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**CLINICAL NUTRITION**

AIU EXAM:

**Nutrients Involved in Blood Health and Immunity**

**ATLANTIC INTERNATIONAL UNIVERSITY  
HONOLULU, HAWAII  
SUMMER 2022**

**September 10, 2022**

## Introduction:

This chapter provides the reader with an overview of the role of blood in maintaining health: from pregnancy to infancy and childhood, and throughout the lifespan. In order for blood to perform its functions of maintaining health, it requires a number of nutrients. These nutrients include iron, copper, zinc, vitamin K, folate, and Vitamin B12. The chapter goes on to describe the impact of each of the above-mentioned nutrients on blood and overall health, and the implications for not maintaining sufficient levels in body. These implications are far reaching, and include child development, motor function, memory, mood, immune function, cardiovascular health, and preventing and healing from disease. The chapter provides information on the interactions between the nutrients and how they can help or hurt nutrient absorption. It provides examples of foods that contain each nutrient as well as situations in which an individual may become deficient in a particular nutrient, including those who consume plant-based diets, the malnourished, individuals who are obese, and individuals who are pregnant. Suggestions are made for supplementation to assist with any deficiencies that are caused by diet, lifestyle or health-related factors.

## Chapter 12 questions:

### 1. The micronutrient most closely associated with blood clotting is

- a. iron.
- b. vitamin K.
- c. zinc.
- d. vitamin B12.

### 2. Which of the following statements about iron is true?

- a. Iron is stored primarily in the liver, the blood vessel walls, and the heart muscle.
- b. Iron is a component of hemoglobin, myoglobin, and certain enzymes.
- c. Iron is a component of red blood cells, platelets, and plasma.
- d. Excess iron is stored primarily in the form of ferritin, cytochromes, and intrinsic factor.

### 3. Homocysteine is a

- a. by-product of glycolysis.
- b. trace mineral.
- c. by-product of incomplete methionine metabolism.
- d. B-vitamin.

### 4. Which of the following cells produce antibodies?

- a. plasma cells.
- b. antigens.
- c. macrophages.
- d. helper T cells.

**5. Breastfeeding promotes infant health because breast milk contains**

- a. antiserum.
- b. ceruloplasmin.
- c. intrinsic factor.
- d. antibodies.

6. **True** or false? Blood has four components: erythrocytes, leukocytes, platelets, and plasma.

7. True or **false**? Iron deficiency causes pernicious anemia.

8. True or **false**? Wilson disease occurs when copper deficiency allows accumulation of iron in the body.

9. **True** or false? Studies suggest that excessive vitamin A, iron, or selenium can impair immune function.

10. **True** or false? Macrocytic anemias can result from deficiencies of either folate or vitamin B12.

**11. In the chapter-opening story, Mr. Katz was given an injection of vitamin B12. Why didn't his physician simply give him the vitamin in pill form?**

Vitamin B12 deficiency is common and the chances of having a B12 deficiency rises with as we age. As we know, symptoms of B12 deficiency include pale skin, shortness of breath, and fatigue, but can also cause the destruction of nerve cells. When this happens, the individual loses the ability to maintain their body position or engage in coordinated movements. When the central nervous system functions are disturbed, the deficiency can further lead to psychological and emotional changes such as confusion, depression, paranoia, and irritability (p. 470)

Due to the fact that B12 injections are time consuming for medical professionals and patients alike, coupled with the fact that insurance does not always cover non-medication treatments, research has been done to investigate whether oral doses of vitamin B12 could produce equivalent results as an injection. Though the studies are

limited, the evidence derived does suggest that 2000 mcg doses of oral vitamin B12 daily and 1000 mcg doses initially daily and thereafter tapered to weekly and then monthly may produce equivalent outcomes intramuscular injections in patients who are B12 deficient (Vidal-Alaball et al, 2005).

The study does note, however, the incidence of vitamin B12 deficiency increases with age, and it is thought that this is due to the fact that elderly people are more likely to suffer from food-cobalamin malabsorption, which is caused primarily by gastric atrophy (Vidal-Alaball et al, 2005).

