

# Immunity and Nutrition

Marinda Venter (RD [SA])

## Introduction

Immunity is the body's personal line of defence. It includes all the processes in which the body protects itself against a "polluted" environment; maintains a consistent internal environment for protection against pathogenic micro-organisms, viruses, cell mutations and to protect the body against the production of unwanted cellular by-products. Although genetics, age and hormones play an important role in immunity, nutrition is a key determinant of immune status. Sixty percent of the body's immunity is situated in the gastro-intestinal tract (GIT).

**Anatomical barriers** like the skin, mucus membranes and epithelium linings are the first line of defence. The gastro-intestinal tract (GIT), being exposed to a myriad of ingested pathogens, is a frontline immune organ. It is immunologically interconnected with other mucosal surfaces like the respiratory tract, the uro-genitary tract and the mammary glands (breasts). In a healthy GIT, the inborn immune system which include tight junctions between epithelium cells, gastric acid, digestive enzymes, other secretions and peristalses, protects the body from foreigners like micro-organisms, entering the body.

If the anatomical barriers fail, the immune organs and cells of the immune system take action, driving **Immunological reactions**. Immunological reactions firstly, involve cells killing foreigners. Some immune cells are constantly surveying their surroundings to detect invaders. These scavengers ingest and destroy foreigners before signs of illness set in. However, some invaders escape destruction, activating the immune system to initiate an "armed response". Immune cells produce various chemicals through a cascade of reactions whose aim it is to fight off the foreigners or unwanted bodies. This response to infection or injury results in inflammation (red, swollen, painful, fever). Inflammation is a healthy immune system's way to fight off infection or injury, to remove damaged tissue, heal wounds, and promotes recovery from external stressors. In this way, acute inflammation and oxidative stress are beneficial and self-terminating. The GIT is considered the command centre for an immune response.

However, when there is chronic exposure to a source of inflammation, a low grade chronic inflammatory response develops. Cells of chronically inflamed tissue produce oxidative molecules, blood clotting factors and other bio-active chemicals that is detrimental, increasing the risk for obesity, insulin resistance, diabetes mellitus, cardiovascular disease, cancer, Alzheimer's disease, etc.

A third part of the immune system is the **GIT-microbiota**. It is the micro-organisms that inhabit the entire GIT which protect the host and are an important determinant of health. These micro-organisms directly promote GIT health and support the anatomic and immunologic immune system.

## Nutritional factors related to the immune system

When we consider nutrition in immunity, some roles are clearer than others. Various nutrients play a vital role in the synthesis of immune cells and their chemical warfare, but exactly which nutrients and how much is not fully known.

What we know is:

- protein-energy malnutrition results in an impaired immune response
- nutrients are essential for maintaining anatomical barriers and deficiencies presents itself as dysfunctional barriers
- with 60% immunity in the GIT, nourishing the GIT and its inhabitants is a key factor.
- dietary habits are probably one of the key determinants of the overall inflammatory process in chronic conditions

A baby’s very first nutritional encounter will determine a lot of what’s happening in the future. Breastmilk lays the foundation for the immune system. It paves the way for a strong intestinal lining and GIT barrier and creates the ideal environment for protective bacteria. Once the scene is set, various nutrients are needed for building barriers and to make immune cells and their by-products.

a. Nutrients associated with anatomical barriers

Protein, especially milk peptides	Vit A	Vit C	Zinc
Omega-3	Pro-biotics (live bacteria)	Pre-biotics (fibre) Milk sugars (oligo-saccharides & human milk oligosaccharides)	Growth factors in breast milk

b. Nutrients associated with the Immune response

Protein, especially milk peptides	Vit A	Vit D	Vit E
Vit B6	Vit B12	Folate	Vit C
Selenium	Zinc	Polyphenols	Omega-3
	Pro-biotics (live bacteria)	Pre-biotics (fibre) Milk sugars (oligo-saccharides & human milk oligosaccharides)	

c. Nutritional factors contributing to chronic inflammation

1. Overweight and obesity
2. Exacerbated post-prandial inflammation
  - Overweight and obesity
  - High energy meals
  - High GI (glycemic index) meals
  - Meals with a high saturated fat content

