Dietary Defense: How Nutrition Can Impact Immunity
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Autumn Health Picks
Who am I?

• Hometown: Mount Pleasant, MI
• Education: Truman State University Class of 2019, Exercise Science, Biology Minor
• 2nd year PhD student in the Division of Nutritional Sciences at UIUC
• American College of Sports Medicine Certified Exercise Physiologist
• I study how diet and exercise interact with the gut microbiome and immune system
Learning Objectives for Today

• How does your immune system respond to pathogens?

• How is this influenced by nutrition and lifestyle factors?

• What can I do to keep myself as safe and healthy as possible?
I am not a doctor, this is not medical advice

• Everyone is different, diet and exercise recommendations are most effective when individualized. Lots of factors to account for

• Always best to consult a physician regarding any uncertainties you may have

• Exercise caution! None of this will make you immune or remove all risk completely

• Most effective approach is a combination of things
  • Additions, not replacements
What does a Virus do?

• Virus incorporates its own DNA or RNA (or both) into cells

• Uses cellular replication devices to replicate itself

• Releases more of itself and kills the cell in the process

*Not all viruses act the same, this is a broad stroke generalization

(Retrieved from thebiomanual.com)
When I say Immunity, what comes to mind?
## Innate vs Adaptive Immunity

<table>
<thead>
<tr>
<th>Innate Immunity</th>
<th>Adaptive Immunity</th>
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<tbody>
<tr>
<td>- Behavioral (disgust of certain smells)</td>
<td>- Delayed (hours to days to even weeks)</td>
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<tr>
<td>- Physical barriers like skin and mucus</td>
<td>- Long Lasting</td>
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<tr>
<td>- Inflammation (redness, swelling, fever, pain, loss of function)</td>
<td>- Responsible for continued immunity</td>
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<tr>
<td>- Fast acting</td>
<td>- Pathogen specific</td>
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<tr>
<td>- Non specific</td>
<td>- Why vaccinations work</td>
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These are classified separately but important to note they work together and help orchestrate each other!
Innate Immunity, after barriers

Pathogen (coronavirus, influenza, rhinovirus)

Leukocytes and other cells act as sensors

Initiate pathogen clearance mechanisms and release mediators like Cytokines and Chemokines

Inflammatory response: Initiates vasodilation, recruitment of more leukocytes, and production of inter/intracellular defense mechanisms to kill infected cells

(redness, swelling, etc.)
Innate Immune Response

Inflammation

Bacteria trigger macrophages to release cytokines and chemokines

Vasodilation and increased vascular permeability cause redness, heat, and swelling

Inflammatory cells migrate into tissue, releasing inflammatory mediators that cause pain

(Macrophages and neutrophils are types of leukocytes)

Some of these helper T cells will help B cells mature, initiating clonal expansion and maturation into plasma cells, which can secrete pathogen specific antibodies (this takes a matter of days).
In Summary

Once past anatomical barriers and inside host tissues, leukocytes will recognize the pathogen and attempt to clear it (with the help of some other defense mechanisms) while also sending signals to other immune cells that there is a problem and they need help. While the other leukocytes/lymphocytes come over via an inflammatory response, some leukocytes bring the antigen to the lymph tissue for the maturation of pathogen specific lymphocytes like T cells and plasma cells (which secrete antibodies) and help clear the pathogen.

Effectors = activated lymphocyte/leukocyte subsets (and some other players)
The Peril of COVID-19

• A non specific, yet severe response

• Delayed immune response that attempts to ‘compensate’

• “Cytokine Storm” that contributes to the development of ARDS (Acute Respiratory Distress Syndrome)

• Your immune system is killing you, many treatments are immunosuppressive

Symptoms can vary widely in early infection stages, and do not always have to be respiratory related. Be aware!
Nutritional Factors

To take into account for Cold, Flu, COVID-19, and others
Excess Fat Mass

• Strong association between excess fat mass content and the severity of COVID-19 and influenza

• Chronic inflammation associated with excess fat mass causes inappropriate immune responses due to disruption in immune homeostasis

• Arterial dysfunction associated with excess fat mass interferes with respiratory immune response

Remedied by a combination of diet, exercise, quality sleep etc.