According to one study, the body absorbs approximately 1.3 percent of a 1,000 mcg oral dose of Vitamin B12. It also found that absorption rates from intramuscular injections, which are absorbed rapidly because of the blood supply in the muscle, were between 55-97% (Carmel, 2008).

As the text notes, most non-vegan individuals under the age of 51 are able to maintain an appropriate level of B12 by consuming foods that contain the vitamin. An estimated 10% to 30% of adults older than 50 years experience gastric atrophy. Gastric atrophy results in low stomach-acid secretion, and since stomach acid separates Vitamin B12 from the protein we consume, if the amount of stomach acid is too low, the body cannot free up a sufficient amount of the vitamin from food sources alone (p. 466).

For this reason, combined with the facts that Mr. Katz condition had already deteriorated to such a great extent, the physician likely felt that intramuscular injection would allow for a more prompt and more absorbable treatment.

**12. Jessica is 11 years old and has just begun menstruating. She and her family members are vegans (that is, they consume only plant-based foods). Explain why Jessica's parents should be careful that their daughter consumes not only adequate iron and zinc but also adequate vitamin C.**

There are several factors involved in Jessica's situation that would make it important for her parents to ensure she is consuming adequate amounts of iron, zinc, and vitamin C. These include the fact that she is a growing child, the fact that she's menstruating, and that she consumes a plant-based diet.

Iron deficiency, the most common nutrient deficiency in the world, can have health consequences. Some populations are at a higher risk for iron deficiency, including children and adolescent girls (p.450). Part of the reason for this is that the amount of iron stored in the body can vary greatly between males and females, with women storing less than men. Females also experienced increased iron loss for reasons related to their menstrual cycle. A typical menstrual cycle, for example, leads to losses approximately 14 mg of iron (Institute of Food and Medicine, 2001).

Another factor related to iron deficiency simply not consuming enough of it in the diet. Plant foods contain only non-heme iron, which is less bioavailable than the heme iron found in animal products. According to the text, the bioavailability of iron from a plant-based diet is only about 10%, while the absorption rate of the standard Western diet is about 14%-18% (p. 449).

Some plant foods such as fortified cereals, soybeans, lentils, and spinach, are good sources of iron, and though non-heme iron is less bioavailable than heme iron, the absorption of non-heme iron can be enhanced by eating them with vitamin C-rich foods (p. 452). This is why ensuring adequate amounts of Vitamin C is also important. In addition to consuming Vitamin C with iron, Jessica's parents could also consider cooking with cast iron cookware since the iron in the pan will be released into the food while it cooks (p.450).

Like iron, zinc absorption rates increase during periods of growth of growth, puberty, and pregnancy. Zinc also assists with regulation of other hormones, such as human growth hormone (HCG), sex hormones, and corticosteroids (p. 456). Importantly, high non-heme iron intakes such as those that might be observed in vegans, can inhibit zinc absorption (p.456). Though supplementation might seem like a good idea, iron supplements are made of non-heme iron, so efforts should be made by Jessica's parents to get most of her daily iron intake from food sources.

**13. Robert is a lacto-ovo-vegetarian. His typical daily diet includes milk, yogurt, cheese, eggs, nuts, seeds, legumes, whole grains, and a wide variety of fruits and vegetables. He does not take any supplements. What, if any, micronutrients are likely to be inadequate in his diet?**

Based on the information provided, Robert may be deficient in Vitamin B12, Iron, and Zinc.

Since Vitamin B12 is found almost exclusively in animal foods, consuming a vegetarian diet increases the risk of deficiency. Individuals consuming a plant-based diet will need to eat foods that are B12 fortified or consume B12 in supplement form (p.466).

Plant foods contain only non-heme iron, which is less bioavailable than the heme iron found in animal products. According to the text, the bioavailability of iron from a plant-based diet is only about 10%, while the absorption rate of the standard Western diet is about 14%-18% (p. 449). Its absorption is largely influenced by the amount of stomach acid a person possesses, so individuals with low levels of stomach acid will have a decreased ability to absorb iron. Iron absorption is negatively impacted by phytates, polyphenols, vegetable proteins, fiber, and calcium, all of which make up a large part of Robert's diet.

