



Nutrition and Immunity

Immunity is Built not Born

**Malaysian Dietitians Association
Webinar
24 October 2020**

Intan Hakimah Ismail, MD, MMed Paeds, PhD
Associate Professor of Paediatrics
Consultant Paediatrician
Clinical Immunologist and Allergist
Universiti Putra Malaysia



MYS-03/10H19/20092

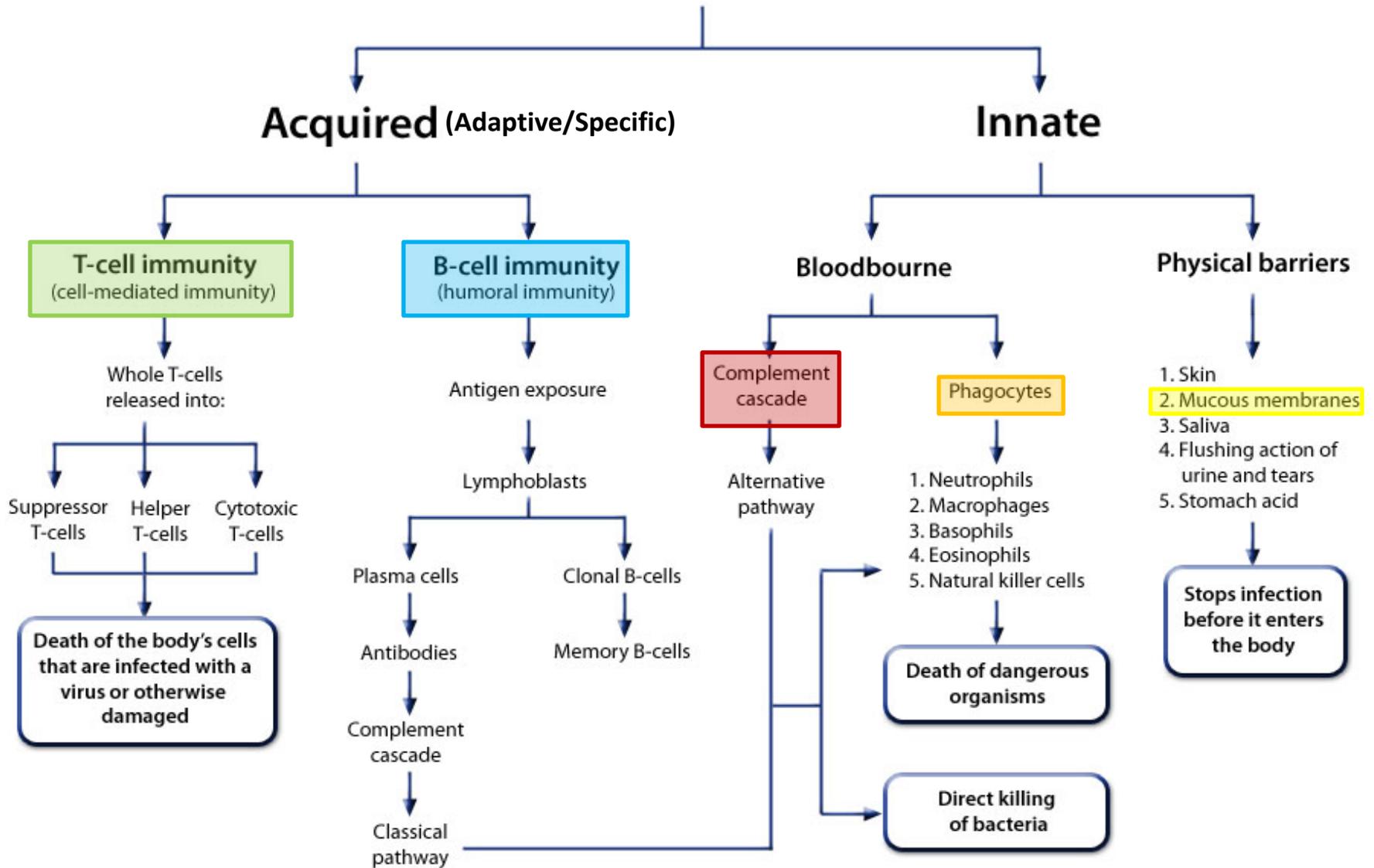




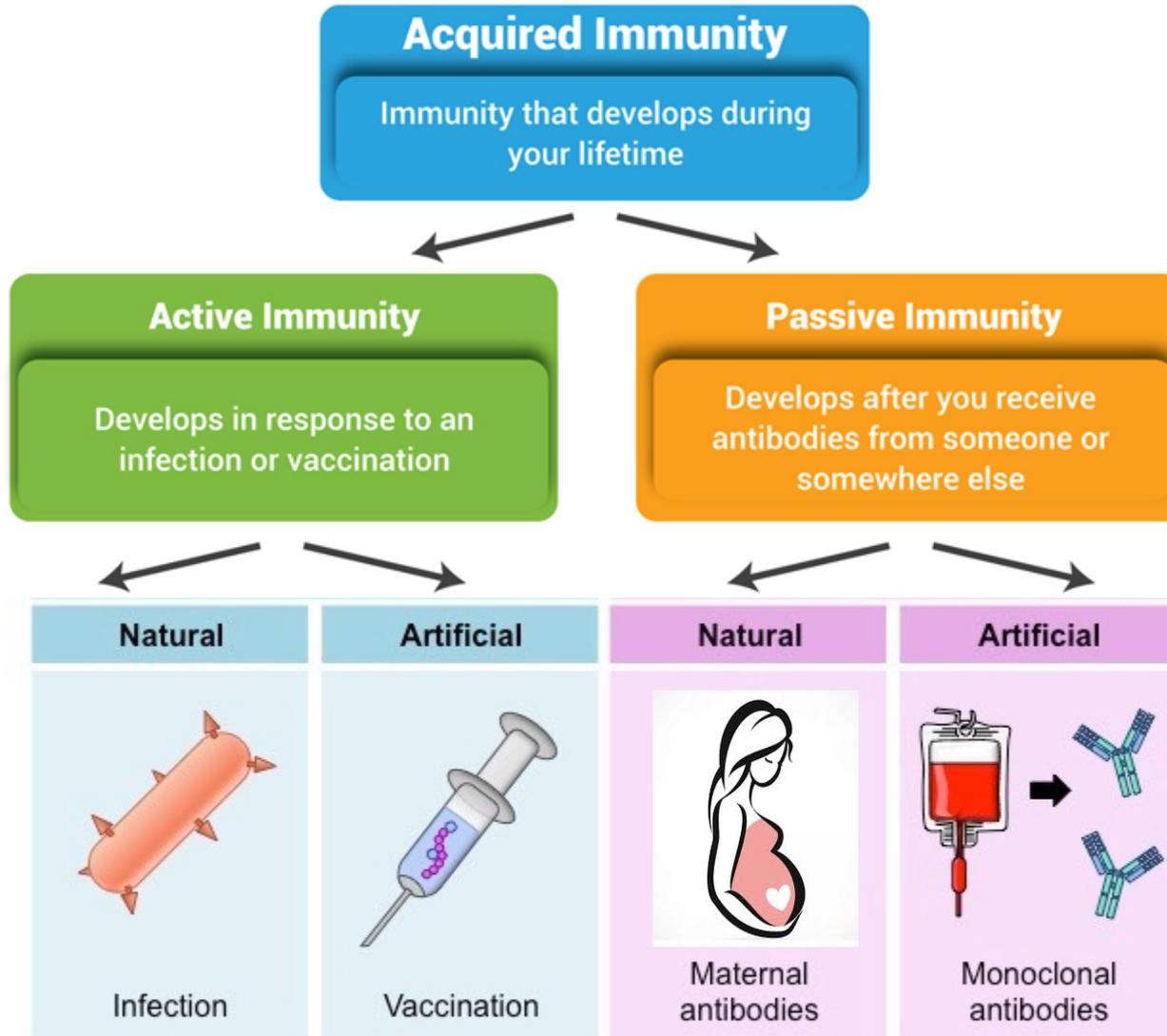
Learning objectives

- What is the immune system?
- What are the types of immunity?
- How is food related to immunity?
- Overview of gut microbiota
- Immune boosting foods

Immune system



Types of acquired immunity





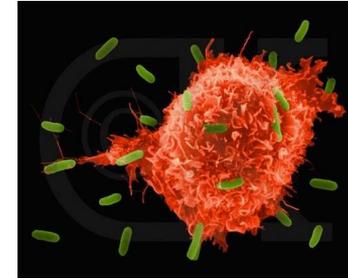
Differences between innate and adaptive immunity

Innate Immunity	Adaptive Immunity
Non-specific immunity	Specific immunity
response is antigen independent	response is antigen dependent
There is immediate maximal response	There is a lag time between exposure and maximal response
NOT antigen-specific	Antigen-specific
Exposure results in NO immunologic memory	Exposure results in immunologic memory

