absorbs it better when eaten with healthy fats (like olive oil or avocado).
- After eating, lycopene is absorbed in your small intestine and sent through your blood to different parts of your body.
- It builds up the most in the liver, adrenal glands, and prostate.
- Lycopene acts as an antioxidant, which means it helps protect your body's cells from damage.

FUN OR HISTORICAL FACTS

- Tomatoes are the biggest source of lycopene for most people.
- Cooked or processed tomatoes (like pasta sauce or ketchup) actually give you more usable lycopene than raw tomatoes.
- Interest in lycopene grew in the 1990s when studies linked it to lower risk of prostate cancer.
- Lycopene has no taste or smell, but it's one of the most powerful antioxidants found in food.

WHY IT'S IMPORTANT

- Lycopene plays a role in the immune system of the body
  - Induces apoptotic cell death
- Protects DNA, lipids, and proteins from oxidative damage
- Inhibits cancer cell growth
  - Decreases phosphorylation of extracellular signal-related kinase (ERK
- Supports heart health by reducing oxidate stress
- Helps in lowering cholesterol levels and improving blood circulation

TOO MUCH/TOO LITTLE

- Deficiency of lycopene
  - Low intake leads to increasd risk of cardiovascular health
  - In men, lower levels might be linked to prostate health issues
- Toxicity of lycopene
  - Generally very safe, even at high doses
  - Orange-red skin discoloration might appear from ecessive tomato or supplement intake, harmless and reversible

FOOD SOURCES




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Magnesium

A Key Player in Cellular Processes

Student Name: Prbhuv Nigam

Student Name: Kshreya Arora

NUTRIENT INTRODUCTION

- A Nutrient is an ingredient or substance that promotes/helps create growth, provides energy, and maintains life.
- A nutrient or "nutritious substance" is also known for providing nourishment, which is derived from the Latin word "nutrientum".
- The present participle of "nutrire" which is o nourish, suckle, feed,
- Magnesium specifically is an essential mineral within the body as it helps in numerous bodily functions such as nerve and muscle function, blood pressure control, blood sugar regulation, and bone health
- The word magnesium is derived from an ancient Greek disdrict "Magnesia"

The Importance of Magnesium

- Muscle and Nerve Regulation(electrolyte balance, signal transduction)
- Enzymatic cofactor for over 600 reactions
- Works alongside calcium and vitamin D to support bone health
- Enhanced energy production, sleep, and mood
- Commonly used in combination with vitamin B2 for reducing migraine frequency
- Related conditions include: Hypertension, Migraines, Type 2 Diabetes, and more.

Digestion, Absorption, Metabolism

- Digestion: The chemical and mechanical breakdown of food into smaller molecules. In this process enzymes break down the carbohydrates from the foods into sugars, fats into fatty acids, and proteins into amino acids and glycerol. Magnesium helps digestion by activating enzymes that help in breaking down food and also by supporting muscle contractions in the digestive tract for regular bowel movements.
- Absorption: is the process of a transfer of nutrients from the digestive tract into the lymph of bloodstream. The key process in absorption is nutrients which pass through the intestinal wall and into the blood vessels to be delivered to the body. Magnesium regulates the transport of minerals across the cell membranes which support the proper nutrient uptake in the intestines
- Metabolism: All the chemical reactions done within the body that use nutrients in order to produce energy or help build cell components. Magnesium supports metabolism by acting as a cofactor which is a non protein substance that helps an enzyme properly work. Magnesium does this is over 300 different enzymatic reactions including anabolic and catabolic reactions

Excess and Deficiency

- Excess can be caused from medications or supplements
  - Effects: Diarrhea, low blood pressure, and cramping
    - The NIH writes, "Very large doses of magnesium-containing laxatives and antacids (typically providing more than 5,000 mg/day magnesium) have been associated with magnesium toxicity"(NIH).
- Deficiency can be caused by an improper diet, alcohol use, or medication
  - Effects: Muscle weakness, hypertension, fatigue

FUN OR HISTORICAL FACTS

- Sir Humphry Davy first isolated magnesium in 1808
- Magnesium is the fourth most abundant mineral in the body.
- Magnesium was used as a curative as early as ancient times, in the form of laxatives and Epsom salts.
- Magnesium is regularly used in the acute treatment of eclampsia during pregnancy and acute myocardial infarction
- 50-60% of body magnesium is incorporated into the crystal mineral lattice of bones and teeth.
- There are about 4-6 teaspoons of magnesium in the human body.
- Only 1% of totally body magnesium is found in the blood, the remainder is found in the bone and inside the cells of the muscles, heart and liver.
- Only about 20-50% of magnesium intake is actually absorbed by the body.

FOOD SOURCES

The NIH states, "The DV for magnesium is 420 mg for adults and children age 4 years and older"(NIH).

- Almonds
  - 1 Oz(~23 nuts) ~ 80mg
- Spinach
  - 1/2 Cup ~ 78mg
- Cashews
  - 1Oz ~ 74mg
- Yogurt
  - 1 Cup ~ 42mg
- Milk
  - 1 Cup ~25mg

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This poster was created as part of the UNC Nutrition Research Institute's Virtual Internship Program

Omega-3 Fatty Acids

Did you know that people who eat seafood at least once a week are less likely to of heart disease than people who rarely or never eat seafood?

Student Name: Latika Sazzala

Student Name: Smira Susarla

NUTRIENT INTRODUCTION

Did you know that your body is nearly 60% fat? But not just any fat—essential fats like omega-3s play a key role in keeping your brain sharp, your heart healthy, and your body balanced. Omega-3 fatty acids are a group of polyunsaturated fats that our bodies can't make on their own, which makes it vital to get them through the foods we eat. The name "omega-3" comes from their chemical structure—specifically, the first double bond appears at the third carbon atom from the omega (or methyl) end of the fatty acid chain. This small detail has a big impact, influencing how these fats function in your body. According to data from the 2011–2012 National Health and Nutrition Examination Survey (NHANES), most children and adults in the United States consume recommended amounts of omega-3s in the form of Alpha-Linolenic Acid (ALA). As research continues to uncover how omega-3s influence everything from memory and mood to inflammation and immunity, it's clear that they're more than just a health trend —they're a crucial part of a healthy life.