- Distorted omega-6:omega 3 ratio – too much n:6
- 3. High omega-6 (n:6) intake
- 4. GIT Immune dysregulation with increased GIT permeability
  - Diet high in saturated fat
  - Low fibre diets - diets high in processed/refined carbohydrates; low intake of fibrous carbohydrates e.g. high protein diets

### **Dietary advice for optimal immunity**

The more desperate we are for quick fixes, the more reality hits home that there are no quick fixes. An optimal functioning immune system started way back with the first 1000 days of a baby's life, breastfeeding or not, and what we introduce. We can eat a lot to support our immune system, but most harm comes from pro-inflammatory agents, hard at work in fat tissue. Now, maybe more than ever, we are confronted with the risk of overweight and inactivity as inflammatory agents, being demonstrated by their contribution to Covid-19 hospitalizations. According to Dr D Mozaffarian, cardiologist and Dean at Tufts University, Boston, Massachusetts, "we should be focusing on public health messages on reducing diabetes and obesity as a means to reduce severe COVID disease". In the USA, about 64% of severe Covid-19 cases (hospitalizations) are related to lifestyle diseases like obesity and type 2 Diabetes.

Furthermore, confirming that immunity is rather a factor of a long term life style, is the contribution of a healthy GIT to immunity. A focus point of immuno-nutrition is GIT health, paying a lot of attention to beneficial bacteria and their nutrition as well as fibre intake in general. The Covid-19 pandemic has also shed light on the role of the GIT/GIT microbiome. According to researchers, dysbiosis (imbalance in the GIT bacteria) weakens the immune system, thereby predisposing to more severe acute respiratory syndrome and contributing to long Covid. Microbial imbalances are detected in Covid 19 patients. Blood analysis of these patients confirms that their microbial imbalance correlates with elevated concentrations of inflammatory markers. It also reinforces the message of following a plant based diet, supporting the GIT and its microbiome.

#### a. Practical Recommendations to optimize nutrients related to immunity

##### PROTEIN

(Provide milk peptides and human milk peptides, amino acids, zinc, selenium, vit B12, vit B6, folate, vit A, vit D, probiotics, n:3 fats, growth factors in breast milk)

1. Sufficient, good quality protein is not negotiable and animal protein scores very high. Although animal protein is of high biological value, limit red meat intake to max 3x/week. Too much can also be detrimental to GIT health. As liver is a concentrated source of immuno-nutrients, do consider it as a portion of your red meat intake. Stretch your red meat portions by eating smaller portions more often; combined with plant sources like beef shavings added to a salad, or in combination with legumes as in Bobotie.
2. Increase dairy as protein source; dairy is per gram possibly the most cost-efficient protein source, providing immune building dairy peptides and milk-sugars. Fermented dairy, like yoghurt, has anti-inflammatory properties and should be eaten 1-2xdaily. Whey, the watery part after the curd has been removed for cheese making, is rich in anti-inflammatory amino-acids like cysteine. It is

especially important in the elderly. Ricotta cheese is the best food source of whey, providing 11g/100g soft cheese. Milk will provide 1.6g/250ml. One way to include ricotta is to add it as protein to salads.

3. Fatty fish provide omega-3 (n:3) fat. The recommended portions are 100g 2x/week. Fatty fish include mackerel, sardines, pilchards, anchovies, salmon, herring, trout and oysters.

4. Animal protein is about the exclusive source of vit B12, with milk and fish the most bio-available sources. Yeast, sea algae like spirulina and fermented soy does not provide active vit B12 and is therefore not bio-available. Vegans need a reliable source like fortified soymilk or a vit B12 supplement. The same accounts for vit B6. Meat, liver, poultry and fish are the best sources. Although available in plant sources, it seems to be less bio-available.