For practical diet/weight loss advice, check out Ru Liu’s talk from 9/23: Decoding that Diet You Saw on the Internet: Vegetarian, Vegan, and Paleo Diets
https://mediaspace.illinois.edu/playlist/dedicated/159616411/1_ep5zdi5m/1_7xirxl9y

Green and Beck, 2017
Sanchis-Gomar et al., 2020
The Western Diet: Not Always Ideal

- High in saturated fat, sugars, refined grains, and calorie dense foods, low in fiber
  - Promotes weight gain
  - Epidemic status in US
- Tends to be low in key micronutrients
- Role in cardiovascular disease
- Associated with chronic inflammation and cellular stress

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Key Micronutrients
Important note:

Micronutrients have an upper limit! This means that consuming too much can be harmful or even lethal! Make sure you are aware of the requirements specific to you before supplementing or eating too much!

Vitamin D and Immune Function

- Leukocytes all respond to vitamin D
  - Actually classified as a hormone
- Plays a role in prevention of autoimmune conditions
- Pivotal in proper function of many leukocyte subsets
  - Reduces severity of inflammatory response by improving other pathogen clearance mechanisms
  - Enhances development of some leukocytes
  - Reason to believe it may influence antibody production

Insufficiency of vitamin D is very common – estimated 1 billion people worldwide have low vitamin D levels
Vitamin D and Viral Infections: Epidemiology

• Large nationwide sample sizes have linked vitamin D status to:
  
  • COVID-19 mortality rates
  
  • Infection Rates of respiratory tract infections
  
  • Illness Severity of the common cold, influenza, and COVID-19
Vitamin D COVID-19 RCT - Spain

- All patients treated with standard of care
- Patients randomly allocated to vitamin D or no treatment (2:1 ratio, 50 patients on Vit D, 26 in control)
- Vit D treatment consisted of three high doses 1, 3, and 7 days after admittance
  - Reduced the risk of ICU admission 25 fold
- Too few deaths to run statistics on, but 2 control patients did die

76 patients with COVID-19 Pneumonia

Vitamin D Treatment (50 patients)

Only 1 individual required ICU admission

Control (26 patients)

50% required ICU admission
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Current evidence suggests maintaining adequate vitamin D status to be critical in immune resilience and minimizing risk of contraction of viral respiratory infections, especially COVID-19
Selenium

• Important for production of selenoproteins: required for many cellular viral defense mechanisms

• High Selenium status and supplementation increase production of key immune cells in viral response

• Increases lymphocyte antioxidant activity

• Deficiency is associated with higher viral infection mortality risk (especially COVID-19)
Zinc

• Precursor for many antiviral associated proteins

• Deficiency is associated with:
  • Increased risk of viral infection
  • Thymic atrophy: defective adaptive immune response

• Supplementation displayed clinical improvement in symptoms in children with pneumonia

Picture of red meat, shellfish, legumes, seeds, nuts
Zinc Supplementation for COVID-19 Patients – Clinical Case Reports

1. Four patients given high dose oral zinc salts saw marked improvements in symptoms

2. Three patients with gastrointestinal symptoms were all discharged within five days

Zinc supplementation may be helping, but more controlled studies like RCTs are needed to prove this hypothesis.
Vitamin A

• Important for proper barrier function and thus communication between leukocytes

• Plays a role in leukocyte maturation

• Deficiency diminishes antibody functions

• Supplementation has been shown to increase antibody production in viral/vaccination situations

Canete et al. 2017
Patel et al, 2019
Vitamin E

• Protects from oxidative stress damage

• Important for both T and B cell (adaptive response) mediated functions

• Important for delaying immunosenescence (age related decline)
Vitamin E

- Nursing home residents supplementing vitamin E displayed fewer sick days when exposed to the common cold
- Improved biomarkers of illness during Hepatitis B Virus
- Higher intakes may be needed in the elderly

Oversupplementation may exert negative side effects – be aware!
Vitamin C

• Potent antioxidant, protects from oxidative stress damage
  • May help reduce consequential damage from infection/inflammation