WHY IT'S IMPORTANT

Omega-3's have many roles in your body such as providing calories that help give your body the energy it needs to go through with everyday tasks, as well as in helping in the functions of the heart, lungs, blood vessels (etc.). Omega-3's also are one of the important components within the membranes that cover each cell in the body.

Some of the effects of omega-3's on health include: lowering the risk of cardiovascular disease (eating healthy while including fatty fish and other types of seafood can aid in protecting you from heart related problems); cancer prevention(studies suggest that people who are getting more of the omega-3's through dietary supplements and food have a lower chance of colorectal cancer and breast cancer); cognitive function (research shows that people who are consuming more omega-3's through fish have a lower risk of developing dementia, Alzheimer's disease, and other cognitive function related problems).

HOW IT WORKS

Once consumed through foods like fatty fish, flaxseeds, or chia seeds, omega-3 fatty acids begin their journey through the digestive system. In the small intestine, they are broken down by pancreatic enzymes, primarily lipases, which convert them into free fatty acids and monoglycerides. These smaller components are then absorbed by the intestinal lining and repackaged into chylomicrons—lipid transport particles that carry omega-3s through the lymphatic system and into the bloodstream. Once circulating in the body, omega-3s are delivered to various tissues, where they are incorporated into cell membranes, converted into bioactive molecules like eicosanoids and resolvins (which help reduce inflammation), or used for energy through beta-oxidation. The efficiency of absorption can depend on the form—omega-3s from fish oil (EPA and DHA) tend to be better absorbed than plant-based ALA. Overall, this complex process allows omega-3s to influence everything from heart health to brain function.

TOO MUCH/TOO LITTLE

The recommended intake of EPA and DHA combined from dietary supplements is no more than 5/g a day (as per the U.S. FDA). There can be side effects from excessive intake of supplements (although mild) such as: heartburn, nausea, bad breath, diarrhea, headache, and stomach discomfort.

Although rare in the U.S., omega-3 related deficiencies can occur. A deficiency can cause scaly skin that is rough, as well as an itchy rash that is swollen.

FUN OR HISTORICAL FACTS

There are many fun historical facts that got us to our vast understanding of Omega-3 Fatty Acids today:
Greenland Eskimo Study (1970s): Danish researchers Bang and Dyerberg found that Inuit populations, despite high-fat diets, had low rates of heart disease. Their secret? A diet rich in omega-3s from fish and seal meat—this discovery kickstarter global interest in omega-3s.
Ancient brain food: Early humans likely evolved larger brains partly due to diets high in omega-3-rich seafood, especially along African coastlines.
Traditional medicine: Ancient civilizations, like the Greeks and Egyptians, used fish oils medicinally—though they didn't know about omega-3s, they knew fish helped with inflammation and general health.
Modern breakthrough (1929): George and Mildred Burr discovered essential fatty acids, laying the foundation for understanding omega-3s as vital nutrients.

FOOD SOURCES

There are a variety of food sources that provide omega-3's which include:
Fish and seafood (cold-water fatty fish: salmon, tuna, herring, and sardines)
Plant oils (flaxseed, soybean, and canola oil)
Nuts and seeds (flaxseed, chia seeds, and walnuts)
Fortified foods (certain brands of eggs, juices, yogurt, milk, soy beverages, and infant formulas)

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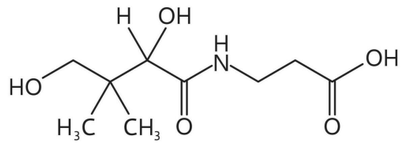
Panthothenic Acid

Student Name: Sid Dutta

Student Name: Vishu Venkatesh

NUTRIENT INTRODUCTION

Also known as Vitamin B5, it is a water soluble nutrient that is used for metabolic functions around the body. It help turns the food that we eat into energy that our body can use. Vitamin B5 breaks down the individual macronutrients such as carbohydrates, proteins, and fats [1].



WHY IT'S IMPORTANT

It plays a very important role in the body becaues it is used throughout many different body functions [3].

- Mainly, it is used for energy production and metabolizing the fats, carbs, and proteins that we eat.
- Making red blood cells and proper brain function.
  - Important for synthesis of acetylcholine which is a neurotransmitter used for memory and muscle contraction.
  - Enhances skin, hair, and nail health through moisturizing abilities [3].

HOW IT WORKS

Digestion:
- It is present as part of coenzyme A or a carrier protein. These complexes are broken down in the small intestine. by enzymes into 4' phosphopantetheine, and then are dephosphorylated to pantetheine and then hydrolyzed to panthothenic acid to be absorbable by the body [6].

Absorption
- About 50% of dietary panthothenic acid is absorbed
- Free Panthothenic acid is absorbed through a sodium dependent active transport system (SMVT)
- Passive diffusion happens sometimes during saturation at higher dietary intakes.
- It enters the bloodstream by red blood cells [6].

Metabolism
- Synthesized CoA and ACP is formed distributed in the body, found most in the liver and kidneys and etc
- Excess acid is excreted in urine since it cannot be stored in large amounts [6].

TOO MUCH/TOO LITTLE

Too Much:
It is actually considered safe at a high level because the toxic effects are considered to be rare, and there has not been an established tolerable upper intake level. However, there is a chance that it can lead to:
- Diarrhea or other stomach upsetting issues when taken in doses of 10 grams or more.
- Toxicity has generally not been observed in food which has a lot of this nutrient [3].

Too Little:
This is very rare to happen because it is found in majority of food. When it does happen, it is linked to genetic disorders, and cause issues such as fatigue, restlessness, headaches, or numbness. Muscle cramps and vomiting can happen as well [3].

FUN OR HISTORICAL FACTS

- The name comes from Greek word "pantou", which means "everywhere". This is due to the natural abundance of this nutrient as its found in food all around us [4].
- It was discovered in 1933 by Roger J. Williams, as he found it was necessary to grow yeast. He named it panto because he found it widely distributed through all kinds of food [1].
- A single avocado contains 2.8g of pantothenic acid which is over 50% of your recommended daily intake [5].

FOOD SOURCES

The good thing about panthothenic acid is that it is found in almost all food sources [2].