5. An egg a day will bring you a far way; a compact protein source with vit A and D in the egg yolk.

6. Plant protein, generally found in legumes and pulses (dry beans and dry peas), are a powerhouse of benefit. Regular consumption is necessary to support a plant-based diet and supplement reduced meat intake. Aim for 2 cups a week, maybe divided in smaller portions if it is a bit daunting. There are various interesting ways of including them – hummus, falafel – or stick to the old fashion of Dutch pea soup and Chilli con Carne. They provide excellent pre-biotics for GIT health, decrease the GI and are very good sources of folate and vit B6.

7. Powders and potions are attractive for their beautiful promises and convenience. Remember that whole foods are more than the sum of the individual parts and packed in a way to enhance digestion and absorption.

## CARBOHYDRATES

(Provide fibre and pre-biotics, phenols, vit E, vit B6, Vit A precursors like Beta-carotene, folate, milk sugar e.g. milk oligosaccharides and human milk oligosaccharides)

1. Whenever you give consideration to a meal, an eating style or even a weight loss diet, consider the amount and variety of fibre it provides. Carbohydrates are the best sources of fibre!
2. According to research “micronutrients such as folate, vit B6, polyphenols and anti-oxidant compounds, along with pre-biotics such as inulin, oligosaccharides and immune modulators such as beta-glucan, present in whole grains, potentially work synergistically to lower oxidative stress, inflammation, and pathogen load.” Whole grains can be defined as the whole intact grain kernel or ground, cracked, flaked fruit of the grain which principle components (the starchy endosperm, germ and bran) are present in the same relative proportions as they exist in the intact grain. It is the sum of the parts of whole grains that are likely to maintain gastro-intestinal health. Whole grains would be brown rice, mealies, barley, pearl wheat, rolled oats. Apart from choosing high fibre starches, at least 3 portions should be whole grains.
3. Low GI starches are the preferred choice as they aid in glycemic control and limit post-prandial inflammation.
4. Starchy vegetables are good sources of vit B6. Darker yellow sweet potatoes are also some of the best sources of beta-carotene. Sweet potatoes have a low GI and baby potatoes with skin an intermediate GI. However, newer potato varieties, like Carisma with a low GI value, are available.

## FRUIT / VEGETABLES

(Provide vit-C, vit A precursors like Beta-carotene, folate, selenium, polyphenols and pre-biotics e.g. fibre)

1. The recommendation is 5-10 portions a day. A portion is ½ cup cooked vegetables, 1 cup salad, or fruit the size of a cup. Colours are king! Aim high and try to include the following daily
  - Dark green – spinach, asparagus, broccoli, green beans, peas
  - Bright yellow – carrots, butternut, mango, papaya, yellow melon, peach
  - Red/Pink/Purple – tomatoes, beetroot, berries, watermelon, plums, grapes
  - Cruciferous vegetable – cauliflower, pak choy, cabbage, Brussel sprouts, broccoli, kale
  - Onion family – onions, garlic, spring onions, chives, leeks
  - Vitamin C rich – citrus fruits, kiwi fruit, red peppers, strawberries, tomatoes, melons
  - Others – apple, baby marrows, cucumber, celery, radishes.
2. Fresh herbs add to the nutritional green pool. Chop into salads and make dressing or marinades like a chimichurri sauce with parsley served with beef, or basil pesto served on potatoes.
3. Spices include ginger, turmeric, cinnamon, cumin, nutmeg, paprika, curry etc. They are well known for their anti-inflammatory properties. Spicy rubs are hot foodie fashion – get a few recipes; look to the North for Harissa, Chermoula or Mechoui paste or to the East for Thai curry.
4. Variety in cooking methods covers the absorptive spectrum of nutrients. Sometimes cooking improves absorption, but most vitamins doesn't like heat and light. Thus opt for short cooking periods with little water or steam.
5. Real food is the best because of many synergistic actions and low risk of adverse effects due to excess. As an example, research indicates that in a healthy person, vit C reaches saturation at 100mg. At 200mg there is little or any increase in blood concentration and can increase kidney stones in prone people or act as pro-oxidant.
6. Tea, especially Rooibos has enough polyphenolic credentials to recommend 2-4 cups per day.
7. Take the challenge of a plant based diet and try to eat 40 or more different plants a week! Remember starches will be part of the number as well as herbs, spices and plant fats.