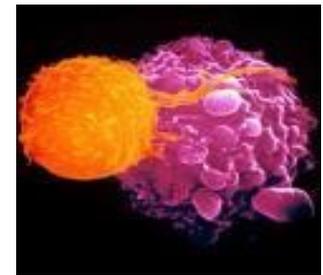


Role of immune system

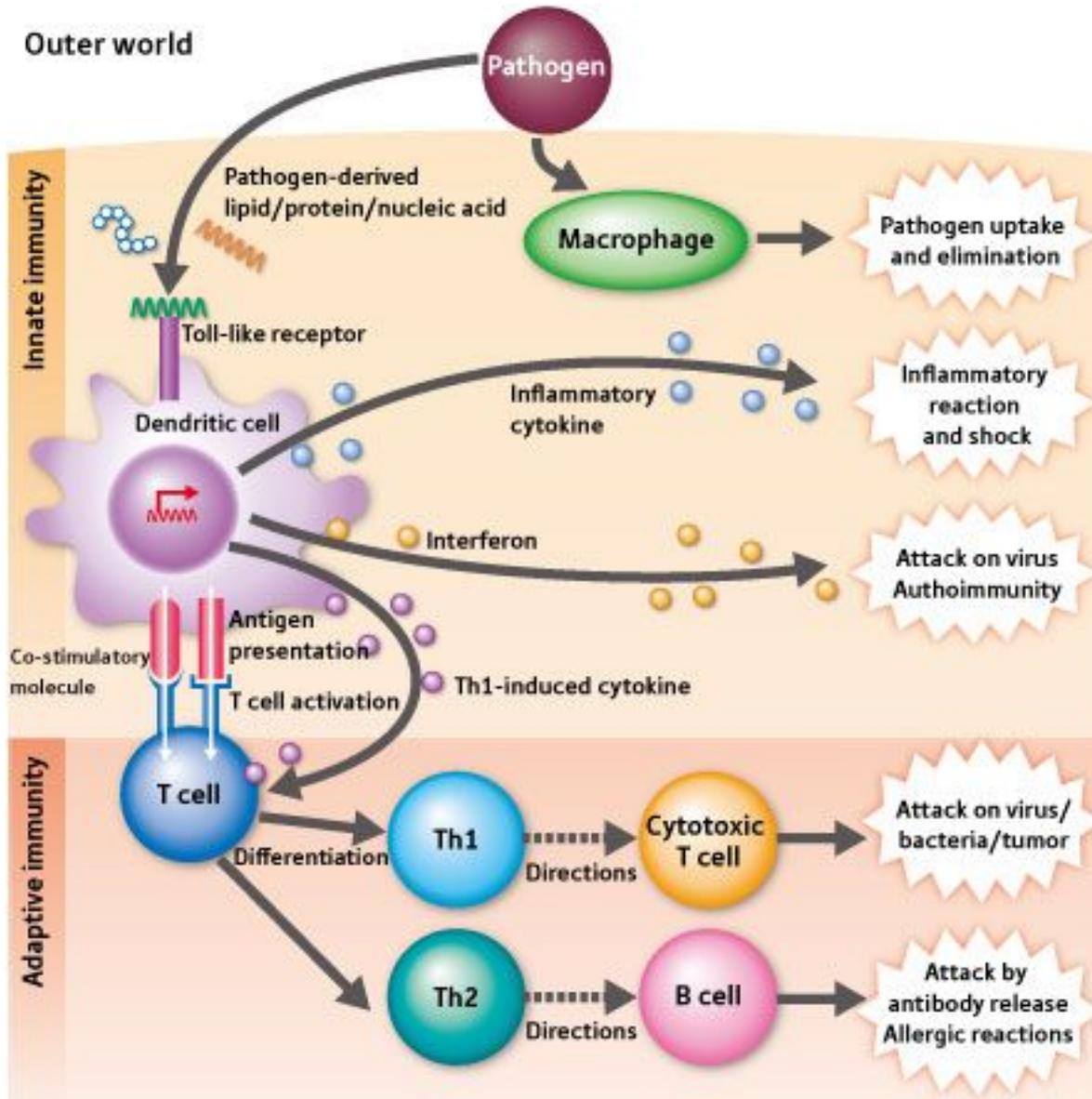
- Defense against microbes
- Defense against the growth of tumor cells
 - kills the growth of tumor cells
- Homeostasis
 - destruction of abnormal or dead cells
(e.g. dead red or white blood cells, antigen-antibody complex)



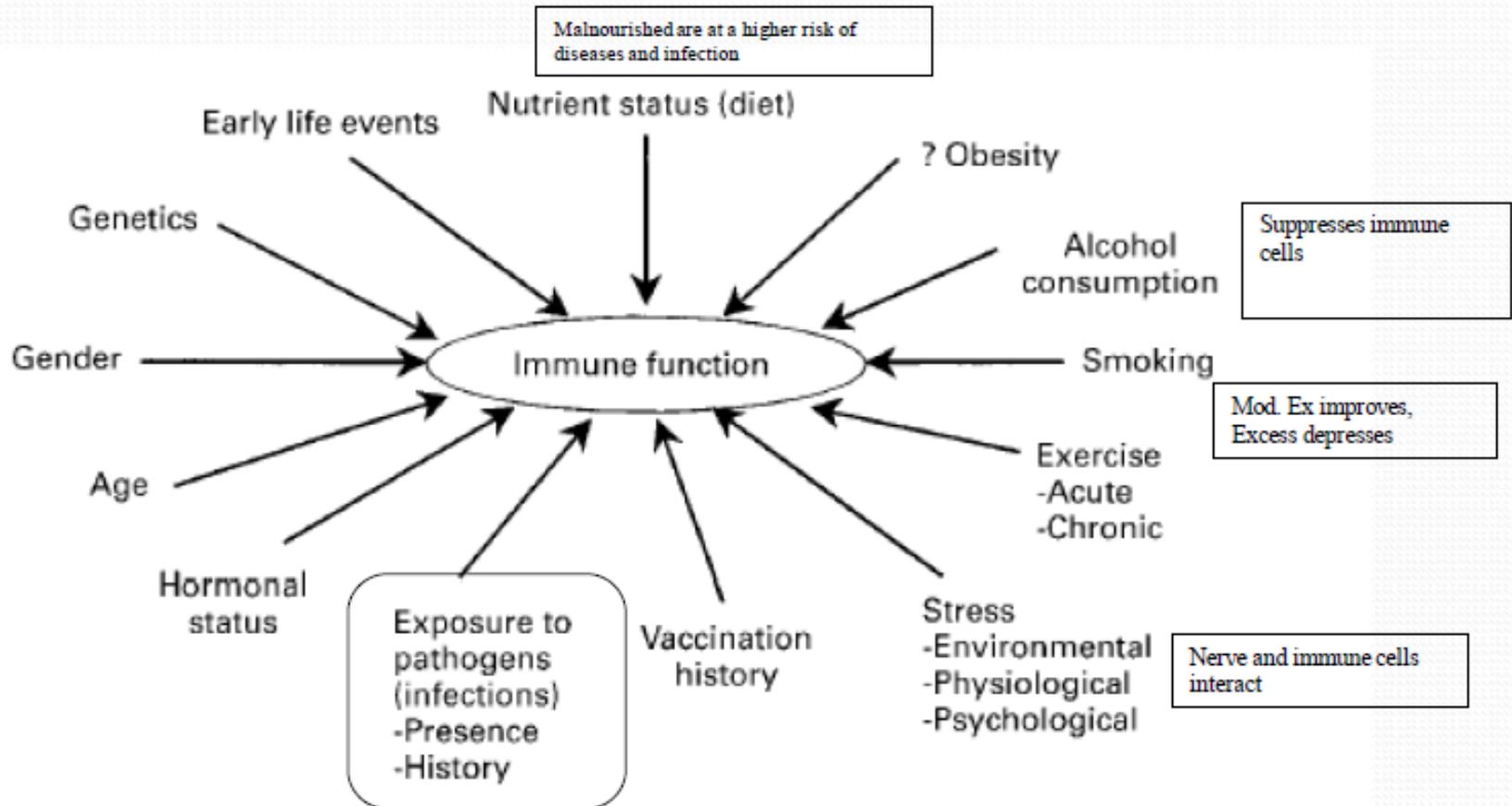
Infections



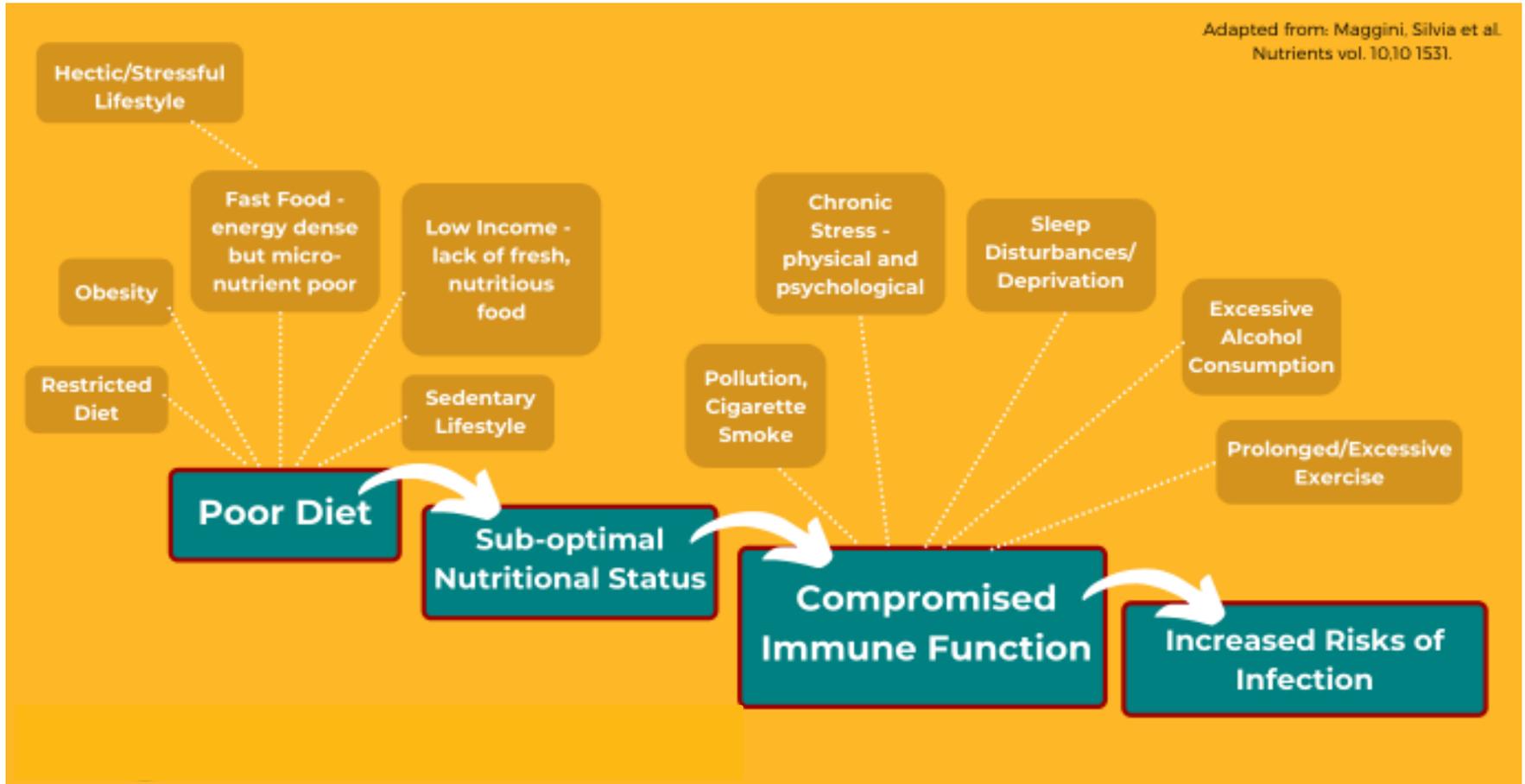
Cancers



Factors affecting immune system



Lifestyle factors that depress immune system



Things that can go wrong with immune system

Over-reactive immune system

Autoimmune conditions → caused by IgG, IgM or cells → Lupus, rheumatoid arthritis, others

→ Evaluated by **Rheumatologist/Immunologist** or organ specific specialists, for example, Neurology, Nephrology, GI, etc.

