

An holistic approach to immunity, inflammation and metabolic health

Philip Calder
Professor of Nutritional Immunology
University of Southampton
Southampton
UK
(pcc@soton.ac.uk)

BASF Day of Science, May 27 2021

The opinions shared and expressed in this presentation and webinar are my own and do not reflect the views and opinions of BASF.

What is immunity?

→ Our ability to defend ourselves against pathogens (bacteria, viruses etc.)

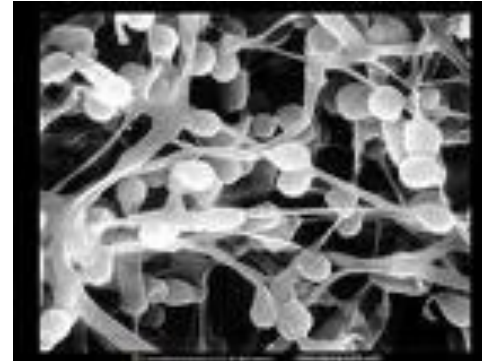
Bacteria



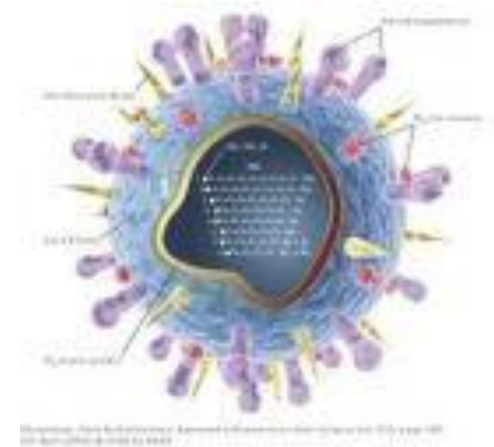
Parasitic worms



Fungi



Viruses

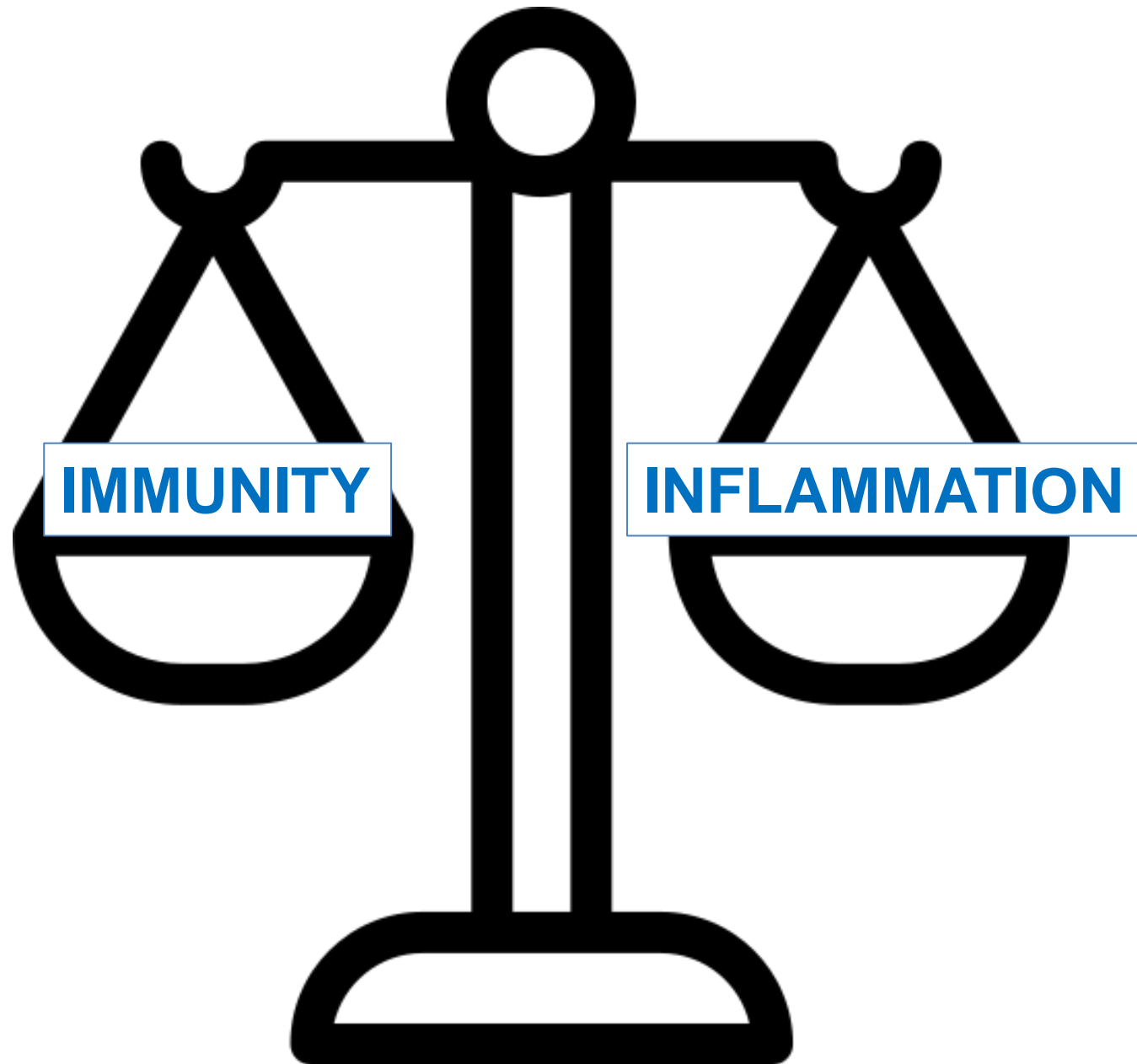


What is immunity?

→ Our ability to defend ourselves against pathogens (bacteria, viruses etc.)

What is inflammation?

→ It is part of (innate) immunity so it is helpful – however when inflammation is excessive or uncontrolled it is harmful



What is immunity?

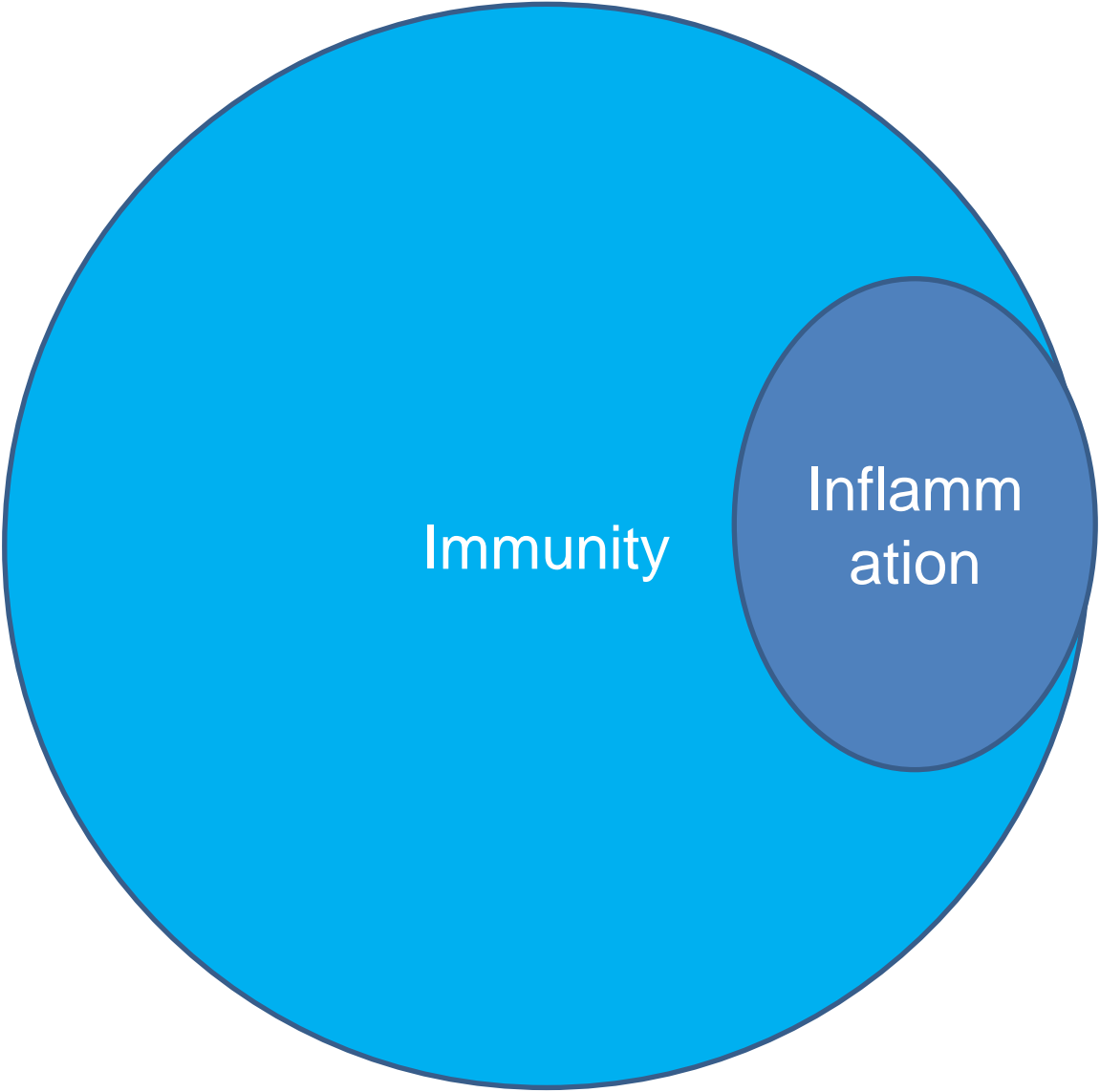
→ Our ability to defend ourselves against pathogens (bacteria, viruses etc.)