Importantly, the phytates and fiber that are found in whole grains and beans also significantly negatively impact zinc absorption, thus a zinc deficiency may be present (p. 457).

**14. Janine is 23 years old and engaged to be married. She is 40 lb overweight, has hypertension, and her mother suffered a mild stroke recently, at age 45. For all these reasons, Janine is highly motivated to lose weight and has put herself on a strict low carbohydrate diet recommended by a friend. She now scrupulously avoids breads, cereals, pastries, pasta, rice, and “starchy” fruits and vegetables. Identify two reasons why Janine should begin taking a folate supplement.**

Jeannine should begin taking a folate supplement for two reasons, which I will detail below.

1) Childbearing

Because Jeannine has cut out many sources of dietary folate such as fortified breads and cereals, she should supplement with folate to ensure adequate levels should she become pregnant. There is overwhelming evidence that folate deficiency or abnormalities in folate metabolism during pregnancy are associated with increased incidence of developmental abnormalities, in particular, neural tube defects (Daly et al, 1995). Folate supplementation can significantly reduce the occurrence of these disorders (MRC Vitamin Study Research Group, 1991). Since Jeannine is engaged to be married and is likely sexually active and capable of becoming pregnant (whether that is her intention or not), she should supplement with folate to help prevent neural tube defects in the baby if she does conceive (p. 468).

2) To prevent heart problems

Folic acid deficiency has been linked to a predisposition to atherosclerotic cardiovascular disease (Verhaar et al, 2002). Given that Jeannine is only 23 years old, overweight, and already experiencing hypertension, it's important that she supplement with folate to support heart health. Likewise, her mother had a stroke at a relatively young age, so Jeannine may be genetically predisposed to heart problems. Folate is necessary for the metabolism of the amino acid methionine and if there is an insufficient level of folate in the body, methionine cannot be metabolized properly. When this happens and blood levels of homocysteine begin to increase, and studies have shown that that elevated levels of homocysteine are associated with a 150-200% greater risk for several vascular diseases (Velhaar et al, 2002). These diseases substantially increase a person's risk for a heart attack or stroke. There is also an increased risk of blocked arteries due to the fact that homocysteine also increases blood clotting. In addition to lowering homocysteine levels, folate also supports heart health by taking antioxidant action and interacting with eNos (Velhaar et al, 2002). In a 1998 study on folate supplementation in relation to risk of heart disease in women, a higher reported



intake of folate was associated with lowered risk of nonfatal heart attack and fatal coronary heart disease (Rimm et al, 1998). Thus, consuming ample amounts of folate may decrease Jeannine's risk for a heart attack or stroke (p. 469).

**15. What health risk do people who are emaciated and people who are obese have in common? Why?**

Both emaciated individuals and people who are obese are at risk for a compromised immune system. Within those who are emaciated, this is due to malnutrition. As we've learned, a healthy diet provides all the nutrients the immune system requires to carry out its function of protecting our bodies. Being deficient or having subclinical levels of even one nutrient can cause abnormalities in immune function, regardless of the health status of the host. A 2004 study by Beck et al. demonstrated that viruses that multiply in malnourished individuals become more infective and destructive than viruses multiplying in the well-nourished (Beck et al, 2004). Unfortunately, malnutrition and infection create a vicious cycle, since being malnourished increases the risk for infection and then infection suppresses the appetite and often causes vomiting and diarrhea, and then not having an appetite and experiencing vomiting and diarrhea can contribute to nutritional deficiency. Nutritional deficiency then increases risk of infection (p. 474). Thus, even low-level nutrient deficiencies can negatively impact immune function.