Allergies → caused by IgE → allergic rhinitis, food allergy, asthma

→ Evaluated by **Allergist/Immunologist**



Under-reactive immune system

Immunodeficiency and Infections

→ Evaluated by **Allergist/Immunologist and Infectious Disease (ID) specialist**

Cancer

→ Evaluated by **Oncologist**



Immune system disorders

Can be divided into 3 major categories:

1. hypersensitivity disorders

- caused by an allergen
- Food allergy, allergic rhinitis, anaphylaxis

2. autoimmune disorders

- immune system attacks self
- RA, SLE

3. Immunodeficiency disorders

- DiGeorge syndrome, AIDS



How is food related to immunity?

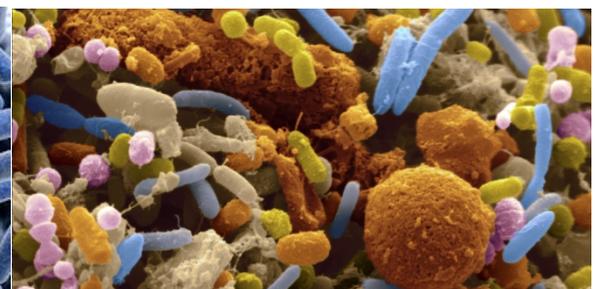
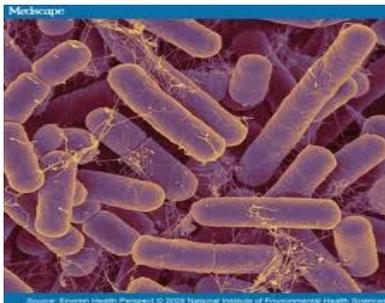
- Not only protects from infections, the immune system also has a role in cancer surveillance, brain function and aging
- Almost 70% of all immune cells are present in your gut
- Gut associated lymphoid tissue (GALT)
- GALT is the largest immune cells
 - More immunoglobulins are produced in your gut than anywhere else in your body
 - A significant part of your immune system interacts with what you eat



Microbiome and microbiota - what are they?

Microbiome: the collective genomes of all microbial cells living in human body

Microbiota: the collection of microbial communities colonising a particular habitat



The human microbiome – a complex organ

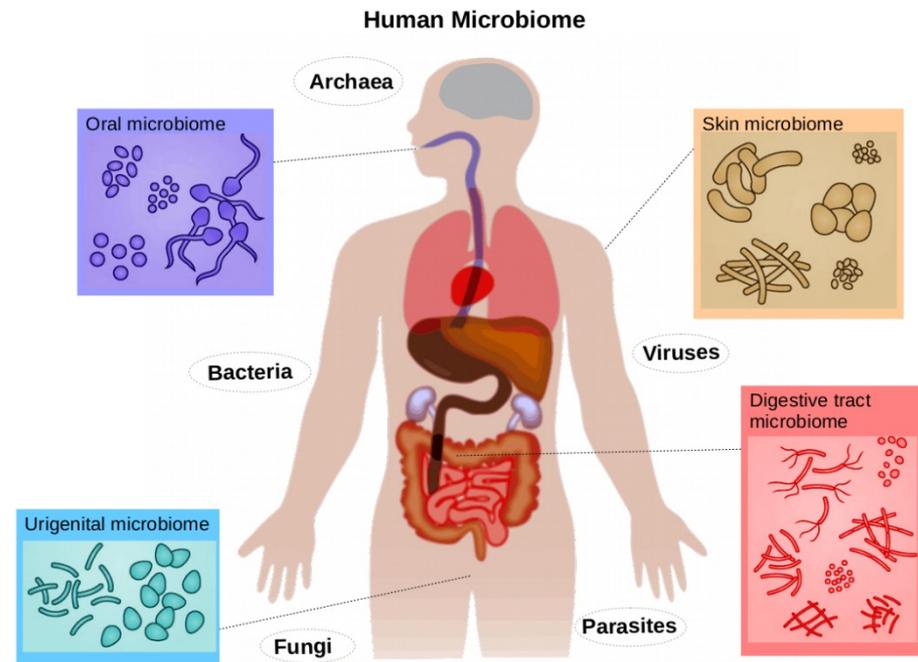
Complex community of microbes - 200 trillion microbial cells on/in human body: mouth, gut, vagina, skin

10x the number of human cells in our bodies

Gut microbiome is 150x larger than the human genome

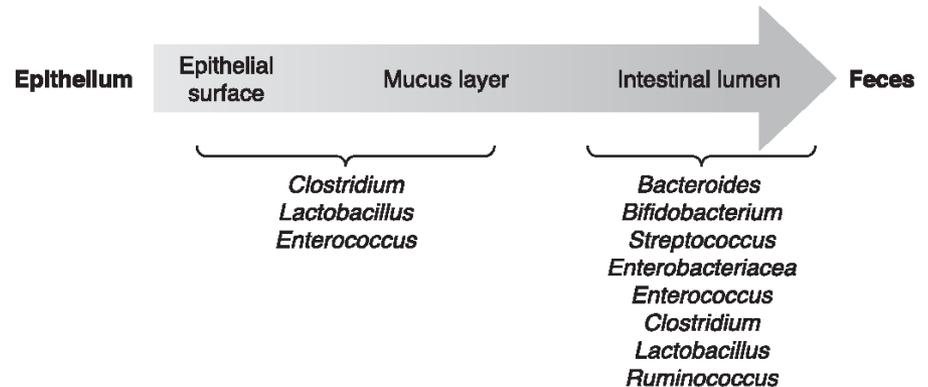
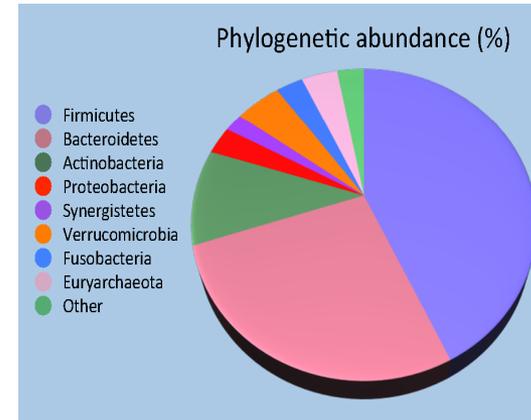
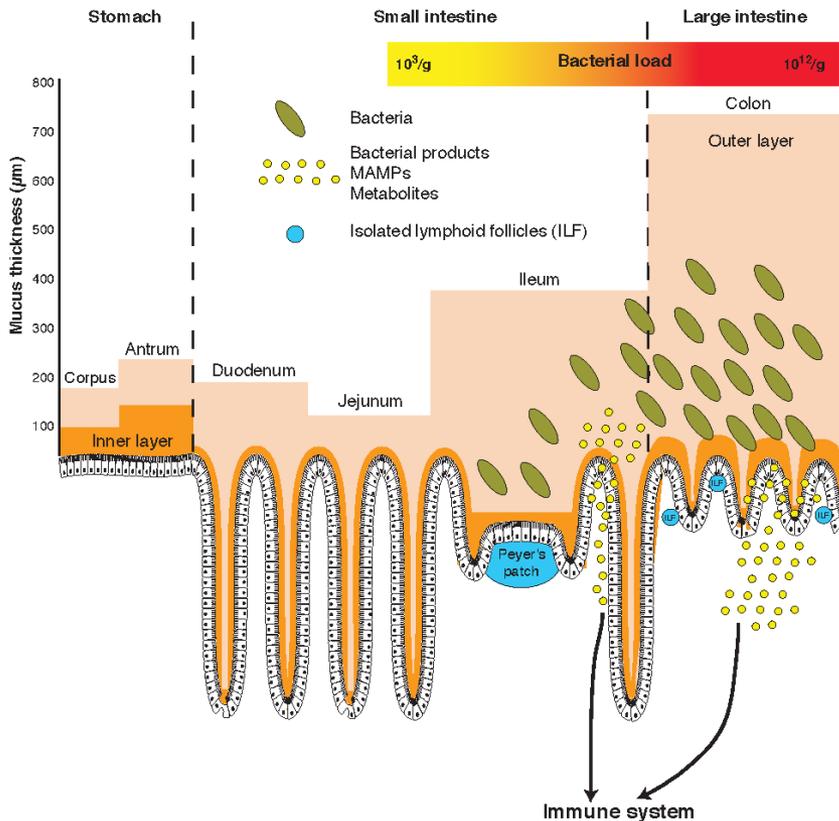
60-70% of immune cells

> 1000 different bacterial species in intestine



Gut microbiota: where are they?