What is inflammation?

→ It is part of (innate) immunity so it is helpful – however when inflammation is excessive or uncontrolled it is harmful

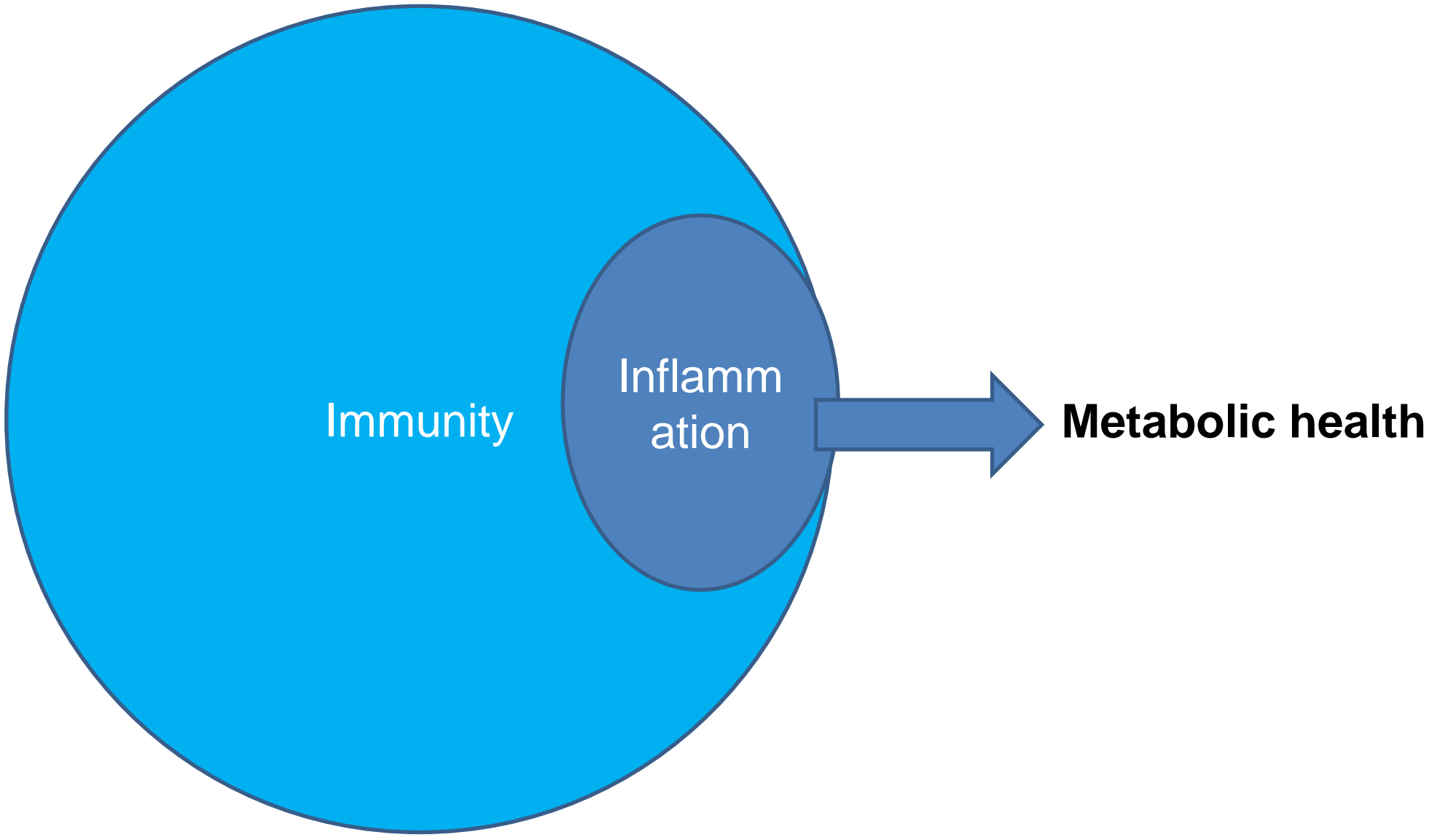
What is metabolic health?

→ Having “ideal” levels of blood sugar, triglycerides, high-density lipoprotein (HDL) cholesterol, blood pressure, and waist circumference, without using medications (= absence of metabolic syndrome)