In recent years, obesity has become a public health crisis, with nearly 75% of adults in the US being overweight or obese (Fryar et al, 2020). Though studies on obesity and immune function were in their infancy prior to COVID-19, research is beginning to emerge on the impacts of obesity on the ability of the immune system to prevent, fight, and heal infections and viruses. Though the mechanisms underlying the link between obesity and infectious diseases are not well-established, obesity has been associated with increased occurrence of infection, slower wound healing, and poor antibody response to vaccination (p. 474). It has been suggested that this could be due to "chronic low-grade inflammation, hyperglycemia, hyperinsulinemia, and hyperleptinemia, which lead to a weakening of both the innate and adaptive immune responses" (Muscogiuri et al, 2021). It could also be due to the fact that excess body fat can blunt respiratory functions and thereby predispose obese individuals to respiratory infections. Likewise, excessive sweating due to subcutaneous fat as well as skin folds may make the growth and spread of bacteria more likely and may also slow down healing. The low-grade inflammation that is thought to be experienced by obese individuals increases their risk of developing asthma, type 2 diabetes, high blood pressure, and cardiovascular disease (p. 473-474). It also makes obese individuals more likely to develop various types of infections, bacteria in the blood stream, infections of the urinary tract, and mycosis (Muscogiuri et al, 2021).

## Do Zinc Lozenges Help Fight the Common Cold?

1. Based on what you have learned here, do you think taking zinc lozenges can be an effective means of fighting the common cold?

Based on what I have learned, I am not convinced that taking zinc lozenges can be an effective way to fight a common cold. I personally believe that taking a preventative approach and maintaining a sufficient nutrient balance is the better solution for preventing/managing the common cold. Indeed, studies have shown that daily zinc supplementation substantially reduced the incidence of common colds (Roa & Rowland, 2011).

As indicated in the text, results from studies regarding the effectiveness of zinc lozenges for treating the common cold are mixed. The studies that did show zinc lozenges to be effective indicated that zinc should be taken early on. The timing of when it should be taken, along with the frequency required, dosage, different types of zinc, and severity of symptoms in the individual also complicates and likely contributes to the effectiveness (or lack thereof) of taking a zinc lozenge. That said, there are about 500 million cases of the common cold experienced by Americans each year, and with a huge economic burden of close to \$40 billion annually (Fendrick et al, 2003), it is no surprise that there is an interest in obtaining any easily accessible nutrient that could help alleviate symptoms. Given the mixed results from the studies I have read, I cannot conclusively state that I feel zinc lozenges are effective.

2. Have you ever tried them, and did you find them effective?

I have tried zinc lozenges; however, I have used them mostly for daily supplementation rather than to treat a common cold. In the very few times that I have taken them upon the onset of cold symptoms, I have not noticed a difference in the severity or duration of symptoms; however, sucking on the lozenge does tend to provide at least a temporary distraction from the unpleasant symptoms related to the common cold, so it has that benefit, at least.

3. Even if you have only about a 50% chance of reducing the length and severity of your cold by taking zinc lozenges, do you think they're worth a try?

Yes, I do think that zinc lozenges are worth a try if there is a chance that they will help reduce the duration or severity of the cold. Given the lozenges are widely available and therefore easily accessible, low cost, and available in a number of different doses and flavours, I feel that they are worth trying. Although there are side effects to taking zinc lozenges (bad taste in the mouth and nausea), there are not severe, so the benefits may outweigh any minor side effects that are experienced. Long-term high zinc levels may interfere with copper metabolism (Roa & Rowland, 2011); however, so it would be prudent to ensure you're taking an appropriate dose for safe amount of time.



**Conclusion:**

I chose this particular assignment because as more information about the benefits of vitamins and minerals have become mainstream, I have become increasingly interested in the many factors involved in maintaining an appropriate balance of nutrients as well as the implications for even subtle deficiencies. Within the age of a global pandemic and having a career in the health and fitness field, the topic of immunity has been especially interesting to me. Within my career as a Nutritionist and Fitness Coach, I work primarily with women, most of whom are trying to lose weight. In doing so, of course, they must be in a caloric deficit. The information within this chapter is helpful because it brings to the light the importance of maintaining a balance of nutrients, which we know is often impacted when individuals try to diet, as they may cut out entire food groups. I have always taken a balanced approach when creating nutrition plans for my clients; however, this chapter has identified other factors that I will consider when creating nutrition plans moving forward, including what nutrients are important for specific groups of people (those who may become pregnant, the elderly, obese individuals, etc). Overall, I have learned a great deal that I will certainly be able to apply to my own practice.

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