Most abundant in:
- Liver/Kidney
- Sunflower seeds
- Avocados
- Mushrooms
- Eggs
- Whole grain

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The Nutritional Significance of Potassium (K)

How does potassium impact our bodies, and what should you know about it?

Student Name: Aryan Garg

Student Name: Dhiyaa Ravi

NUTRIENT INTRODUCTION

Potassium is a mineral - it is on the atomic scale

Electrolyte - potassium usually found as ion (K+), dissolves in water, and is lost by body through sweat

19th element on periodic table, group 1 Alkali metals

Name Potassium comes from "potash," or ashes of certain potted plants, and symbol K comes from latin Kalium.

Controls nerve signals, transmissions, all of which control human muscle movement. Without potassium, there wouldn't be a connection between our brain and the rest of our body,

WHY IT'S IMPORTANT

Potassium is a mineral and electrolyte that helps the body work properly [1].
It controls fluid balance, muscle movement, and how nerves send signals [1].
About 98% of the body's potassium is stored inside cells [2].
It helps the heart beat normally and supports healthy blood pressure [1].
After we eat potassium-rich foods, the mineral is absorbed in the digestive system [3].
Potassium moves into cells with the help of a special protein called the sodium-potassium pump [3].
This pump helps keep the inside of cells balanced and ready to respond to signals [3].
The kidneys get rid of any extra potassium through urine [4].
After meals, potassium quickly moves into cells to keep blood levels steady [4].

HOW IT WORKS

In neurons (nerve cells), action potentials are sent between connecting cells by sending an "electrochemical gradient" down a line of cells. This gradient is just a charge difference [11]
K+ concentrations inside cell are 30x K+ concentration outside cell, creating an electrical charge difference between two cells, triggering release of neurotransmitters, like dopamine, serotonin, etc. [11]
These regulate everything from thoughts, emotions, muscle cells, voluntary/involuntary organ systems [11]
We need K+ for two main purposes [11]
1- balance out sodium (Na+), Na+ charges get replaced by K+ charges in the membrane of neurons
2- create a electrochemical gradient which allows our brain to communicate with our organs and muscles

TOO MUCH/TOO LITTLE

DV guideline: 4700mg = 4.7 g [10]
Standard range between 3.5 to 5.2 mmol/L of potassium,
Hypokalemia: too little, 21% of us population [10]
Cramps, fatigue, lack of muscle function, heart problems
Hyperkalemia: too much, 2% of us population [10]
High blood pressure, cardiac arrhythmia, high blood pressure
Normal range is a guideline, can be different for different people.
People with good kidney function and good heart health are okay even if they have too much potassium. However, if your kidney function is poor, it can be dangerous because your kidneys won't efficiently excrete potassium and sodium. [10]

RECENT RESEARCH

Studies show that eating more potassium may reduce the risk of stroke and heart disease [6].
Potassium may help lower blood pressure, especially for people who eat a lot of salt [6].
In people with kidney problems, low potassium may make the disease worse over time [7].
Healthy potassium levels are between 4.0 and 5.0 mEq/L in the blood [5].
Very high or low potassium levels are linked to higher death rates [5].
Teen girls who ate more potassium had lower blood pressure as they got older [1].
A healthy diet with enough potassium may help protect the brain and kidneys [7].

FOOD SOURCES

10 quality sources of potassium [8] [9]
Beet greens 39 calories, 28% DV per cup
Salmon 309 calories, 23% DV per 6oz fillet
White beans 249 calories, 21% DV per cup
Avocado 322 calories, 21% DV per avocado
Potato 161 calories, 20% DV per potato
Squash 115 calories, 19% DV per cup
Milk 205 calories, 16% DV per glass
Mushroom 44 calories, 12% DV per cup
Banana 134 calories, 11% DV per banana
Tomato 43 calories, 11% DV per tomato

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Riboflavin: The Essential B2 Vitamin for Cellular Energy

By: Venkat Ramanavar and Neve McMakin

NUTRIENT INTRODUCTION

- Riboflavin is one of the eight essential B vitamins.
- It is water-soluble, meaning it dissolves in water and is not stored in the body — so it must be consumed regularly.
- Plays a critical role in energy metabolism by helping break down carbohydrates, proteins, and fats into energy.
- Vital for the functioning of the electron transport chain, which produces ATP — the body's main energy currency.
- "Ribo-" comes from ribitol, a sugar alcohol related to ribose
- "Flavin" comes from the Latin word "flavus", which means yellow

WHY IT'S IMPORTANT

Riboflavin is vital to many bodily functions. Specifically, Riboflavin aids in cell growth/reproduction, red blood cell production, and release of energy from proteins. For example:

- Riboflavin is an essential component of two major co-enzymes: flavin mono nucleotide (FMN) and flavin adenine dinucleotide (FAD), which work in cellular respiration as vital electron carriers.
- Riboflavin converts the antioxidant glutathione into its active form, protecting cells from oxidative stress.
- Riboflavin aids the absorption of iron into the blood stream preventing diseases such as anemia.

HOW IT WORKS

Riboflavin is usually found in food bound to proteins. During digestion, enzymes in the stomach and small intestine release it from these proteins. Free riboflavin is then absorbed mainly in the small intestine, through active transport when intake is low and passive diffusion when intake is high. Once absorbed, riboflavin is converted into its active coenzyme forms, FMN (flavin mononucleotide) and FAD (flavin adenine dinucleotide). These coenzymes are essential for many redox (oxidation-reduction) reactions involved in energy metabolism, helping the body generate ATP and support the function of over 100 enzymes.

TOO MUCH/TOO LITTLE

Riboflavin deficiencies caused by an insufficient intake or absorption of the vitamin B2 are commonly observed in humans living in developing countries, as well as vegans, those with chronic alcoholism, women on birth control, and infants being fed unfortified formula. Symptoms often include mouth sores, swollen or inflamed tongue, light sensitivity, and fatigue. In more severe cases, Riboflavin deficiencies can impair the body from absorbing other essential nutrients. There are no real known toxic effects from an excessive intake of Riboflavin as it is a water soluble vitamin. Excess Riboflavin is excreted from the body through the urine.