Immunity

Inflammation

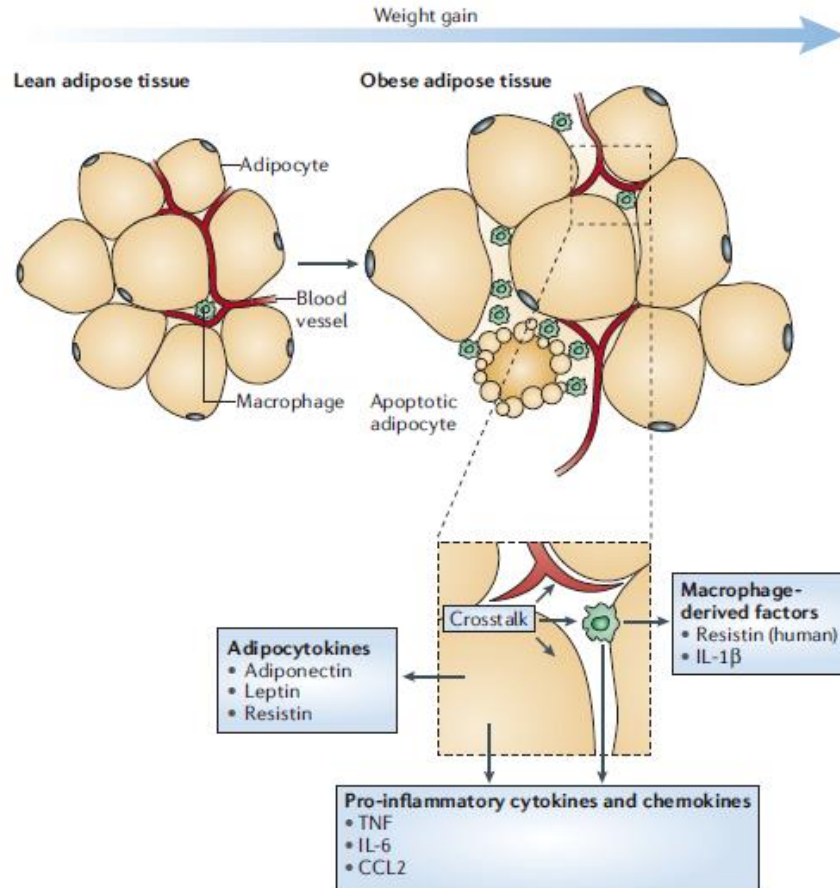


Immunity

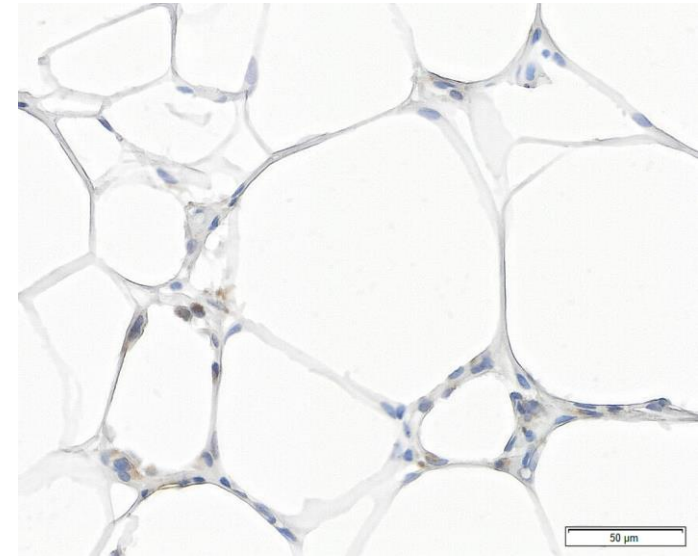
Inflammation

Metabolic health

As obesity develops fat (adipose) tissue becomes inflamed



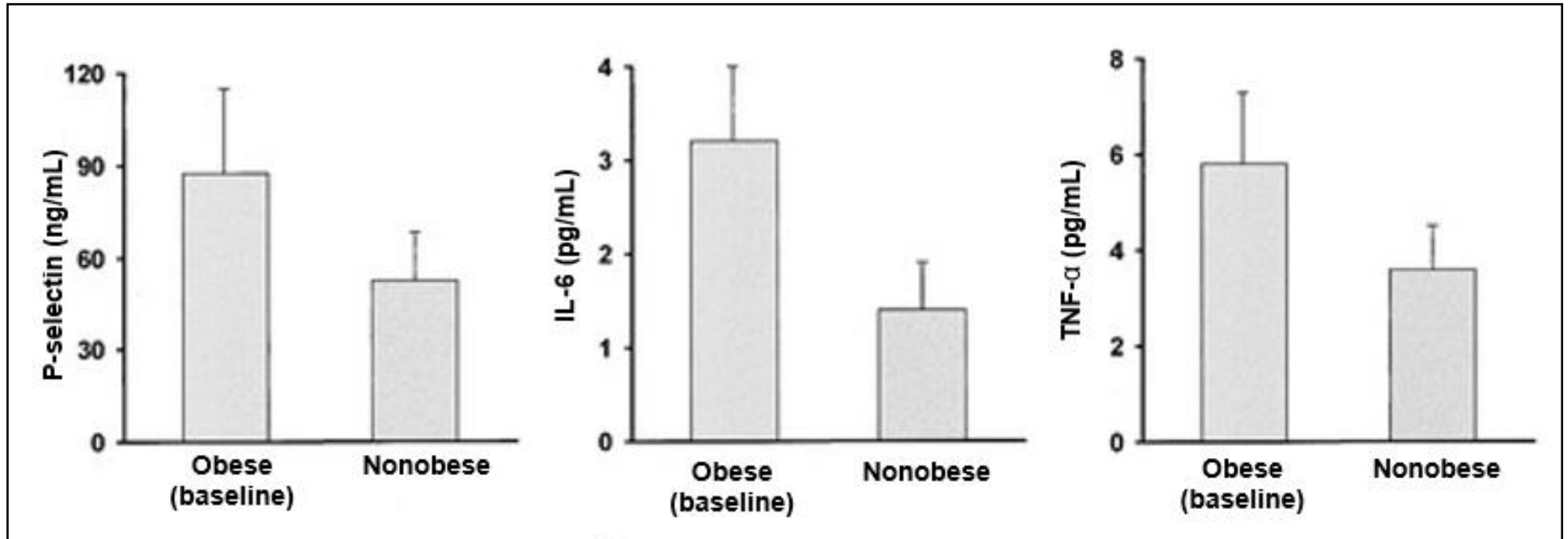
*Tilg & Moschen (2006)
Nat Rev Immunol 6, 772-783*



Real adipose tissue from an individual with obesity, showing macrophages in crown-like structures

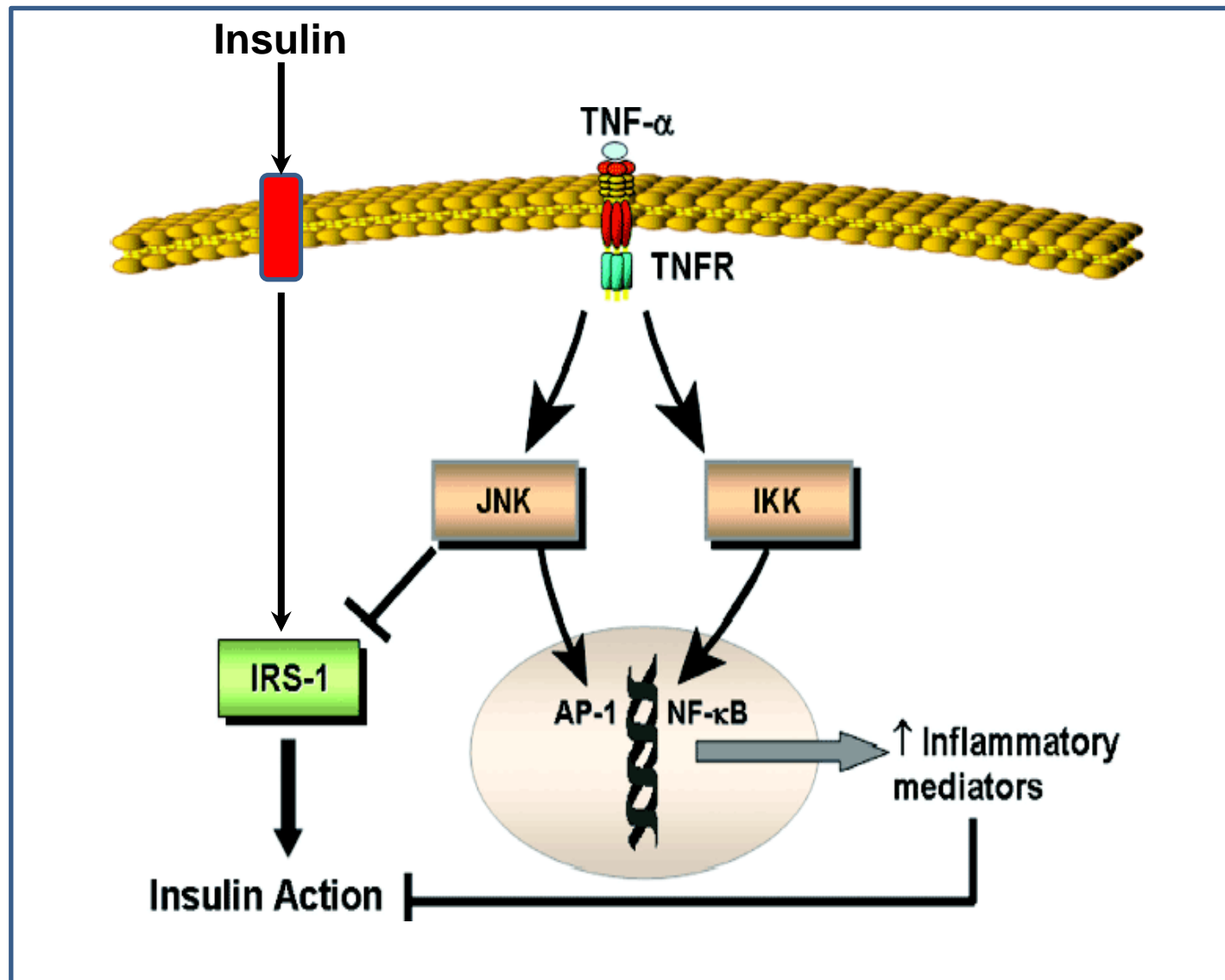
Helena Fisk, unpublished

Blood inflammatory marker concentrations are higher in obese than in normal weight women