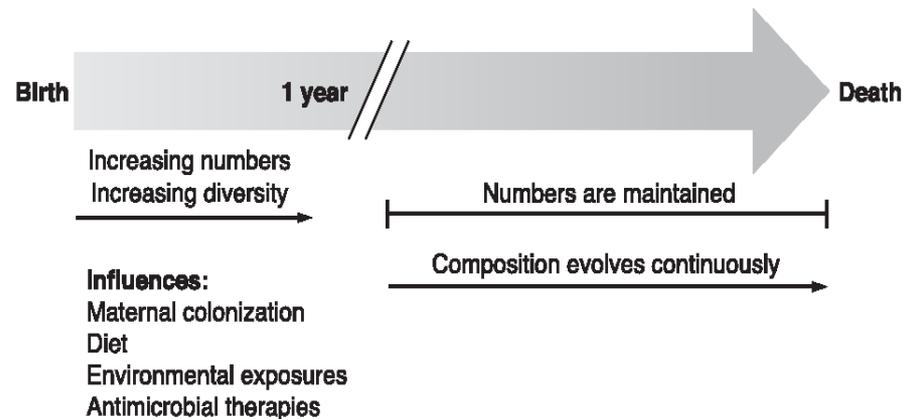
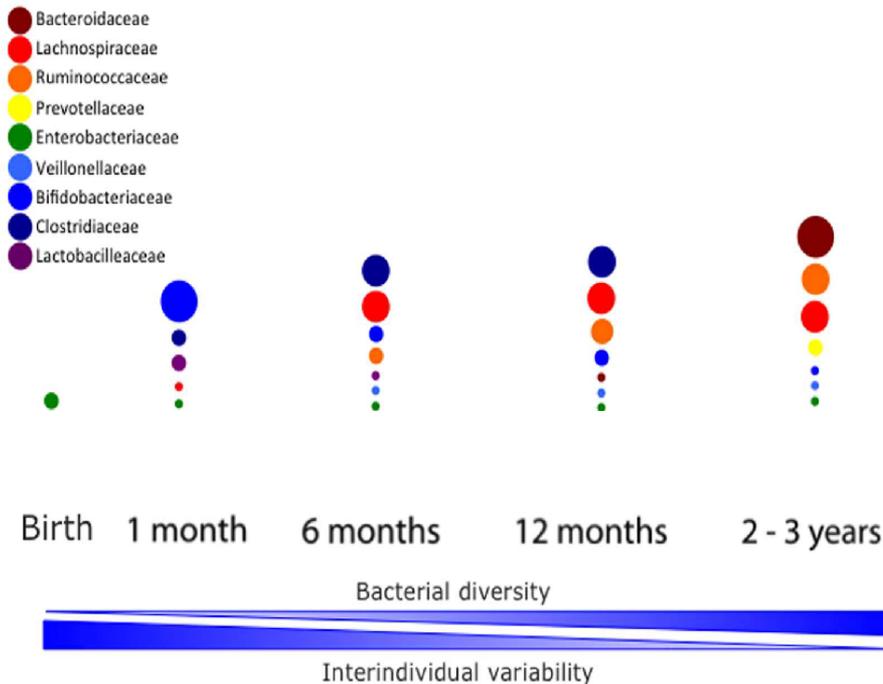
- Longitudinal: bacteria increase in number and composition changes from proximal to distal GI tract
- Latitudinal: bacterial composition also differs between lumen, mucus, and attached to epithelium





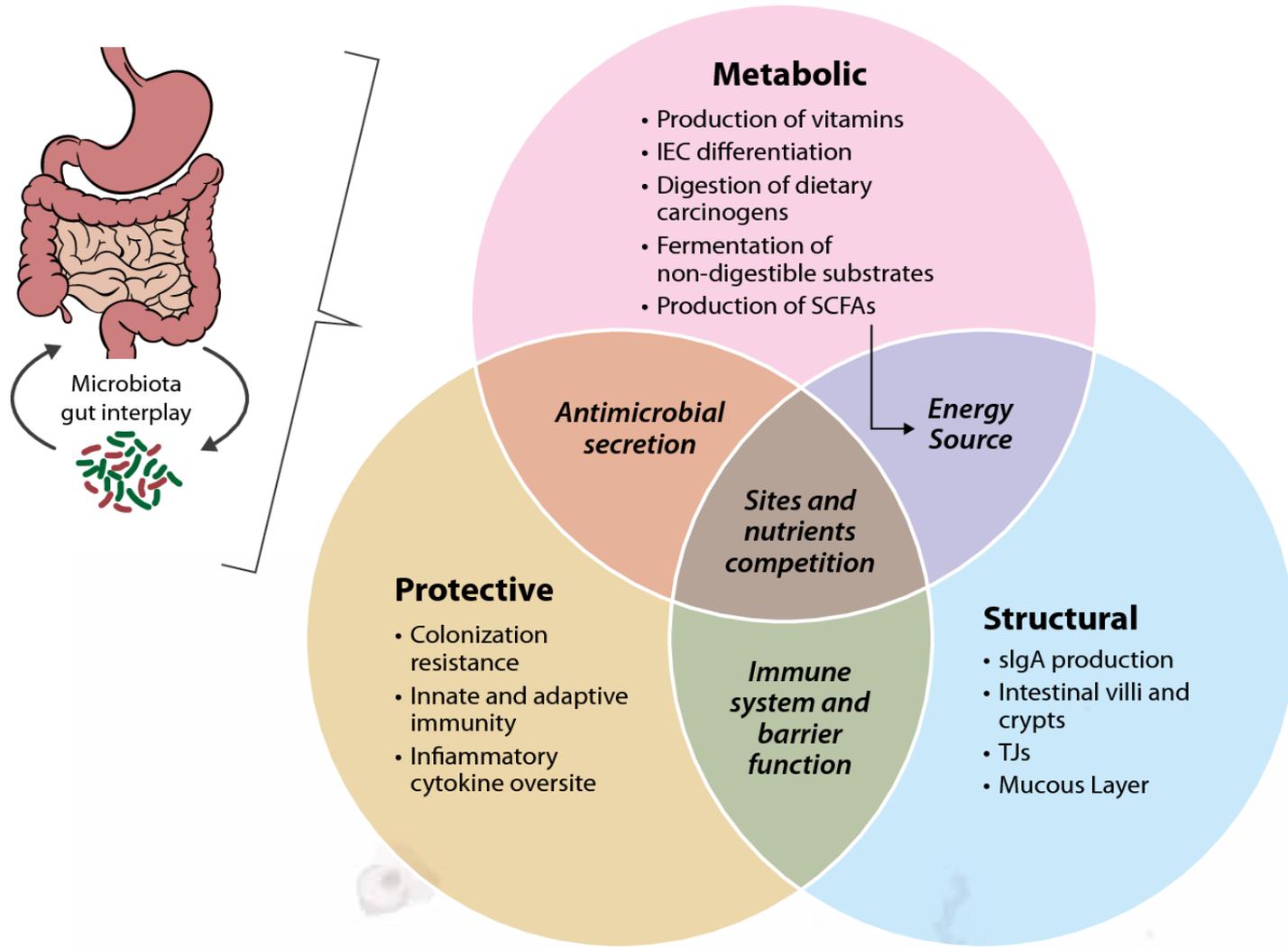
Gut microbiota: where do they come from?

- Colonisation: first bacterial communities – acquired from mother and environment
- Complete adult colonisation : 2 – 3 years
- Composition and diversity evolves continuously