FUN OR HISTORICAL FACTS

- Discovered in the early 1900s, riboflavin was originally known as "the yellow enzyme" because of its bright color.
- In 1935, German chemist Richard Kuhn isolated and named riboflavin and won the Nobel Prize in Chemistry in 1938 for his work on vitamins.
- It was one of the first vitamins to be chemically synthesized, making it easier to add to supplements and fortify foods like cereal and flour.
- Riboflavin is destroyed by sunlight, which is why milk is no longer sold in clear glass bottles,

FOOD SOURCES

Riboflavin cannot be produced by the human body and therefore must be consumed. It is naturally found in a variety of foods, including dairy products such as milk and yogurt, eggs, leafy green vegetables like broccoli and spinach, lean meats, organ meats specifically liver and kidney, legumes, and nuts. In many countries, common staple food like breads, cereals, and pasta are fortified with Riboflavin to help prevent deficiencies. Incorporating a balanced diet that includes both plant and animal based sources can ensure an adequate intake of this essential nutrient.

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Selenium

Student Name: Ananthu Nair

NUTRIENT INTRODUCTION

Selenium is a trace mineral that your body needs in very small amounts, but it plays an essential role in overall health. The name comes from the Greek word Selene, meaning "moon," because it was discovered shortly after tellurium, which was named after the Earth.

Although it may not receive as much attention as nutrients like calcium or iron, selenium is equally important, particularly for the thyroid gland, immune system, and defense against cell damage. It's also special because, as one of the more recently discovered essential nutrients. its significance wasn't entirely acknowledged until the 20th century.

WHY IT'S IMPORTANT

Selenium helps in protecting your body against the damaging effects of free radicals, which are dangerous chemicals that can accumulate over time and cause illnesses. It does this by producing antioxidant enzymes, particularly glutathione peroxidase. Additionally, selenium is important for maintaining the health of your thyroid gland, which influences how your body uses energy. Selenium may even help lower inflammation and increase fertility, according to some research. Even though you only need a small amount, selenium plays a big role in keeping your body balanced and strong.

HOW IT WORKS

Selenium is absorbed in the small intestine, primarily in the duodenum, when consumed in food. When selenium enters your bloodstream, it is converted into selenoproteins. which are vital proteins that carry out vital functions all over your body. These proteins shield your cells from oxidative stress, which over time can harm tissues, and help control your thyroid hormones and immune system. To use it when needed, your body stores selenium primarily in the muscles and liver. Because selenium is involved in so many systems, even slight variations in its levels can have an impact on how your body works.

TOO MUCH/TOO LITTLE

Deficiency in selenium can lead to fatigue, weakened immunity, and weakness. In areas with very low soil selenium levels, severe deficiencies can result in Kashin-Beck disease, which affects bones and joints, or Keshan disease, which affects the heart.

Excess selenium, typically from supplements, can be harmful. This disorder. known as selenosis, can result in nerve problems, stomach problems, brittle nails, and hair loss. Balance is important because teens and adults require roughly 55 micrograms per day and exceeding 400 micrograms can be harmful.

FUN OR HISTORICAL FACTS

1. Selenium was discovered in 1817 by Swedish chemist Jöns Jakob Berzelius
2. It was originally believed to be toxic, but later research showed it's essential in small amounts.
3. Brazil nuts have such high selenium levels that just one nut can meet or exceed your daily needs.
4. In some regions with low-selenium soil, like parts of China, deficiency-related health problems have been reported.
5. Selenium is also used in technology, including photocopiers, solar panels, and glass production due to its electrical and chemical properties.

FOOD SOURCES

Selenium can be found in many everyday foods. both plant-based and animal-based. Eating a balanced combination of these foods typically makes getting enough from your diet easy:

- Brazil nuts - one nut gives more than your daily need
- Seafood - like tuna. salmon. and sardines
- Poultry- chicken and turkey
- Eggs and whole grains - easy everyday sources
- Sunflower seeds and mushrooms - great plant-based options

Eating a mix of these foods can help you meet your selenium needs naturally.

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Sodium

Student Name: Benjamin Ahn

Student Name: Stella Zhu

NUTRIENT INTRODUCTION

Sodium, represented as "Na" on the periodic table, is a highly reactive metal. In nature, it is commonly found in compounds such as sodium chloride (table salt), which makes it more stable.

In the past, salt was sought after for its ability to preserve food, specifically meat and fish, which allowed for trade. Salt can also be used for maintaining weeds as a natural herbicide, or for exfoliation in bath salts. Nowadays, salt is heavily abundant in our diet, which can lead to a higher risk for stroke or heart disease.

WHY IT'S IMPORTANT

Sodium's main role in the human body is to maintain blood pressure and volume. When a person intakes food or drink that contains sodium, the sodium attracts and intakes the water from the bloodstream thus creating more blood. The volume of the blood depends on the amount of sodium a person intakes.

Additionally, sodium maintains the pH balance, allows the body to absorb nutrients including glucose, regulate electrical impulses that triggers muscles like the heart to move, and helps regulate nerve signal transmissions.

HOW IT WORKS

Sodium is a mineral, and primarily controls fluid balance, nerve impulse transmissions. Sodium aids in the communication between brain and body (i.e. muscle movement), which is why it is commonly found in sports/electrolyte drinks, such as Gatorade or Liquid IV.

When sodium is consumed, it is absorbed by the small intestine and enters the bloodstream. The kidneys then regulate the amount of sodium in the body by balancing it with water to keep the body in homeostasis.

TOO MUCH/TOO LITTLE

Although the federal recommendation of consuming sodium is less than 2,300 milligrams per day, according to the CDC (Center for Disease Control and Prevention), an average American consume more than 3,300 milligrams of sodium every day.

Too much Sodium can increase a person's risk of heart disease or stroke, high blood pressure, swelling, dehydration, increase weight, weakness, diarrhea, and trouble with sleeping.

However, an abnormally low amount of Sodium can cause Hyponatremia which happens due to too much fluid in the blood stream. This can cause symptoms including nausea, headache, confusion, seizure, weakness, coma, and more.