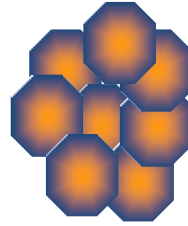


Ziccardi et al. (2002)
Circulation 105, 804-809

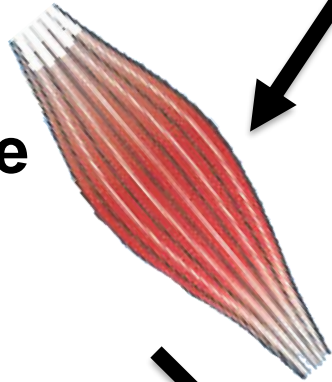
Inflammation causes insulin resistance



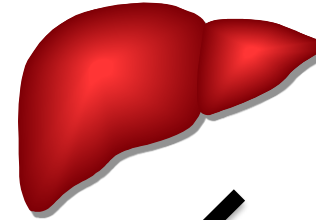
**Adipose tissue
inflammation and
insulin resistance**



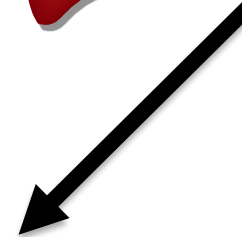
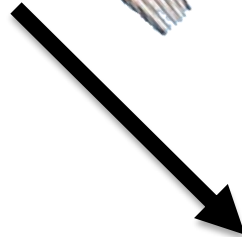
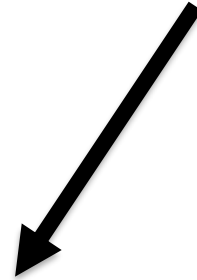
**Skeletal muscle
inflammation
and insulin
resistance**



**Liver
inflammation
and insulin
resistance**



**Systemic inflammation
and insulin resistance**



Insulin resistance

- **Elevated blood glucose (blood sugar)**
- **Elevated blood triglycerides**
- **Lowered HDL**

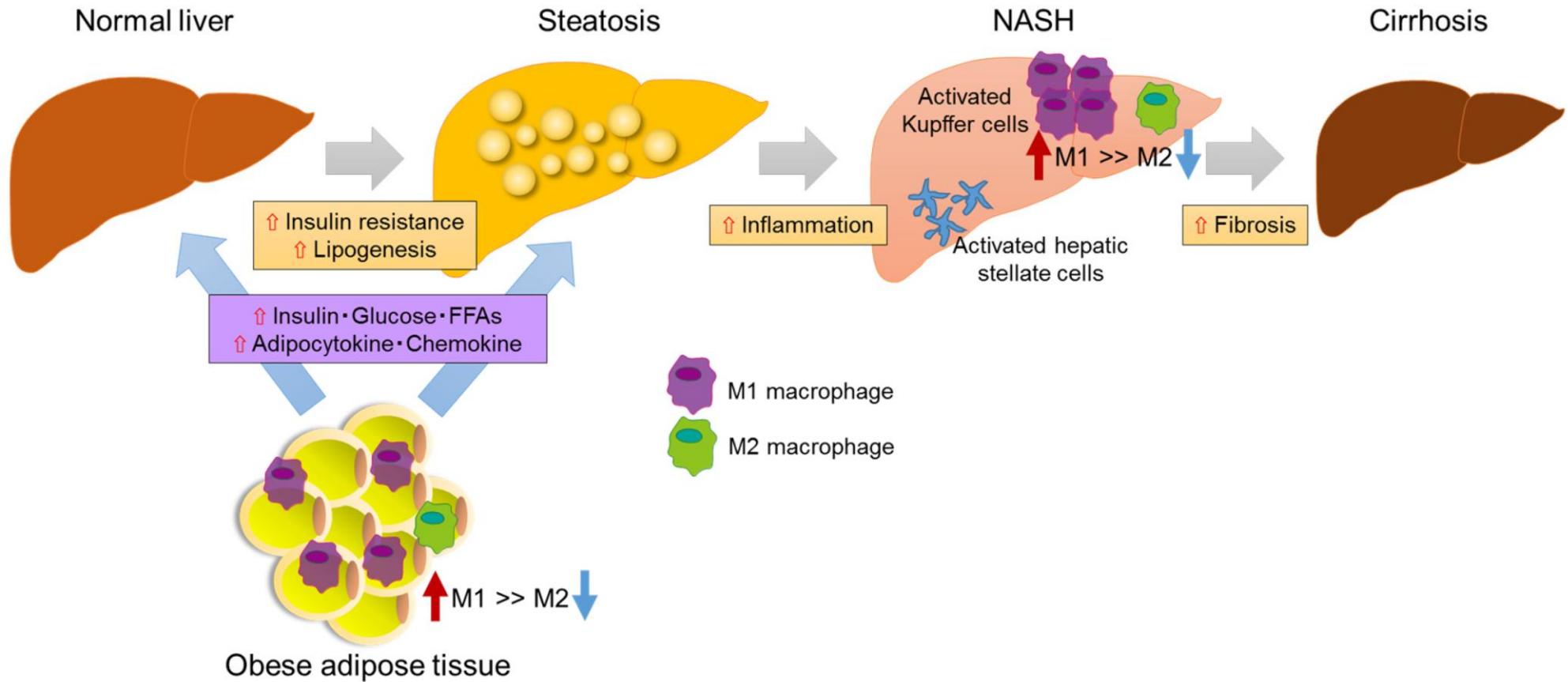
Insulin resistance

- **Elevated blood glucose (blood sugar)**
- **Elevated blood triglycerides**
- **Lowered HDL**