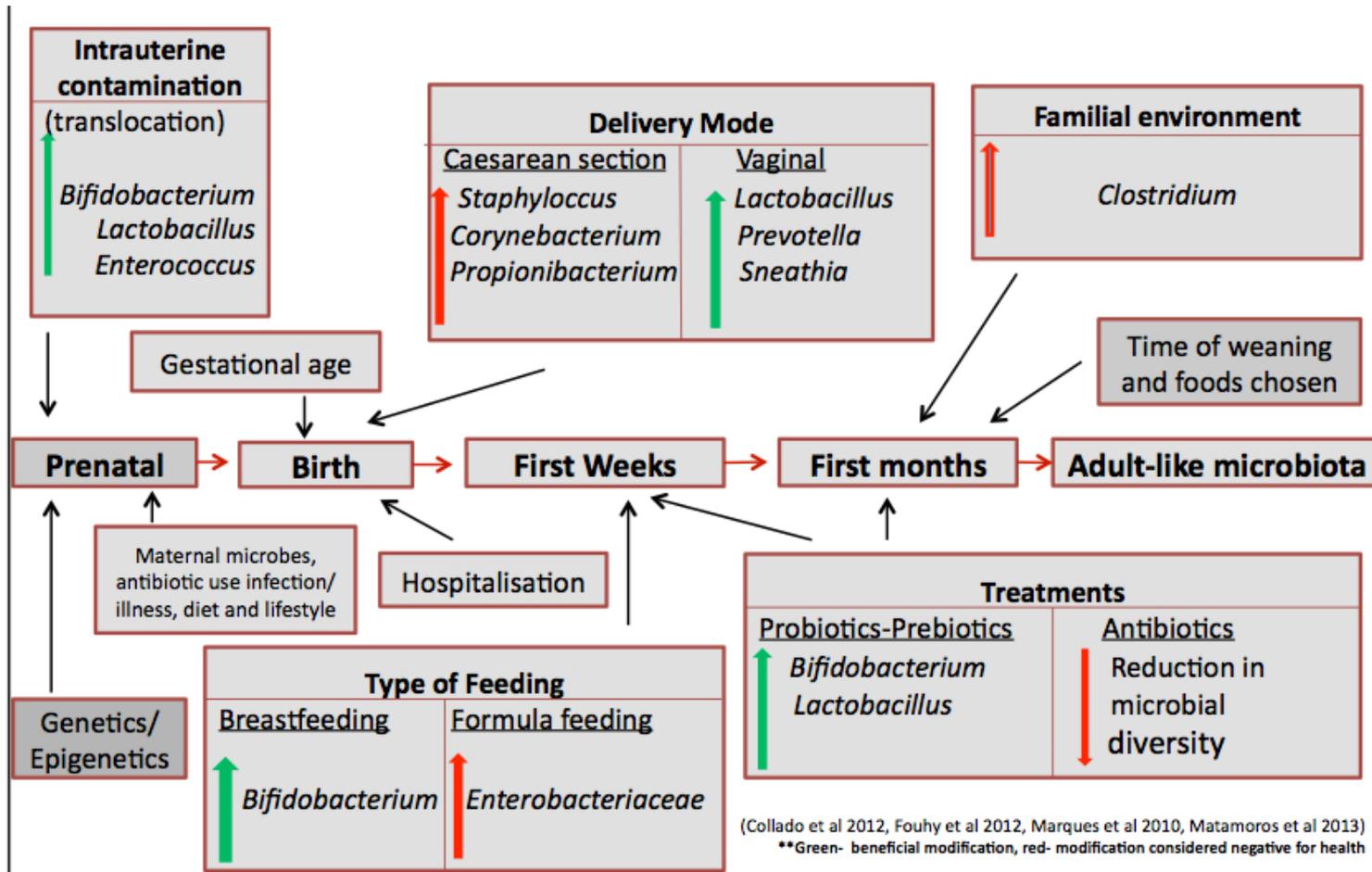




Gut microbiota functions

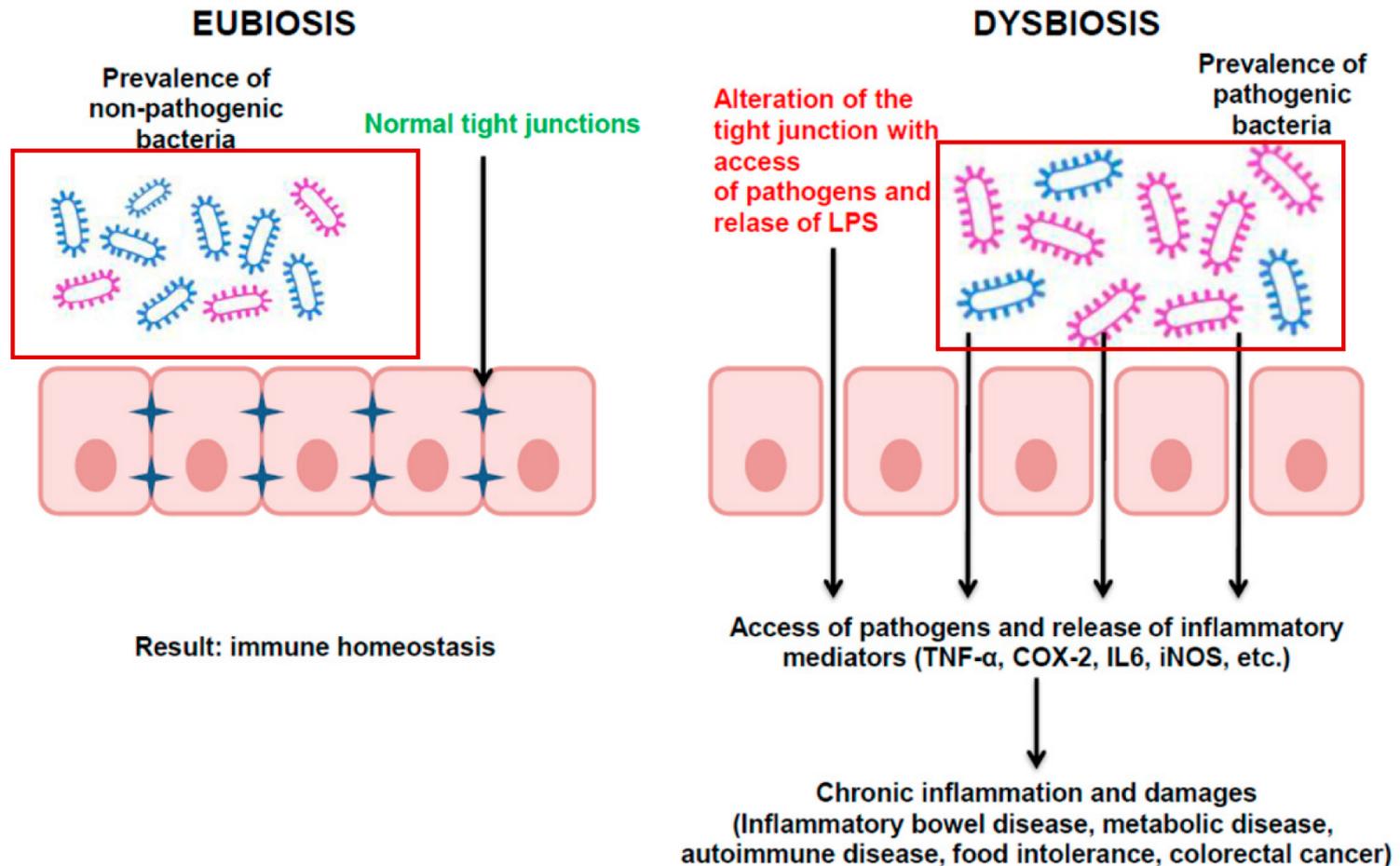


Factors affecting microbiome composition





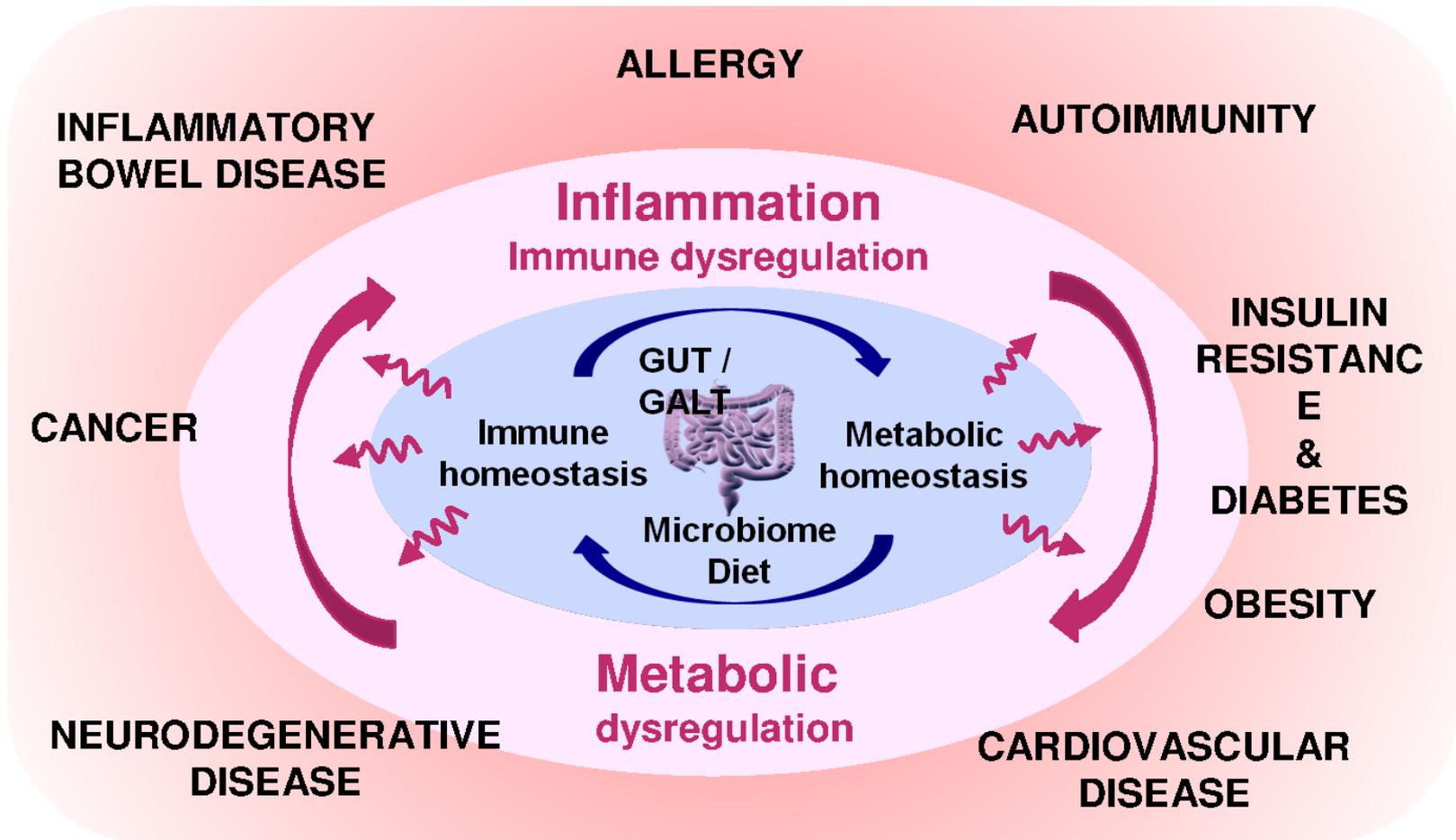
Dysbiosis lead to disease



Central role of the gut and nutrition

In maintenance of immune and metabolic homeostasis

(adverse exposures lead to inflammation and metabolic dysregulation)