FUN OR HISTORICAL FACTS

- Due to salt's usefulness in preserving food, many wars were fought over the control of salt mines, and the trade of salt was heavily regulated.
- The origin of the word "salt" comes from the Proto-Indo-European root "sal-", which means "to glitter" or "to shine".
- In 1807, after isolating sodium from sodium hydroxide (NaOH) using electrolysis, Sir Humphrey Davy found that sodium was a metal.

FOOD SOURCES

- Table salt contains the most sodium (40%)
- Dishes using grain (such as pasta)
- Chips, crackers, salty snacks
- Breads and tortillas
- Processed meat like bacon or ham
- Soup, especially canned
- Pizza
- Frozen food

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Vitamin B6

NUTRIENT INTRODUCTION

Vitamin B6 is a water-soluble vitamin. However, the body does not store it in large amounts. It is found naturally in many foods, as well as added to foods and supplements; it is one of the eight B vitamins.

WHY IT'S IMPORTANT

Vitamin B6 is important because it plays a key role in brain development, maintenance, the nervous system, and the immune system.

HOW IT WORKS

1. Vitamin B6 comes from foods like tuna and nuts.
2. In the intestines, enzymes remove the phosphate so the body can absorb it.
3. The forms pyridoxine (PN), pyridoxal (PL), and pyridoxamine (PM) are absorbed and changed into the active form, pyridoxal phosphate (PLP), inside intestinal cells.
4. PLP then enters the bloodstream and is processed in the liver.

FUN FACTS

Fun Facts

- Check with your doctor before taking vitamin B-6 if you're using any medications. Possible drug interactions include:
- Altretamine. Taking vitamin B-6 with this chemotherapy drug might reduce its effectiveness, especially when also combined with the chemotherapy drug cisplatin.
- Levodopa. Avoid taking vitamin B-6 with this drug used to treat Parkinson's disease. Vitamin B-6 might reduce the effectiveness of the drug.

TOO MUCH/TOO LITTLE

Recommended daily amount for 50 and younger is 1.3mg
Recommended daily amount for those older than 50 is 1.5mg for women and 1.7mg for men.

Too much:

- A lack of muscle control or coordination of voluntary movements (ataxia)
- Painful, disfiguring skin lesions
- Heartburn and nausea
- Sensitivity to sunlight (photosensitivity)
- Reduced senses

To little:

- Depression
- Mouth and tongue sores (glossitis)
- Peripheral neuropathy
- Lack of vitamin B6 in the body is uncommon.

FOOD SOURCES

Vitamin B6 is found in:

- Tuna and salmon
- Banana
- Legumes (dried beans)
- Beef and pork
- Nuts
- Poultry
- Whole grains and fortified cereals
- Chickpeas
- Fortified breads and cereals may also contain vitamin B6.

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Student Name: Jasmine W
Stud e: Srihamsini Telekepalli

Adobe Express

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Vitamin B6

Student Name: Tamanna Ramprasad

Student Name: Sophia Almeida

NUTRIENT INTRODUCTION

- Vitamins are **organic compounds** the body needs to survive
- Sixth B-Vitamin discovered
- Also called **Pyridoxine** because of its similarity to pyridine
- Refers to any of the 6 related compounds also called **vitamens**
- It cannot be stored in the body due to being **water-soluble**
- Involved in keeping blood sugar levels stable, production of antibodies, making hemoglobin, and protein breakdown

HOW IT WORKS

- Consumed through food/supplements often in **phosphorylated forms**
- Digested and then travels to the small intestine specifically the **jejunum**
- **Brush border Membrane of the Small Intestine helps with De-phosphorylation**
  - The phosphate group is removed for absorption by the intestinal cells
  - Passes through passive diffusion
  - Goes through the **villi, microvilli**, and enters the bloodstream
  - **phosphorylation** occurs for it to becomes active again and become **PLP**
- **PLP** binds to proteins to be transported in bloodstream
- Small amounts stored in **liver/muscles**
- **Excess** Vitamin B6 converted to 4-pyridoxic acidic and removed as urine
- Works as coenzyme to synthesis **over 100** different molecules

FUN OR HISTORICAL FACTS

- was experimentally discovered when new diets in rats lead to **acrodynia**
- Usually caused by mercury exposure
- In the 1930s, they discovered the reason for this skin condition in rats was vitamin B6
- Food Sources
  - Chicken,Fish,Potatoes,Chickpeas,Bananas

WHY IT'S IMPORTANT

- Mainly functions as a **cofactor**
- It can also be an "**electron sink**" stabilizing electrons during a reaction
- Helps create **neurotransmitters** like dopamine and serotonin
- synthesizes **Heme** for hemoglobin
- helps remove sulfur or **transsulfuration** of homocysteine to turn it into cysteine
- decreases homocysteine amino acids levels to decrease depression and Alzheimers
- lowered levels on homocysteine also helps heart disease and prevent arterial blockage
- May lower colorectal cancer by reducing cell proliferation and other cancer formations

TOO MUCH/TOO LITTLE

- **Overconsumption** of vitamin B6 through food is harmless
- However, through supplements, it may lead to
  - uncontrollable muscles, photosensitivity, numbness, heartburn, nausea, and skin tissue damage in the skin
- A deficiency of purely vitamin B6 is uncommon
  - Usually presents itself in all vitamins B (like B12, etc.)
  - Generally common with people suffering from **renal dysfunction**, **autoimmune disorders, and dependence on alcohol**
  - Symptoms include confusion, depression, swollen tongue, cracks on lips and corners of the mouth, or anemia
  - May also manifest as irregular brain waves on **EEG**

CURRENT RESEARCH

- **Medical News Today** reported that Vitamin B6 + Doxylamine is an **FDA-approved** treatment for nausea and vomiting during pregnancy. Supported by the **American College of Obstetricians and Gynecologists (ACOG)**, studies involving over 200,000 pregnant women found it to be safe and effective, with no link to birth defects.
- **Vitamin B6 is a critical coenzyme in over 140 biochemical reactions. New findings in 2018 showed**
  - Role in Neurotransmitter Production, Hormone Regulation, Amino Acid Metabolism
  - Has Antioxidant Properties
  - Has Potential in pathogen resistance and drug development like Malaria and Epilepsy
  - **"Golden Rice"** Bio-fortification for plants in places with limited access to diverse diets to help increase nutritional intake

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Vitamin C

A Closer Look At What It Does and Why It Matters

Student Name: Taegan Bajda

Student Name: Ahyoung Song

NUTRIENT INTRODUCTION

Vitamin C is an essential micronutrient, with pleiotropic (multiple) functions related to its **ability to donate electrons**. It is a **cofactor for gene regulatory enzymes** and has **antioxidant properties**, helping protect immune cells and tissues. Specifically, it regenerates antioxidants within the body, **shielding cells from damage caused by free radicals (taking of electrons)**. The name "Vitamin C" has a significant meaning, especially its **scientific name, ascorbic acid**, which means "without scurvy." This nutrient **helps prevent scurvy**, a potentially fatal disease.