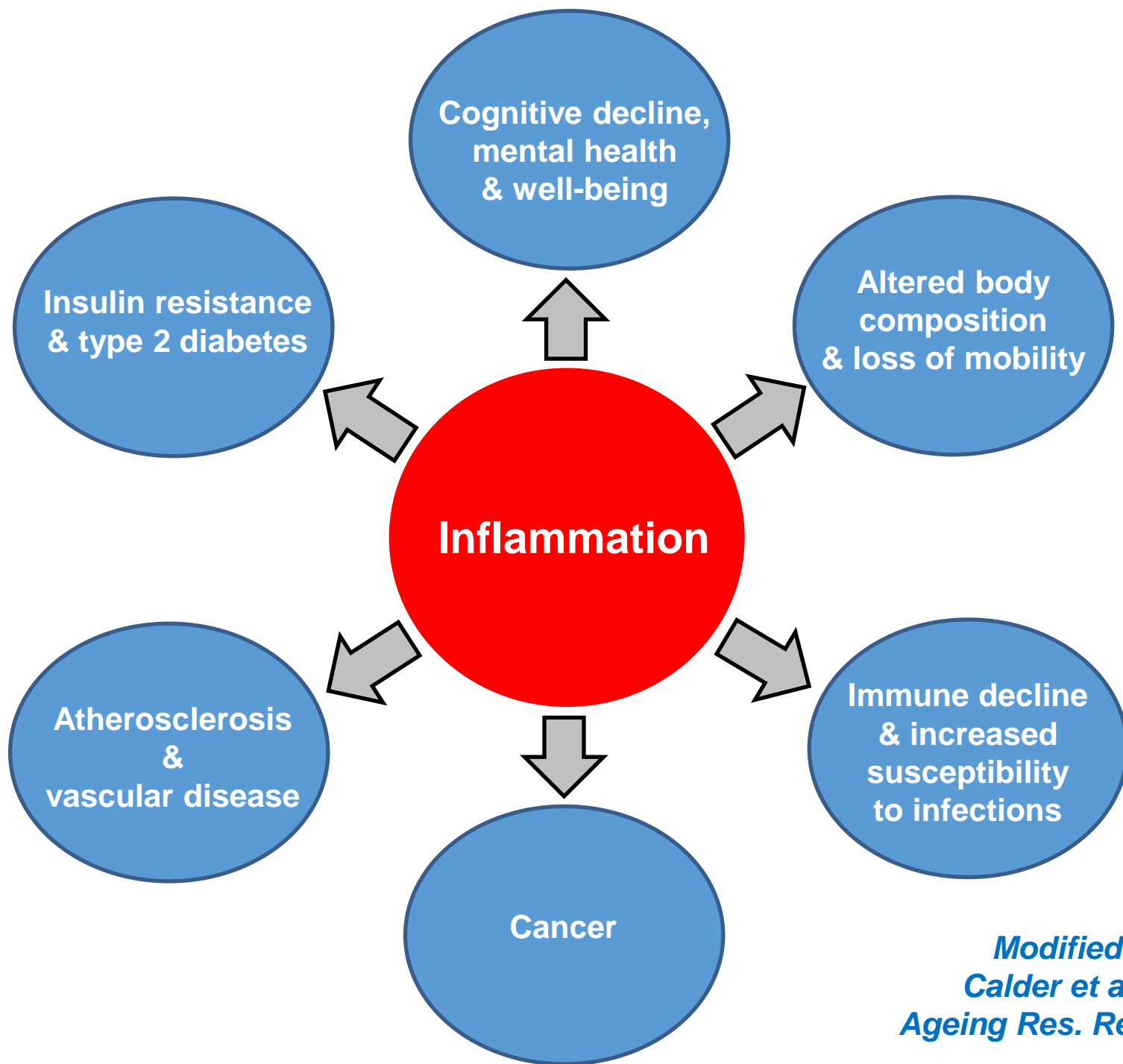
These are the characteristics of poor metabolic health

- **pre-diabetes -> diabetes**
- **increased risk of cardiovascular disease (e.g. heart disease)**

The combination of insulin resistance and inflammation “drives” liver disease



**Inflammation links obesity to poor
metabolic health**



*Modified from:
Calder et al. (2017)
Ageing Res. Rev. 40, 95-119*

PLUTO AND BEYOND • THE SKEPTICAL ENVIRONMENTALIST REPLIES

SCIENTIFIC AMERICAN

MAY 2002
WWW.SCIAM.COM

A FIRE WITHIN

Inflammation's Link to Heart Attacks

PLUS:

Extreme Lasers
Rent a Rain Forest
When Whales Walked



\$4.95 UK £3.50

FEBRUARY 23, 2004

TIME

BUSH'S
MILITARY RECORDS
IS DISNEY MOUSETRAPPED?

THE SECRET KILLER

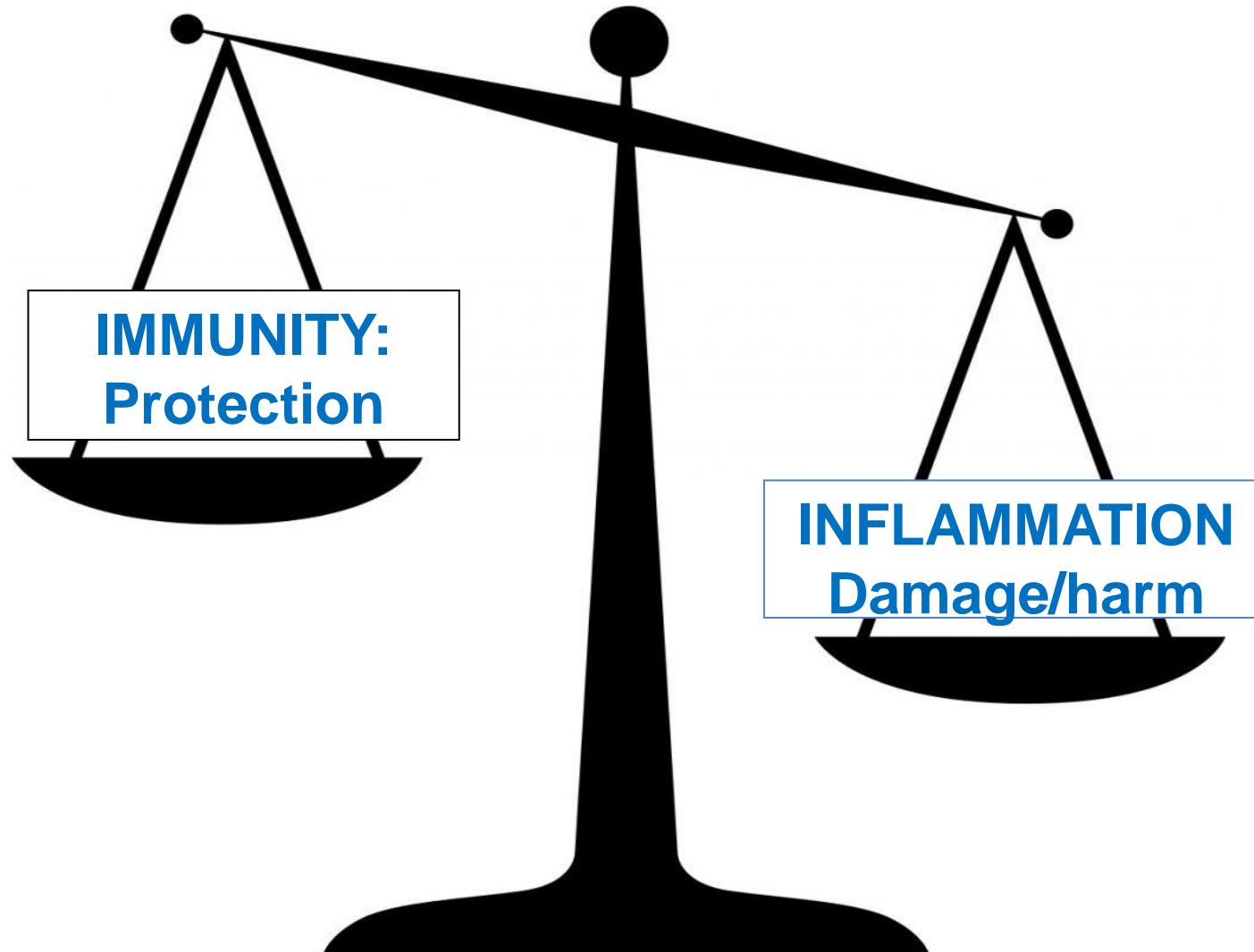
- The surprising link between **INFLAMMATION** and **HEART ATTACKS, CANCER, ALZHEIMER'S** and other diseases
- What you can do to fight it

www.time.com AOL Keyword: TIME

Obesity and immunity

- **Obesity impairs the activity of many immune cells (i.e. it weakens immunity)**
- **People with obesity are more susceptible to many infections**
- **People with obesity do not respond so well to some vaccinations**