## FATS/OILS

1. Saturated fat is detrimental to immunity due to an increased post-prandial inflammatory response and its contribution to a disrupted GIT microbiome. Furthermore it does not add nutrients to the diet. Go for lean meat and limit butter to the special occasion.
2. The A-list immune booster is omega-3 fat (n:3) being protective and anti-inflammatory. Sources of fatty fish were listed earlier. Plant sources include Canola-oil, linseed and its oil, soy and walnuts. These plant oils are pre-cursors of n:3 and about 10% efficiently converted in the body to n:3, therefor making a small yet significant contribution to the total intake.
3. When considering a n:3 supplement, the label should indicate the source of oil, the exact content of fish oil and the amount of n:3 (EPA and DHA) fat. A supplement should provide 500mg n:3 (EPA and DHA) and preferably in the form of triglyceride, re-esterified triglyceride or phospholipid. Ethyl esters are not ideal and contra-indicated in pregnant woman and alcoholics. Take the supplement with a fat containing meal to get the advantage of digestive enzymes for optimal absorption.
4. Mono-unsaturated fats form the bulk of daily fat intake. Sources are olives, avocados, peanuts, nuts and their oils. Canola oil also fits the category. Nutritional preference should firstly be given to unprocessed fats like avocados, peanuts, nuts; then the oils and finally their soft spreads.

5. Although n:6 fats have a bad reputation regarding a pro-inflammatory response, it is due to excessive intake, mostly associated with processed food. It is an essential fat, meaning you need to consume it as the body can't make it. It is mostly provided by seeds like linseed, sunflower, sesame and pumpkin seed and seed oil. Opt for your own seed mix by combining a variety of seeds and add to breakfast or use as salad sprinkle. To maintain the preferred n:6 ratio, prefer a mono-unsaturated oil like canola for general cooking.
6. Fats/oils are the best sources of vit E. Seeds, nuts, avocados and olives are the best sources. Vit E is heat and light sensitive, therefore unprocessed is best or prefer cold pressed oils in dark bottles.
7. Fat soluble vitamins e.g. vit A,D,E need fat for absorption. Take small portions of fat/oils with meals to enhance availability.

## VIT D

In recent years we have learnt that low vit D levels are associated with many chronic diseases. Low vit D levels are usually seen at the end of winter and are associated with acute respiratory tract infections. Vit D came under the spotlight as mortality and severity of Covid-19 infections are related to vit D levels. Numerous observational studies indicated that low vit D levels are associated with poor Covid outcomes, as severe as a 3.7 fold increase in the odds of dying from Covid-19 if a person is vit D deficient on admission to hospital. However as the exact relationship between covid-19 and vit D remains unclear, vit D may reduce the severity of respiratory tract infections possibly via maintenance of tight junctions, killing enveloped viruses and reducing pro-inflammatory cytokines.

We also realized that our vit D status is not as healthy as generally accepted. Avoiding sun exposure as is often advocated, may be harmful to our health. Absorption is also decreased due to sunscreen and people bound to buildings. Other factors that decrease absorption and vit D synthesis are obesity, dark skin and some medication.

Sun is the best and free source of vit D. Under normal circumstances, 5-10min sun exposure of the face, arms and hands, 3x per week should suffice. If a sunscreen of SPF 15-30 is used, the time should be doubled. Very dark skinned people might need 4-6x the amount of sun exposure.

The best dietary sources of vit D is egg yolk, fatty fish and vit D enriched products. Feeding infants and young children non-fortified "health beverages" instead of milk or infant formula, can create severe deficiencies. When vit D status is not optimal, consider a supplement that provides vit D3 and not vit D2 (plant derived, egocaliferol). It should provide 500 – 1000IU (13 – 25mcg), depending on sun exposure.

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