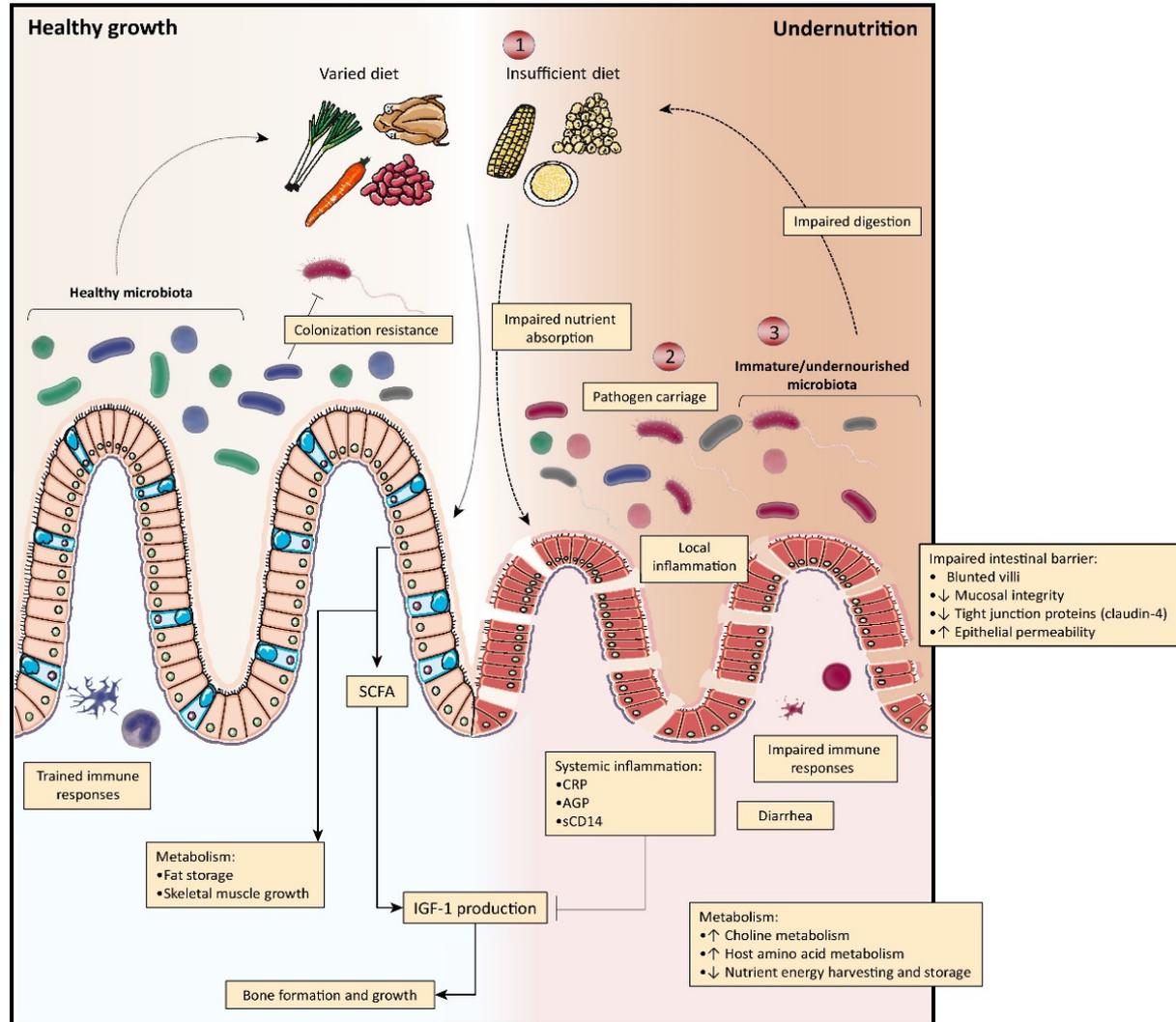




Nutrition-immunity link

- Nutrition is a key factor that can positively influence and train the immune system (directly or indirectly via the modulation of gut microbiota)
- **Macronutrient deficiency**
 - Protein, Calories
 - Malnutrition is the most common cause of immune deficiency world-wide
- **Micronutrient deficiency**
 - Elements, Vitamins
- **Over-nutrition**
 - Excess of macronutrients

The pathways by which microbes in the intestinal lumen interact with host in healthy versus malnourished children





Malnutrition and immunity

- **Loss of fat cells results in low leptin (adipose tissue-derived hormone levels):**
 - Signals nutritional status to the hypothalamus
 - Modifies pro inflammatory immune responses
 - Provides a key link between nutritional deficiency and immune function
- **Infections and malnutrition aggravate each other.**
- **The commonest cause of immunodeficiency worldwide**
- **Mainly affects – CMI, phagocytic function, complement activity, IgA production, cytokine production**



Protein energy malnutrition

- **Associated with reduced**
 - Numbers of CD4 helper T cells
 - CD4/CD8 ratio
 - Macrophage activation
 - Levels of C3, C5 and Factor B → opsonisation → phagocytosis
 - Intracellular killing of bacteria by phagocytes
 - Lysosome levels
 - TNF and IL-12
 - Wound healing



Sites of actions of micronutrients

Epithelial barriers

Vitamin A
Vitamin C
Vitamin E
Zinc

Cellular immunity

Vitamin A
Vitamin B₆
Vitamin B₁₂
Vitamin C
Vitamin D
Vitamin E
Folic acid
Iron
Zinc
Copper
Selenium

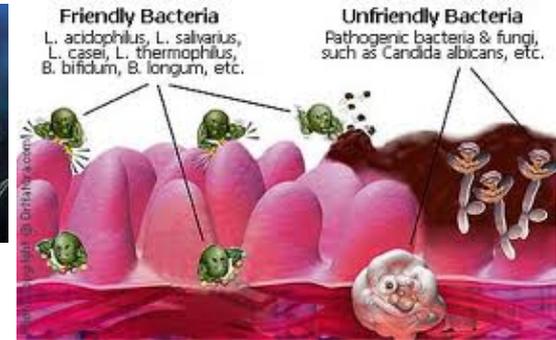
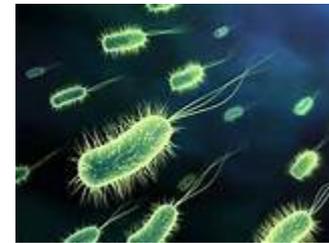
Antibody production

Vitamin A
Vitamin B₆
Vitamin B₁₂
Vitamin D
Vitamin E
Folic acid
Zinc
Copper
Selenium



Micronutrient deficiencies

	<i>Vitamin</i>	<i>Sources</i>	<i>Functions (essential for)</i>	<i>Deficiency diseases</i>
1	Vitamin A	Oil, fish, liver egg, milk, butter and carrots	Eye and lungs	Night blindness
2	Vitamin D	Animal fat, milk ghee, butter	Bones and teeth formation	Rickets
3	Vitamin E	Vegetable, milk, egg yolk and vegetable oils	Sex glands	Hemolysis & sterility
4	Vitamin K	Liver, spinach cauliflower green tomatoes	Blood clotting	Haemorrhage
5	Vitamin B ₁	Cereals, wheat, carrot, milk	Nervous system	Beri-beri
6	Vitamin B ₂	Cereals, milk, egg, liver	Eyes, skin, blood	Slow growth, sore eyes
7	Vitamin B ₄	Meat, fish, cereals, peanuts	Gum and tongue	Inflammation of the tongue and lateral margins of tongue and gums become swollen and red
8	Vitamin C	Lemon, grapes, tomatoes, oranges, apples and vegetables healing	Gums and wound	Scurvy



Immune boosting foods

Restoring microbial balance

- Probiotics and Prebiotics



Journal of Paediatrics and
Child Health

REVIEW ARTICLE

Probiotic effects in allergic disease

Intan H Ismail,^{1,2,4} Paul V Licciardi^{1,2} and Mimi LK Tang^{1,2,3}

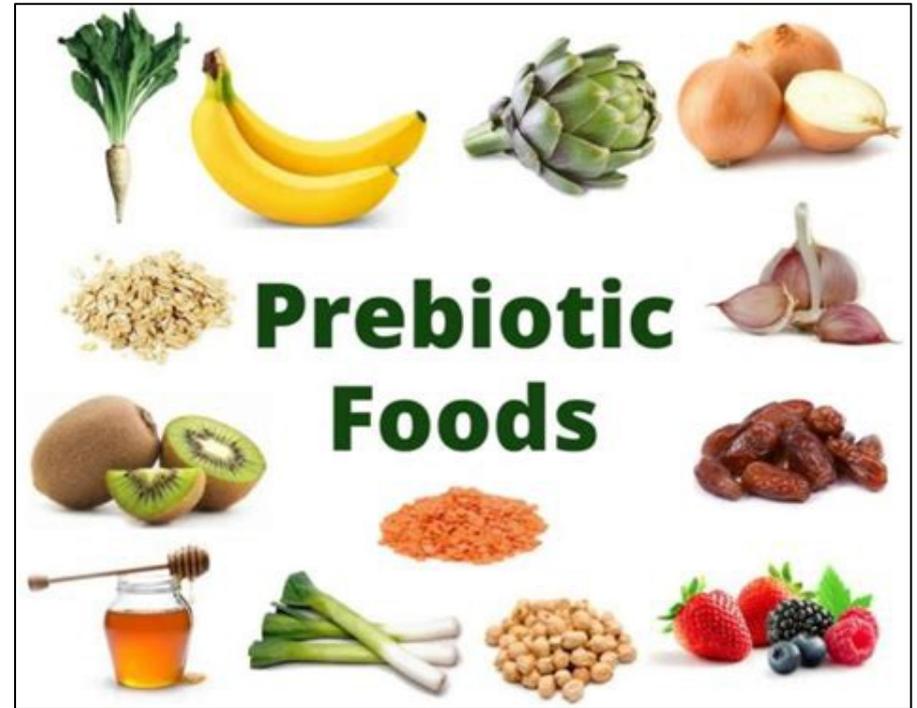
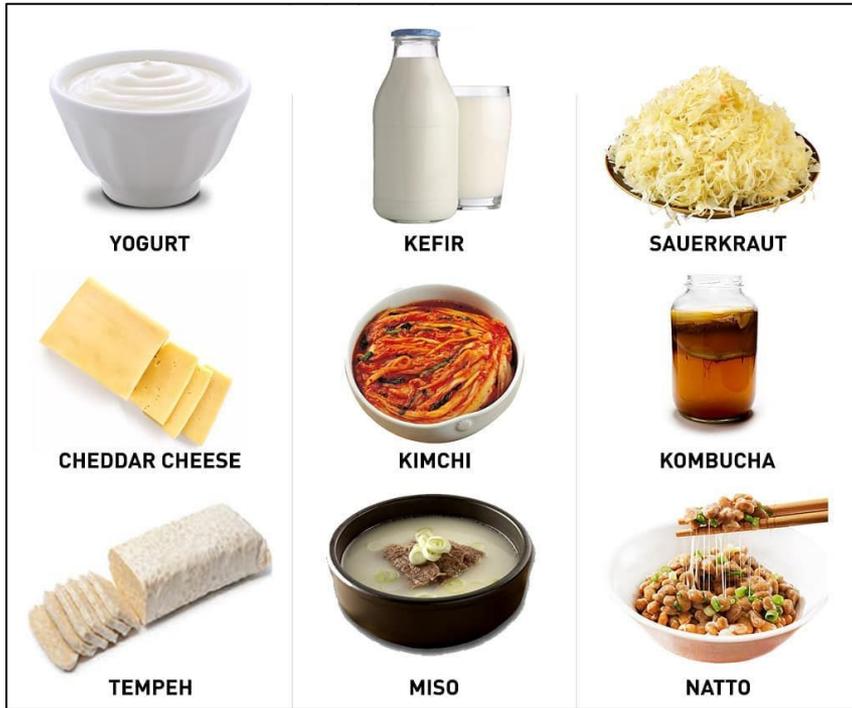
Journal of Paediatrics and Child Health 49 (2013) 709–715