Obesity presents an imbalance between protective immunity and inflammation

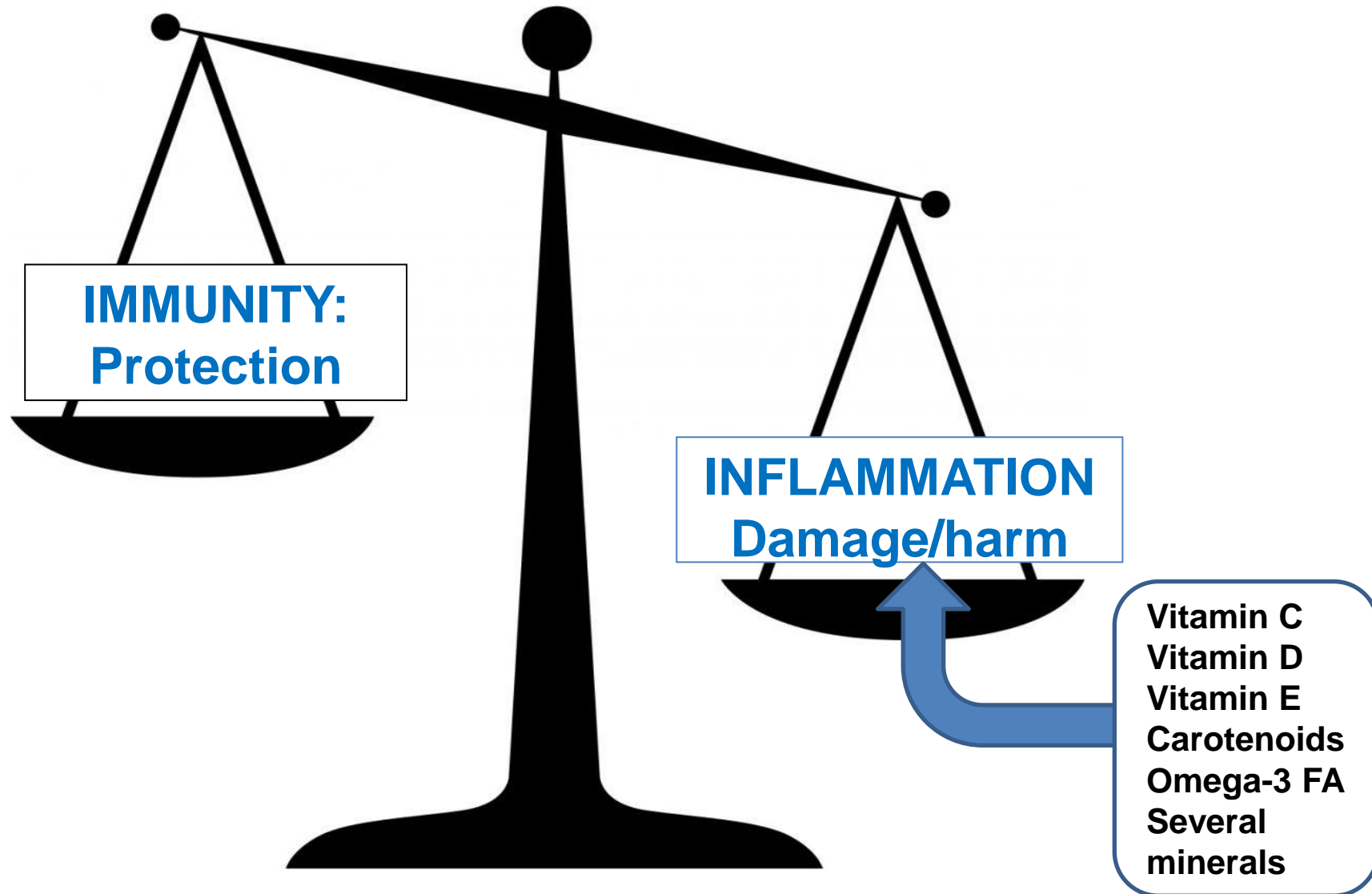


Weight loss will:

- **Reduce inflammation**
- **Increase insulin sensitivity**
- **Improve metabolic health**
- **Improve immunity (fewer infections)**

**Are there nutritional
interventions to consider?**

Many nutrients can help to control inflammation



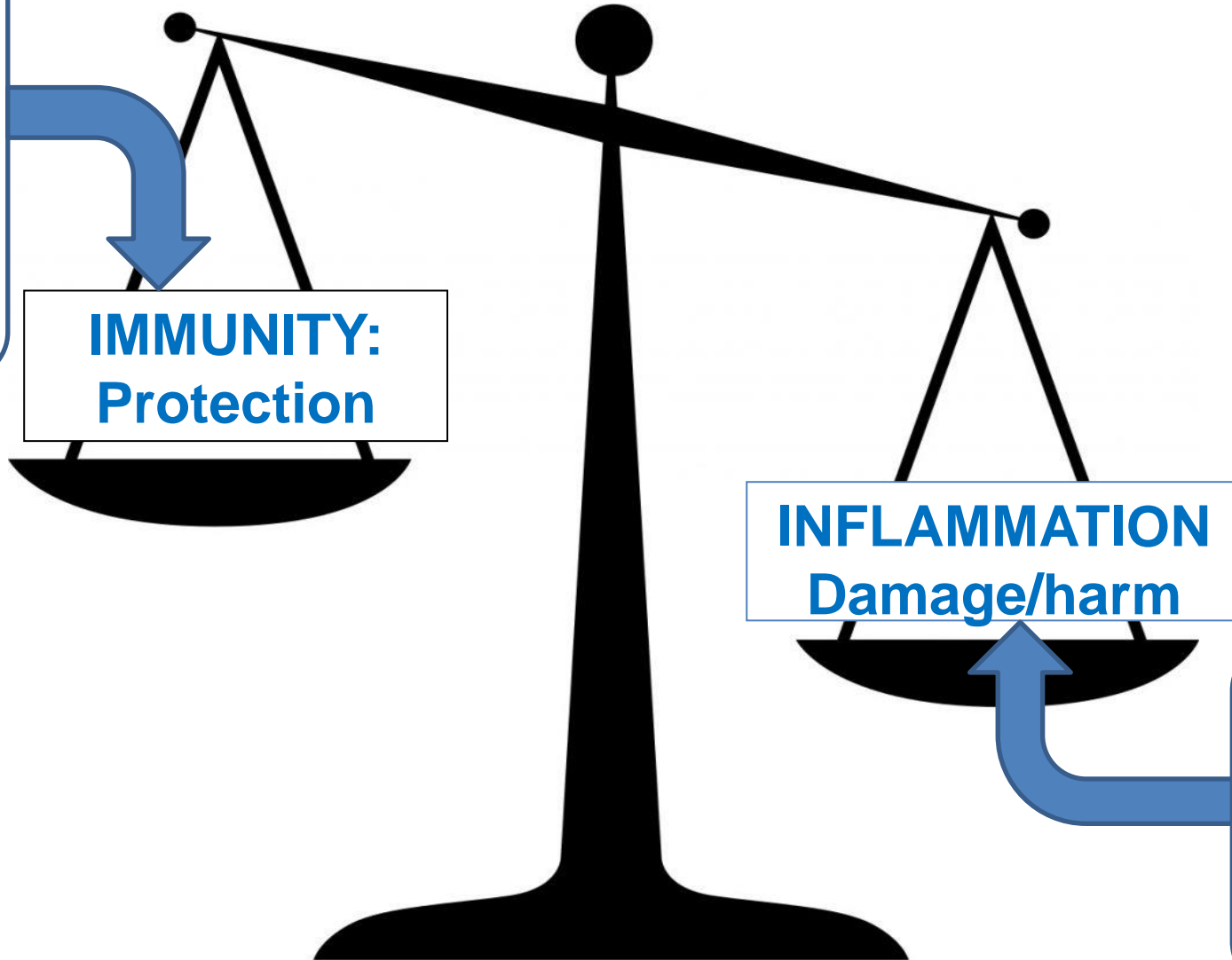
Many nutrients can help to control inflammation