WHY IT'S IMPORTANT

Vitamin C supports various biological processes, primarily assisting **immune defense**. For example, because it influences the activity of certain genes, Vitamin C **helps B-cells and T-cells (types of immune cells) grow and develop**. Therefore, Vitamin C's role includes **reducing the severity and length of the common cold**, **improving respiratory systems** in elderly pneumonia patients, **strengthening people's epidermis** (outer layer of skin, acts like barrier), and **healing wounds**, especially by participating in **collagen synthesis**.

HOW IT WORKS

Unlike fat-soluble vitamins like A,D,E,K, vitamin C is a **water-soluble vitamin**, so it is **absorbed in the small intestines** and doesn't need lipoproteins. Once absorbed, it is **distributed** throughout various parts of the body, with the highest concentrations found in the brain and adrenal glands. If there is too much vitamin C, the kidneys will excrete them via urine. The best way to **maximize vitamin C absorption** is eating with foods containing iron, especially **non-heme iron**, or iron that isn't found in hemoglobin (animal tissue). This is why we typically see citrus fruits on our salads with green vegetables since they contain non heme iron.

TOO MUCH/TOO LITTLE

Scurvy is caused by a **severe deficiency of vitamin C.** It causes gingivitis (inflammation of gums), poor wound healing, pinpoint hemorrhages (signs of collagen breakdown), muscle and joint pain, and many other dangerous symptoms. However, too much or a **toxicity/hypervitaminosis** of vitamin C is equally detrimental to our health. Too much vitamin C can cause oxalate kidney stones, raised uric acid level, rebound scurvy after withdrawing from high doses, and more. Therefore, although vitamin C is a water-soluble vitamin and doesn't get stored in the liver like vitamin A, excessive amounts should be avoided.

FUN OR HISTORICAL FACTS

- Ancient times: scurvy recognized and **onions used to treat it**
- 1700s: Lind's citrus cure trial, Navy used citrus to stop scurvy
- 1800s: British Navy **switched to limes, causing problems**
- Early 1900s: Vitamin C named and isolated
- 1937: **Nobel Prize for discovery** (Szent Gyorgi and Haworth)
- 1970: Pauling promotes high-dose Vitamin C for colds
- 2007: final plant Vitamin C enzyme identified and understood
- **Current times**: research is exploring the potential of Vitamin C to prevent or delay the development of certain cancers and cardiovascular disease (observational and laboratory studies)

FOOD SOURCES

- All citrus fruits
- Tomato juice / tomatoes
- Potatoes
- Broccoli (*vegetables)
- Kiwifruit, grapefruit
- Red and green peppers (*raw, cooking reduces content)
- Strawberries
- Brussels sprouts
- Cabbage, cauliflower, spinach, green peas, etc.

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VITAMIN D

Is sunshine the best supplement? Let's find out!

NUTRIENT INTRODUCTION

Vitamin D is the collective name for *cholecalciferol* (vitamin D3) and *ergocalciferol* (vitamin D2), which are precursors of hormones with an important role in regulation of the metabolism of calcium and phosphates. [1]

Vitamin D is both a **nutrient** we eat and a **hormone** our bodies make. It is a fat-soluble vitamin. [2]

WHY IT'S IMPORTANT

- Supports calcium absorption and bone mineralization
- Fights against infections and chronic diseases
- Supplements are safe, effective, and cost-efficient
- Plays a role in muscle and brain function, reducing falls and supporting mood
- Helps maintain overall immune and skeletal health [3]

HOW IT WORKS

Vitamin D3 (cholecalciferol) is produced in the skin when exposed to UVB rays, converting 7-dehydrocholesterol into pre-vitamin D3, which then becomes vitamin D3. It enters the bloodstream bound to a carrier protein and travels to the liver, where it's converted into 25-hydroxyvitamin D — the main circulating form used to assess vitamin D levels. This form then moves to the kidneys, where it's activated into calcitriol, the hormone responsible for most of vitamin D's effects. Calcitriol binds to receptors in target organs like the intestines, bones, and kidneys to help regulate calcium levels and gene expression. [4] [5]

TOO MUCH/TOO LITTLE

VDD can lead to:

- Weak bones (rickets in children, osteomalacia in adults)
- Muscle weakness and fatigue
- Increased risk of infections and chronic diseases

Excess of Vitamin D can lead to:

- Hypercalcemia (too much calcium in the blood)
- Nausea, vomiting, and kidney problems
- Calcification of soft tissues (like kidneys, heart, or lungs) [10]

SOURCES

Sunlight (UVB exposure)
Fatty fish
Egg yolks
Fortified cereals
Fortified plant-based milks
Fortified orange juice
Cod liver oil
Beef liver
UV-exposed mushrooms
Cheese (small amounts)
Infant formula (fortified in many countries)
Vitamin D supplements (D2 and D3)
[6]

FUN or HISTORICAL FACTS

NEW / CURRENT RESEARCH

A randomized trial found that vitamin D supplements help preserve telomeres, which shorten with age and are linked to disease. [7]

Low maternal vitamin D in the first trimester is linked to reduced fetal growth and increased risk of preterm birth. [8]

New research shows that regular moderate exercise helps maintain vitamin D levels during darker months, even without supplements or weight loss. [9]

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Student Name: HANEYYA UMER SIDDIQUI

Student Name: YUVIKA VASHISTH

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Vitamin E

Student Name: Daniela Salazar Sola

Student Name: Taiwo Olabode

NUTRIENT INTRODUCTION

Vitamin E is an extremely important nutrient in the body. Not only does it function as an antioxidant, but the fat-soluble nutrient also contributes to the overall health of the body in a variety of ways.