MYS-03/10H19/20092





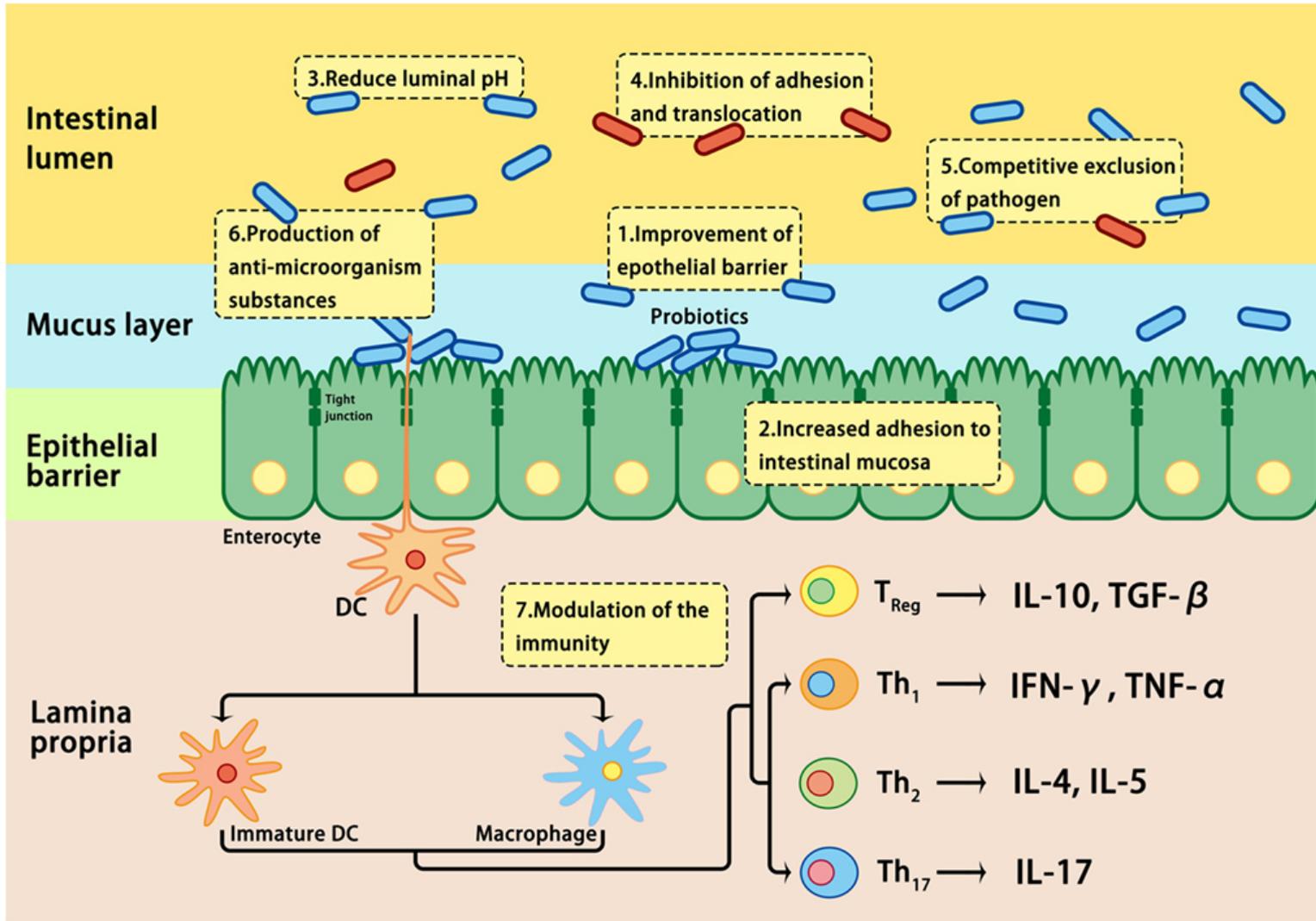
Probiotic and Prebiotic-containing foods



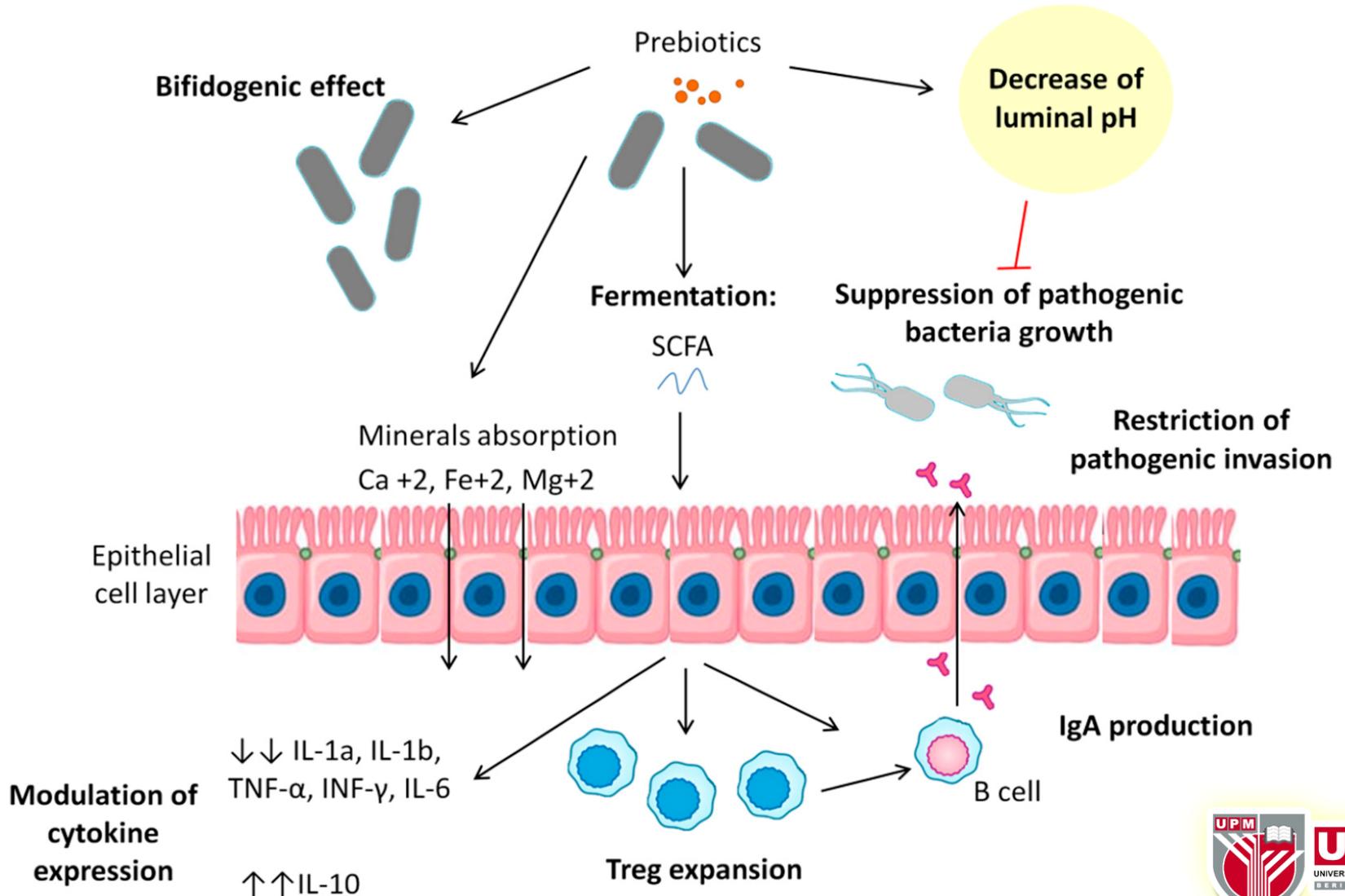
- Yogurt, Kefir, Kimchi
- Tempeh, Miso
- Sauerkraut (refrigerated)
- Pickles (refrigerated)

- Asparagus, Artichoke, Banana, Barley, Beans, Beets, Chicory
- Garlic, Honey, Leeks, Onion, Tomato
- Rye, Soybean, Wheat, Seaweed,