• No conclusive evidence in relation to its role in improved immune responses

Pictures of bell peppers, kiwi, strawberries, oranges
Key Points on Nutrition

• Adequate consumption/status of vitamin D, A, E, Zinc and Selenium are critical for maintaining immune resilience to viral infection

• Supplementation of vitamin D, Zinc and Selenium have enthusiasm in the scientific community in relation to their efficacy in prevention and treatment of COVID-19, influenza, and the common cold

• Vitamin A supplementation may help with prevention and treatment of viral infections, while vitamin C may help with treatment alone

• Adequate dietary vitamin E important, especially in the elderly
Key Points on Nutrition

• Avoiding excess fat mass is very helpful for healthy immune function

• The ‘Standard American Diet’ (SAD) may promote chronic inflammation and deleterious shifts in immune homeostasis due to excess caloric intake, high levels of saturated fat, and inadequate consumption of key nutrients

• It is advisable to:
  • Monitor caloric intake: don’t overconsume
  • Limit dietary saturated and trans fats, replace with unsaturated fats
  • Consume a well-balanced and nutrient dense diet
  • Try to swap out refined grains and/or sugar with whole grains

Visit USDA’s myplate for more resources and guidelines!
https://www.choosemyplate.gov/eathealthy/WhatIsMyPlate
Key Points on Nutrition

• No “Best Diet” for everyone, to each their own

• USDA has three dietary patterns they recommend:
  • Healthy U.S. – Style Eating Pattern
  • Healthy Mediterranean-Style Eating Pattern
  • Healthy Vegetarian Eating Pattern

Don’t need to strictly follow one of these patterns to be healthy, most importantly be consistent, mindful of content, and intentional in approach!
Example meal

- Sirloin
- Spinach
- Almonds
- Avocado
- Strawberries
Other Important Factors

- Get adequate sleep
- Make an effort to manage stress
- Don’t smoke: it’s associated with much higher risk of severe COVID-19 infection
- Reason to believe regular moderate intensity exercise will help, more on this next

Don’t forget about your hygiene!!!
Exercise: Key Points and Take Home from July Talk

Regular moderate intensity exercise has a host of health benefits, and increased immune surveillance and resilience can be added to that list.

While all the negative side effects of unfamiliar and exhaustive exercise may not be universal, it is highly recommended to err on the side of caution in the face of a relatively unknown pandemic virus when risk of infection is abnormally high (adequate carbohydrate and polyphenol consumption may help mitigate this).

For the general population, once you have ascertained that it is safe for you to exercise, keeping bouts between 30 to 60 min (about 3 to 5 times a week) is recommended and seems the most beneficial based on available evidence.
Exercise: Key Points and Take Home from July Talk

• In addition to other benefits, regular moderate intensity exercise can increase immune surveillance and resilience
• Unfamiliar and exhaustive exercise may present negative consequences like increased risk of infection (see J curve) and reduced resilience
• Once you have ascertained that it is safe to exercise, 3-5 bouts of moderate intensity exercise of 30-60 min per week seems the most beneficial for immune health based on current evidence

Nieman and Wentz, 2019
Summary
To Support Optimal Viral Immunity:

• Consume a consistent diet that is balanced in caloric intake, macronutrients and key micronutrients (Vit A, D, E, C, Zinc, Selenium)
  • 10-30 min of Sunlight exposure 5 or more times a week for vitamin D
  • Supplementing key micronutrients where necessary may be beneficial

• 30-60 min of moderate intensity exercise 3-5 times a week

• Adequate sleep, stress management, hygiene, and lifestyle habits
Micronutrient Recommendations from 2010 RDA

• Vitamin E:
  • Men:
  • Women:

• Vitamin A:
  • Men: 900 micrograms RAE/day
  • Women: 700 micrograms RAE/day

• Vitamin D:
  • 600 IU/day for 1-70 years old, assuming minimal sun exposure
  • 800 IU/day for over 70 years old, assuming minimal sun exposure
Micronutrient Recommendations from 2010 RDA

• Selenium: 0.055 milligrams per day
• Zinc:
  • Men: 11 mg/day
  • Women: 8 mg/day
• Vitamin C:
  • Men: 90 mg/day
  • Women: 75 mg/day
References


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