Vitamin A
B Vitamins
Vitamin C
Vitamin D
Vitamin E
Carotenoids
Omega-3 FA
Several
minerals

**IMMUNITY:
Protection**

**INFLAMMATION
Damage/harm**

Vitamin C
Vitamin D
Vitamin E
Carotenoids
Omega-3 FA
Several
minerals



These nutrients can:

- **Help to control inflammation**
- **Help to restore metabolic health
(both directly and via reduced inflammation)**
- **Help to support immunity**

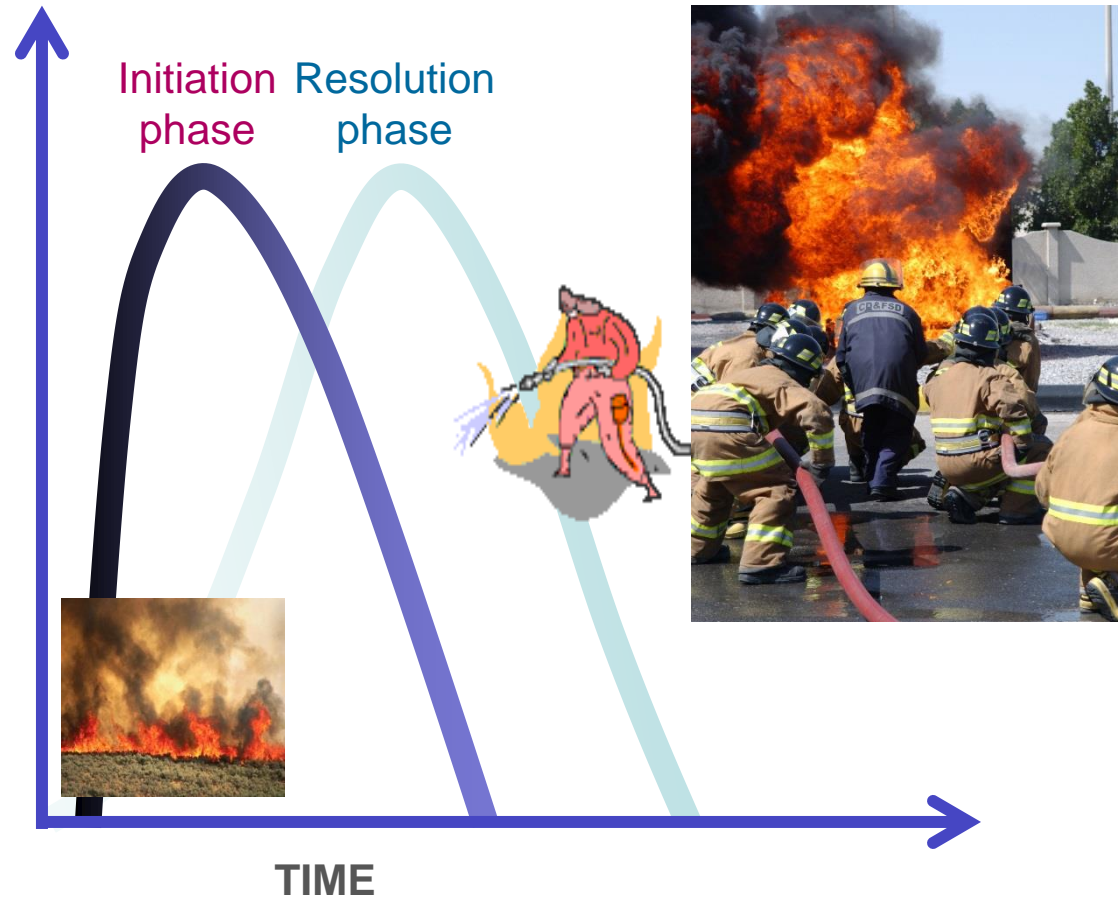
Health impacts would be:

- **Less metabolic disease (diabetes, fatty liver disease ...)**
- **Less cardiovascular disease**
- **Better cognitive health/Less cognitive decline**
- **Healthier aging**
- **Less infectious disease**
- **Better vaccination responses**
- **(Less inflammatory disease)**



One final, very exciting thing

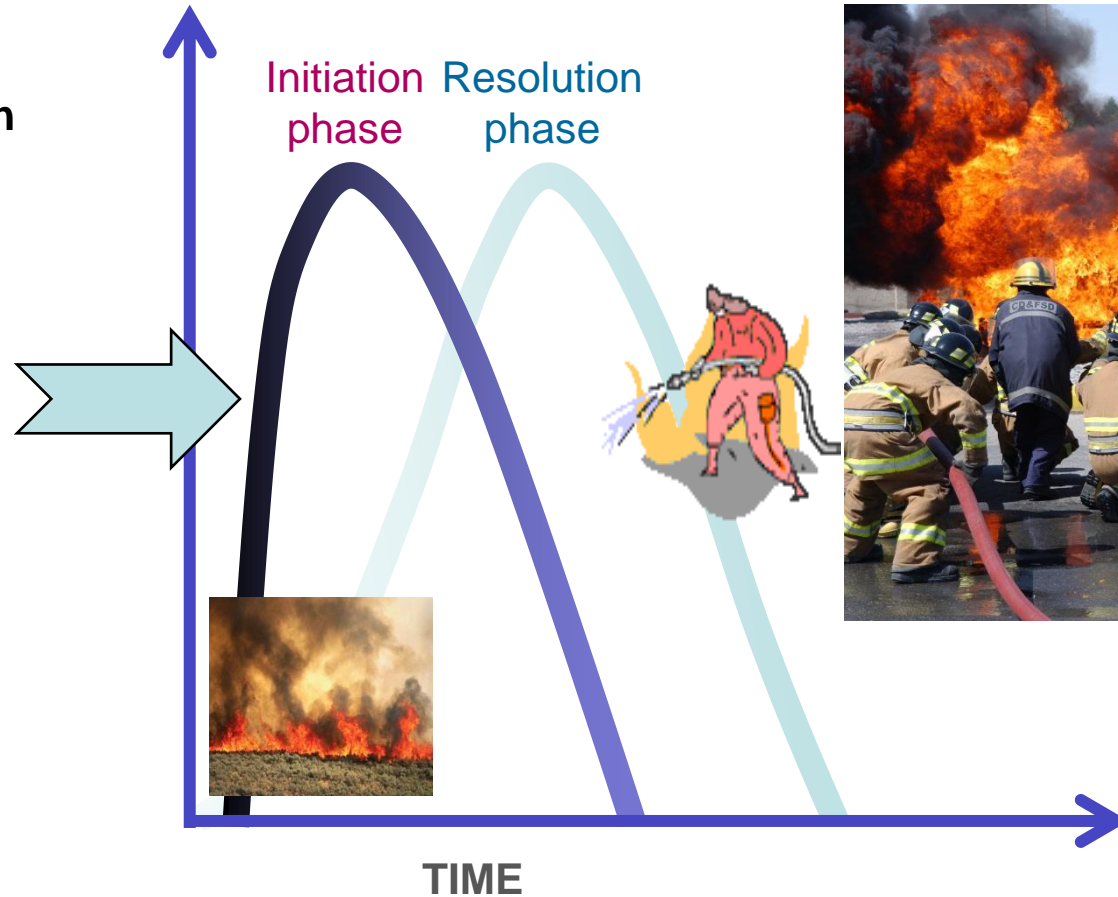
New paradigm Inflammation has two phases: Initiation and resolution