Mechanisms of probiotic action

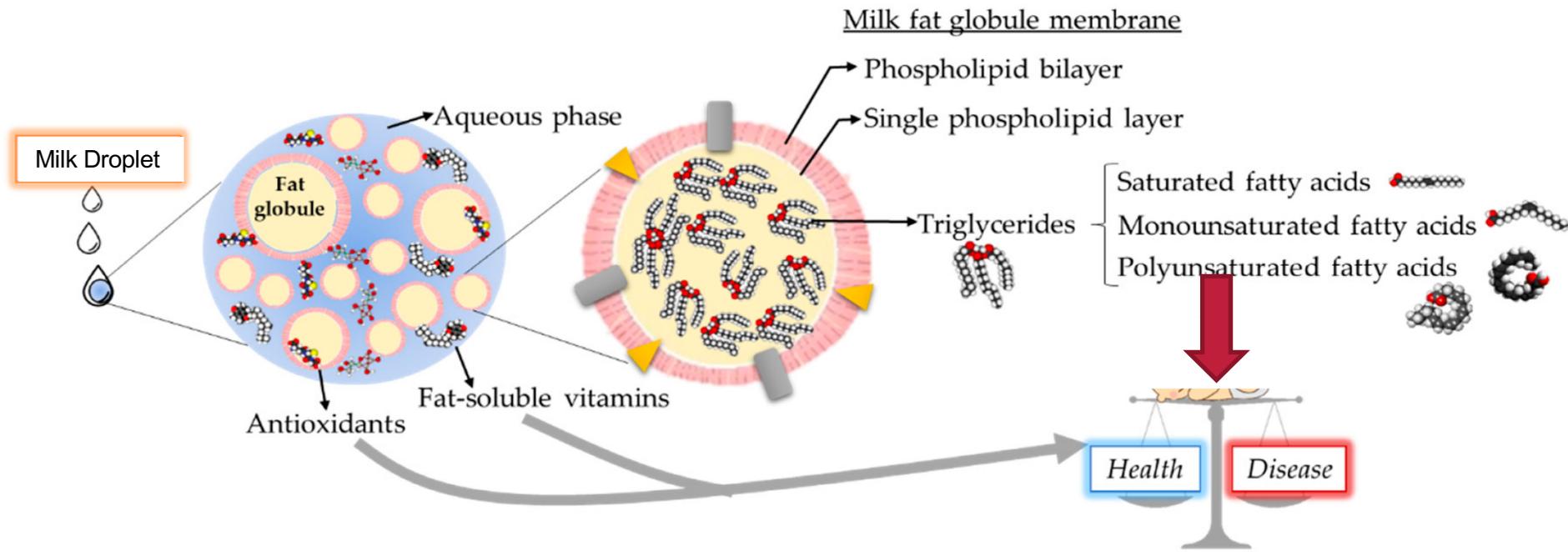


Mechanisms of prebiotic action



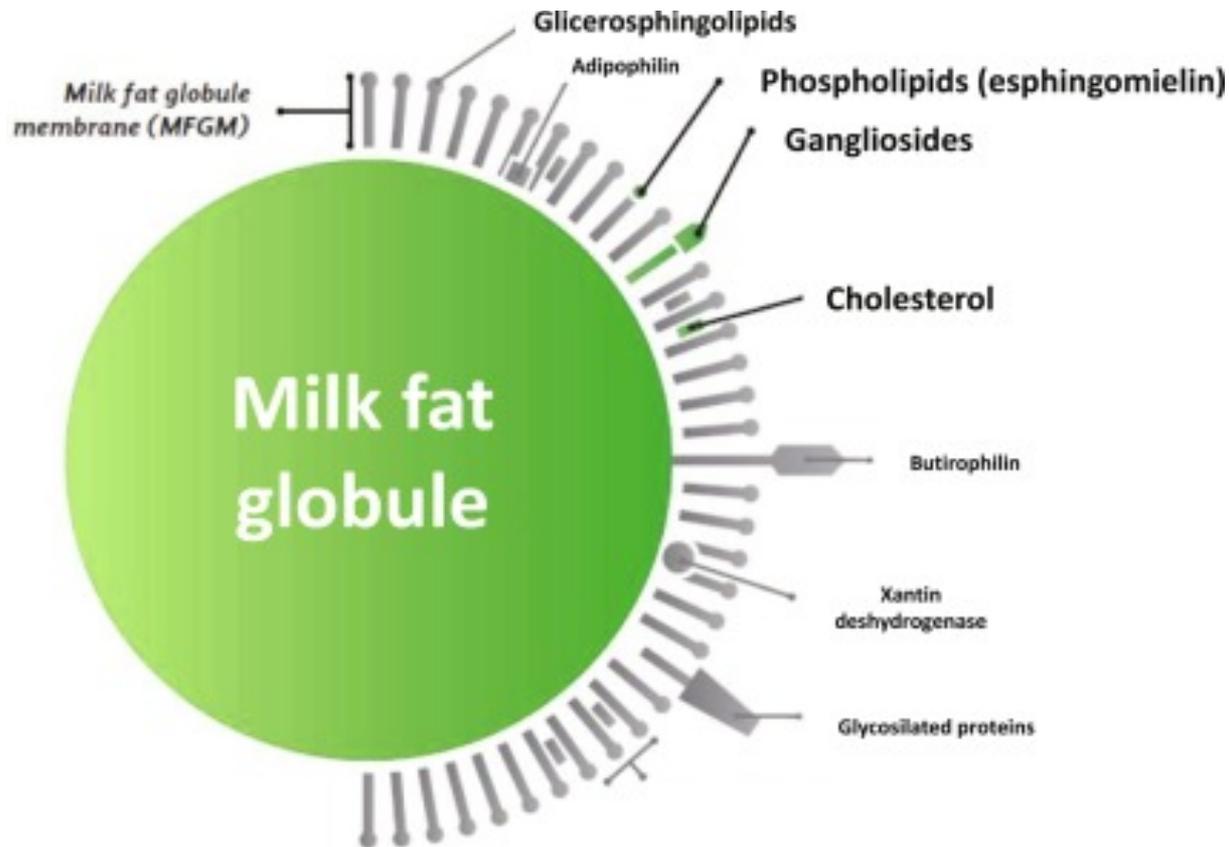
Milk fat globule membrane

- MFG is composed of a triglyceride-rich core surrounded by a tri-layer membrane, known as milk fat globule membrane (MFGM)
- MFGM is a complex mixture of 60% proteins and 40% lipids and functions to stabilise the globule as an emulsion





MFGM components and their potential impact



Evidence suggests MFGM and its components may play an important role in brain development and cognition, protection and digestive health

(Olsen and Faergeman, 2017; Park et al., 2005)



MFGM components and their potential impact

Brain function

- Choline
- Sphingomyelin
- Gangliosides
- Cholesterol
- Sialic acid
- Inositol
- Cerebrosides

Immune defense

- Mucins
- Butyrophilin
- Lactadherin
- CD14
- TLR1
- TLR4
- Xanthine oxidase



VITAMIN D
Rich Food

Salmon

Egg yolks

Oysters

Mushrooms

Cereal and Oatmeal

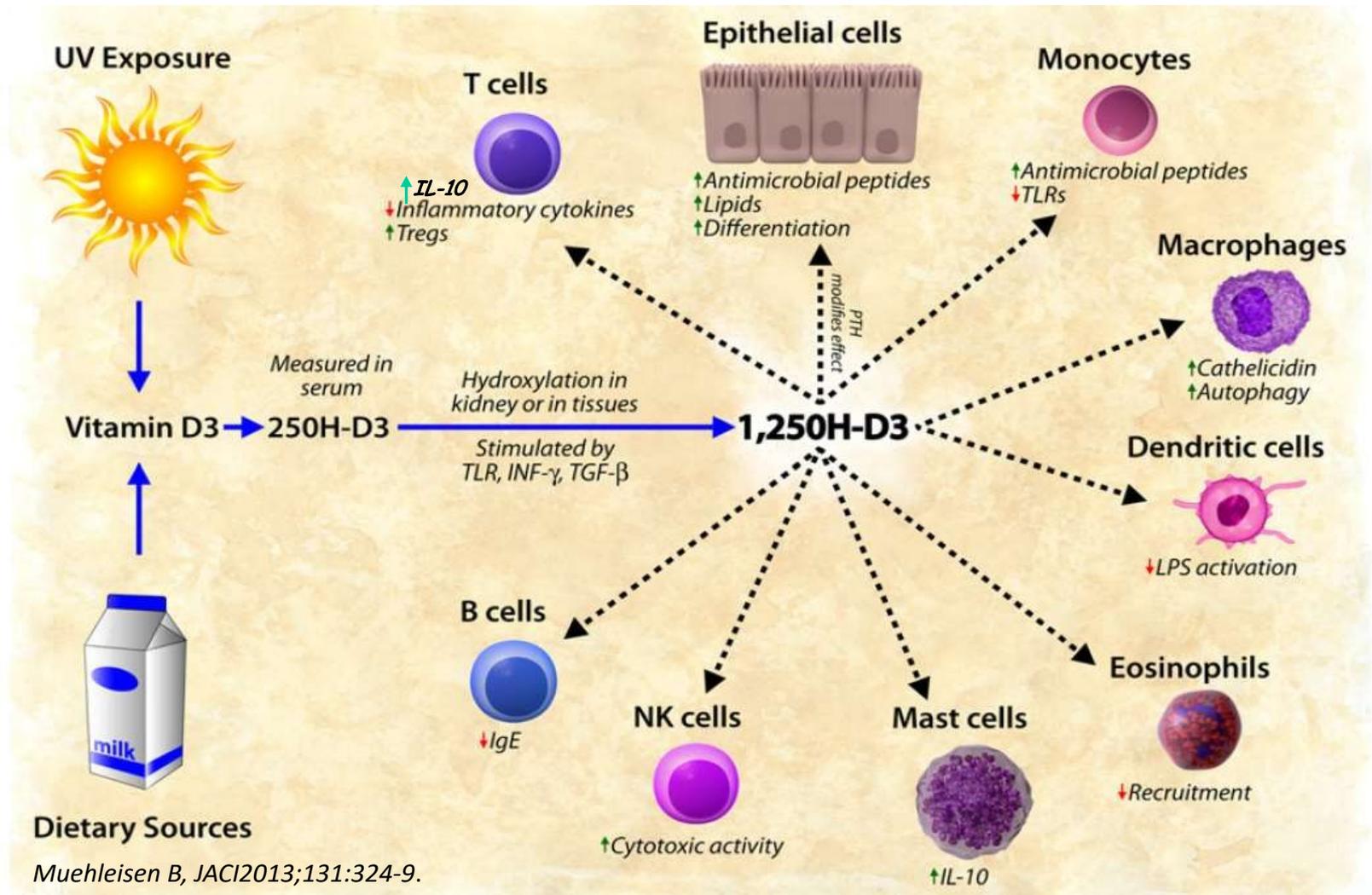
Cod liver oil

Shrimp

Soya milk

Canned tuna

Overview of vitamin D and its interactions with cells of the immune system





Over-nutrition and obesity

- Promotes inflammation
- Promotion of immune system stimulation causing autoimmunity
- Poor wound healing
- Increased susceptibility to respiratory, gastrointestinal, and liver infections



Summary

- The best way to “boost” your immune system is to include foods naturally rich in nutrients and vitamins
 - “**EAT YOUR COLORS**”
- Over-supplementation can be detrimental:
 - Toxicity (Vitamin A)
 - Inhibition of phagocytes (zinc, iron, copper)
 - Obesity in relation to food excess



Thank you