The letter E was assigned to the vitamin because in the early days of nutrient research, vitamins were named in the order that they were discovered.[1] While the name Vitamin E may lead some to believe that the vitamin is only one substance, the term Vitamin E is used to refer to eight different molecules. The most common being α-tocopherol, which is also the most researched form of vitamin E due to its high bioavailability.[2]

WHY IT'S IMPORTANT

One of the primary roles of Vitamin E is its role as an antioxidant. Antioxidants are substances that help mitigate the effects of harmful reactive chemicals produced in the body. If unchecked, these chemicals can cause cancer.[3] Antioxidants also protect the body from unstable molecules called free radicals that can be damaging to cells.[4] These molecules also can lead to cancer or a plethora of other health issues.

Aside from its role as an antioxidant, Vitamin E still has other important functions to perform in the body. Studies have shown that Vitamin E is necessary for supporting the immune system's ability to fight off infection and disease.[5] According to Cleveland Clinic, Vitamin E also acts as a "natural blood thinner" and helps prevent dangerous blood clots.[6]

Overall, it is clear that Vitamin E is an essential nutrient that has multiple roles. Not just in one specific body system, but all over the human body.

HOW IT WORKS

Since Vitamin E is fat soluble, it must first be dissolved into fats in order to be absorbed into the body effectively. The process occurs as follows. First, chewing and the initial stages of regular digestion allow for the vitamin to dissolve into other lipids. In the duodenum, or the initial part of the small intestine, several chemical and physical processes occur to make the vitamin E more readily accessible to the body. Enterocytes, or cells that line the inner intestines, absorb this new form of vitamin E and use a lipoprotein called a chylomicron to transport the vitamin and other substances into the bloodstream.[7] From there, the vitamin is either transported elsewhere, stored in the liver or fat, or excreted.

TOO MUCH/TOO LITTLE

According to Medline, the recommended daily intake of vitamin E for persons 14 years and older is **15mg per day**.[8] Due to the presence of fortified and enriched foods today, vitamin E deficiencies are uncommon, and usually a result of underlying conditions that prevent the absorbance or digestion of fat in the body.[9]

However, deficiencies are still extremely harmful. A lack of this essential nutrient can cause peripheral nerves to die off, which can lead to a neurological condition known as ataxia.[10] Ataxia is described as "poor muscle control" by Cleveland Clinic.[11] Prolonged vitamin E deficiency can also lead to a weakening of the heart and other muscles

An excess of vitamin E can also have many negative consequences. Since vitamin E is a natural blood thinner, taking supplements or excessive amounts while also taking other prescription blood thinners can make excessive bleeding more likely.[12] Excess vitamin E may also prevent vitamin K from functioning optimally.[6]

FUN OR HISTORICAL FACTS

Vitamin E was first discovered in 1922 by Herbert McLean Evans and Katherine Julia Scott Bishop at UC Berkeley. They tested pregnant rats by feeding them 2 distinct diets, one regular and another breasts milk augmented with lard. The rats fed the altered milk didn't produce viable offspring, but were able to with wheat supplemented in. Unveiling Vitamin E to the world.

According to the National Library of Medicine the proper name for Vitamin E is known as Tocopherol. The name "tocopherol" comes from Greek words meaning "birth" and "to bear or carry.[13] Which is a reference to the experiment of pregnant rats which help found Vitamin E.

FOOD SOURCES

Vitamin E is readily accessible in a variety of foods and according to the National Institutes of Health, the vitamin is primarily found in food such as Nuts, seeds, and vegetable oils. Followed by green leafy vegetables and fortified cereals.[14] Vitamin E is a fat-soluble vitamin, so it is best absorbed when consumed with fat. Although due to the nature of American diets. Vitamin E is obtained in the form of gamma-tocopherol from soybean, canola, corn, and other vegetable oils and food product.

For people with dietary restrictions, deficiencies, or diseases that prevent or hinder fat absorption must get Vitamin E in the form of alpha tocopherol in supplements in addition to their daily food.

In general according to University of Kentucky Martin-Gatton College of Agriculture, Food and Environment the United States intake of Vitamin E is low, a deficiency is rare in people with no pre-existing health conditions.[15] In contrast, the daily threshold for Vitamin E is **1,000 milligrams,** but there is no adverse health effects associated with exceeding the amount.

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Vitamin K

Student Name: Hannah Joseph

Student Name: Alyssa Houston

NUTRIENT INTRODUCTION

Vitamin K is one of the fat soluble vitamins which plays a major role in normal blood coagulation. There are two primary forms of it: K1 (phylloquinone) which is available in green leafy vegetables e.g. spinach and kale, and K2 (menaquinone) available in fermented foods and to a lesser extent with animal products.

HOW IT WORKS

Vitamin K aids the body in the production of proteins which aids in the formation of blood clot (clotting) and bone. It mobilizes the clotting factors in liver to avoid excessive bleeding and ligates the combination of calcium in bones and other tissues.

FUN OR HISTORICAL FACTS

Vitamin K is named so because the vitamin has the letter K which is obtained out of German word Koagulation. It was found in 1920s as researchers studying the chicks cholesterol metabolism observed uncontrollable bleeding as a result of deficiency to an unknown substance- which was later discovered to be Vitamin K.
facts

WHY IT'S IMPORTANT

Vitamin K is important for blood clotting, bone health, and calcium regulation in your body. It helps create proteins such as prothrobin for clot formation, as well as osteocalcin for bone strength. Enough vitamin K helps your body with wound healing, reduces your fracture risk, and could help against arterial calcification.

TOO MUCH/TOO LITTLE

Having too little vitamin K can lead to health problems such as excessive bleeding, easy bruising, and slow wound healing because of the decrease in blood clotting. Long-term deficiency could weaken bones and lead to fractures or osteoporosis. In newborns, a deficiency can cause a condition called Vitamin K Deficiency Bleeding (VKDB). Having too much vitamin K is rare and normally not harmful. However, too many supplements, especially vitamin K3, which is a form that isn't recommended for humans, could cause toxicity which would damage your liver and cause red blood cell breakdown.

FOOD SOURCES

- Kale
- Spinach
- Broccoli
- Brussels Sprouts
- Collard Greens
- Lettuce
- Green Beans
- Egg yolks
- Cheese
- Liver
- Chicken

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Vitamin K

All about its function(s) & background information!

Student Name: Mahip Sompura

Student Name: Sohan Jogi

NUTRIENT INTRODUCTION

Vitamin K is a group of vitamins that aid in certain physiological functions. It is made up of the naturally occurring K1 and K2 vitamins, or phylloquinone and menaquinones, respectively.

Menaquinones can be further broken up into different compounds–MK4-MK13. Synthetic constituents include K3 and K4. **Vitamin K plays an integral role in the clotting of blood.** In addition to this, it **contributes to the development of 11 to 12 different proteins that regulate the "calcification of connective tissues"** [1]. This process is extremely important in bones, as well as in arteries. Therefore, it can be concluded that Vitamin K is indispensable in promoting and maintaining cardiovascular and bone health.

WHY IT'S IMPORTANT

First off, Vitamin K is necessary to prevent excess bleeding. Whenever you get a scratch, or fall on your knee, you normally start bleeding. Vitamin K plays a key role in the expression of proteins that naturally modulate bleeding, creating blood clots to close up the injury. Without Vitamin K, our blood would have a tough time clotting, leading to excess bleeding for even the slightest of injuries. Vitamin K doesn't just aid with surface level injuries though, **it aids in the repair of internal blood vessel ruptures.** The second reason why Vitamin K is so important is because it promotes bone density and bone health. It is vital for the maturation of 10+ proteins that aid in the calcification of bones, modulating their expression and effects.

HOW IT WORKS & HOW BODY PROCESSES IT

Vitamin K functions as a cofactor for the enzyme γ-glutamyl carboxylase, enabling the carboxylation of glutamate residues on vitamin K-dependent proteins. This modification allows the proteins to bind calcium and become biologically active. Once activated, these proteins fulfill various roles such as acting as clotting factors, natural anticoagulants, osteocalcin (which promotes bone mineralization), and matrix Gla protein (MGP), which helps prevent vascular calcification [4].

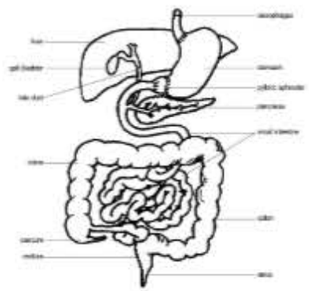
The two main forms in Vitamin K; K1 and K2 are both absorbed in the small intestine with the help of dietary fats and bile salts, then packaged into chylomicrons and transported to the liver via the lymphatic system [5]. In the liver, vitamin K is converted between active and inactive forms for reuse, as vitamin K stores in the human body are limited, especially in the liver [6].

TOO MUCH/TOO LITTLE

Vitamin K deficiency brings about many problems, both physical and physiological.

- **Excessive bleeding/hemorrhage** are common signs of Vitamin K deficiency.
- Since Vitamin K is vital in the calcification of bones–the process in which strong minerals are deposited into the bones, making them strong–its absence would cause **bone weakness, lack of bone mineralization, and even osteoporosis.**
- Such a deficiency can occur naturally through many ways; low vitamin content in breast milk, low placental transfer of vitamin k, and low clotting factors [3]. These are mainly infantile scenarios. *Adult deficiency is extremely rare, and is normally due to an underlying disorder or drug use.* In its natural form (K1 and K2),
- Vitamin K is not known to cause toxicity, even at high rates. However, synthetic forms including **K3 (Menadione) at high levels may lead to oxidative damage and liver toxicity**.

FUN OR HISTORICAL FACTS



Vitamin K can be found in the liver, brain, heart, pancreas, and bones.

Did you know? Vitamin K2 is produced by gut bacteria! This is why maintaining a healthy gut is crucial for having healthy Vitamin K levels.

FOOD SOURCES

IVitamin K can be commonly found in "green leafy vegetables, vegetable oils, and cereal grains" [2]. More specifically, Vitamin K1–phylloquinone–is found in several vegetables, while Vitamin K2–menaquinone–is in fermented cheeses; K2 can be traced to "bacterial origins" [1].

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Zinc: Your Body's Mineral Genius!

Student Name: Sadie Okner

Student Name: Mariah Victorien

NUTRIENT INTRODUCTION

- 140 BCE then 1651 [7][5]
- German derived from Persian word meaning stone [6]
- micro nutrient [3]
- found in all body tissue and fluids [3]
- essential to enzymes digesting food [3]
- helps immune and metabolism [3]

WHY IT'S IMPORTANT

Zinc is significant because it is essential for many internal processes. It aids in healing wounds, boosts the immune system, and is necessary for healthy growth and development, particularly in childhood and adolescence. Along with supporting the activity of more than 300 enzymes involved in digestion, nerve function, and metabolism, zinc plays a role in DNA synthesis and cell division. [9] [10]

HOW IT WORKS

- Digestion: In the stomach, stomach acid and enzymes release zinc from food proteins. [8]
- Absorption: Carrier-mediated transport primarily absorbs zinc in the small intestine, particularly the jejunum. Efficiency is dependent on body requirements, dietary factors (such as phytates that can inhibit it). [9]
- Metabolism: After absorption, zinc is carried by the bloodstream attached to proteins such as albumin. Muscles, bones, and organs store trace amounts of it. The body regulates absorption and excretion by controlling zinc levels. [10]

TOO MUCH/TOO LITTLE

Deficiency:

- hair loss, skin changes, eye problems, more infections, wounds not healing, loss of smell and taste, and diarrhea [4]

Excessive:

- nausea, vomiting, loss of appetite, abdominal cramps, diarrhea, and headaches [2]

FUN OR HISTORICAL FACTS

- every cell in the body requires zinc to multiply [1]
- natural insect repellent and sun protector
- can store six times more energy/pound than any battery system [1]
- first used to treat eye ailments [7]

FOOD SOURCES

- Red Meat
- Poultry
- Dairy
- Bread
- Rice
- Oysters

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