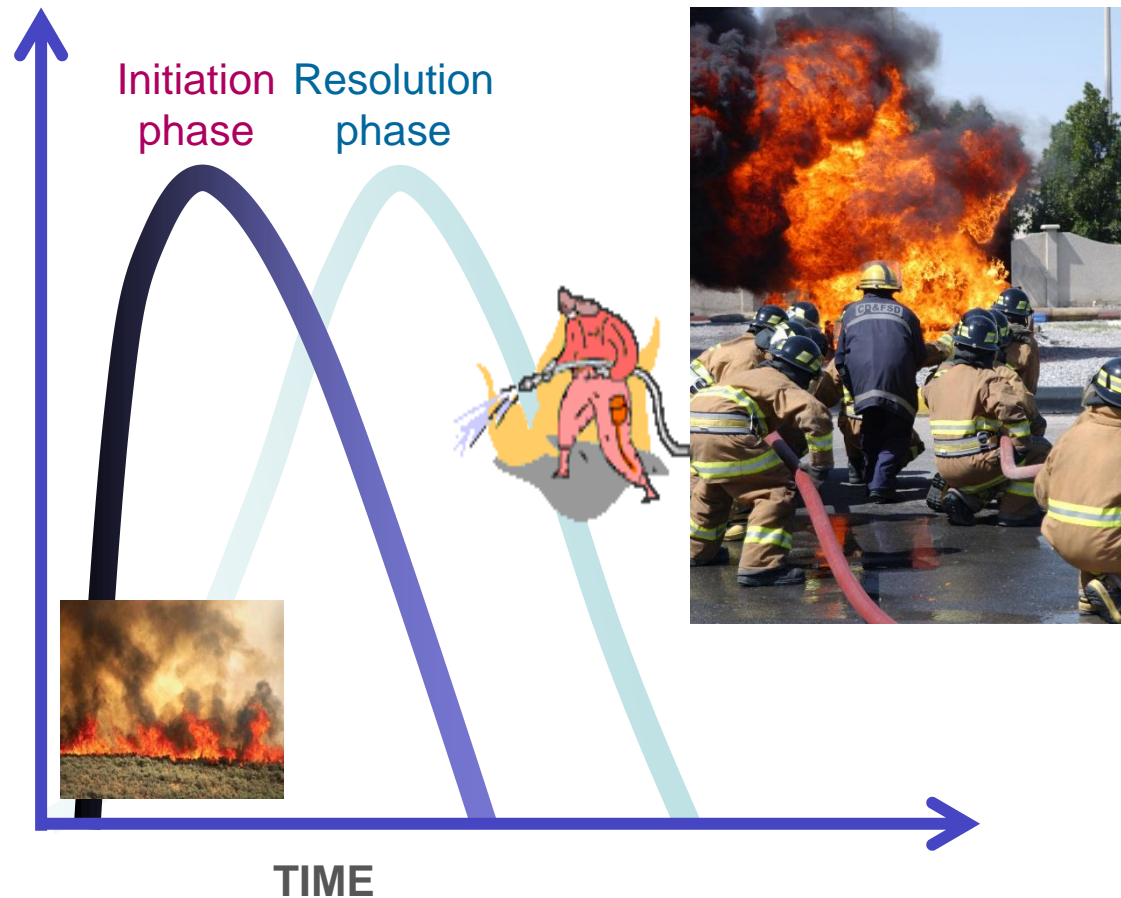
New paradigm Inflammation has two phases: Initiation and resolution

Several nutrients control the initiation & propagation of inflammation – these are referred to as “anti-inflammatory”:

- Vitamin C
- Vitamin D
- Vitamin E
- Carotenoids
- Omega-3 FA
- Several minerals



What chemicals are present during the resolution phase?

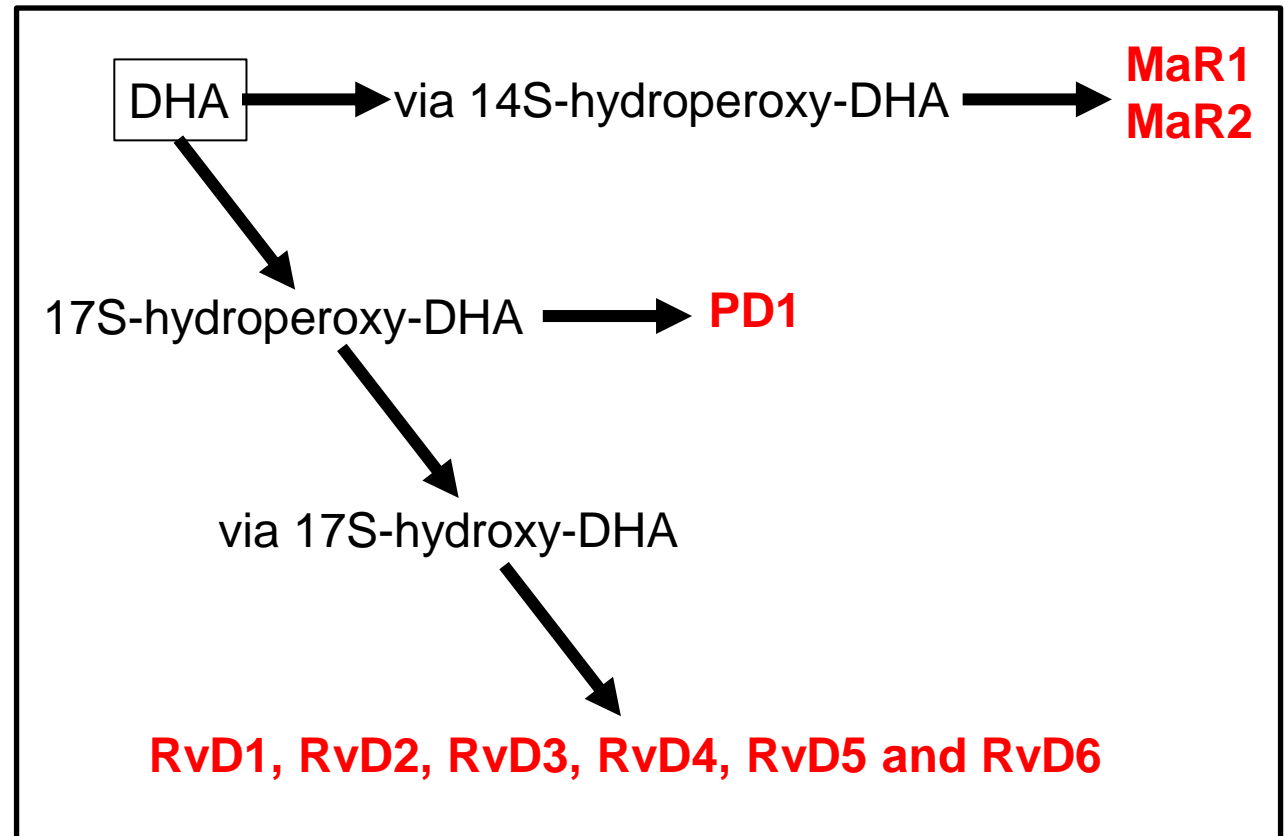
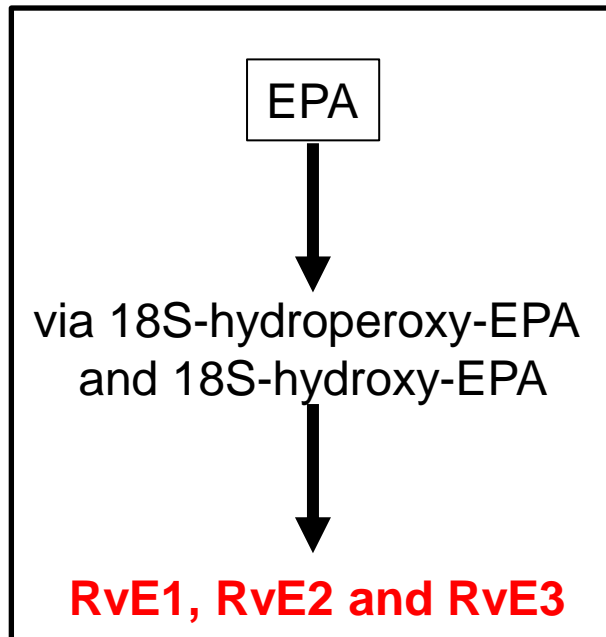


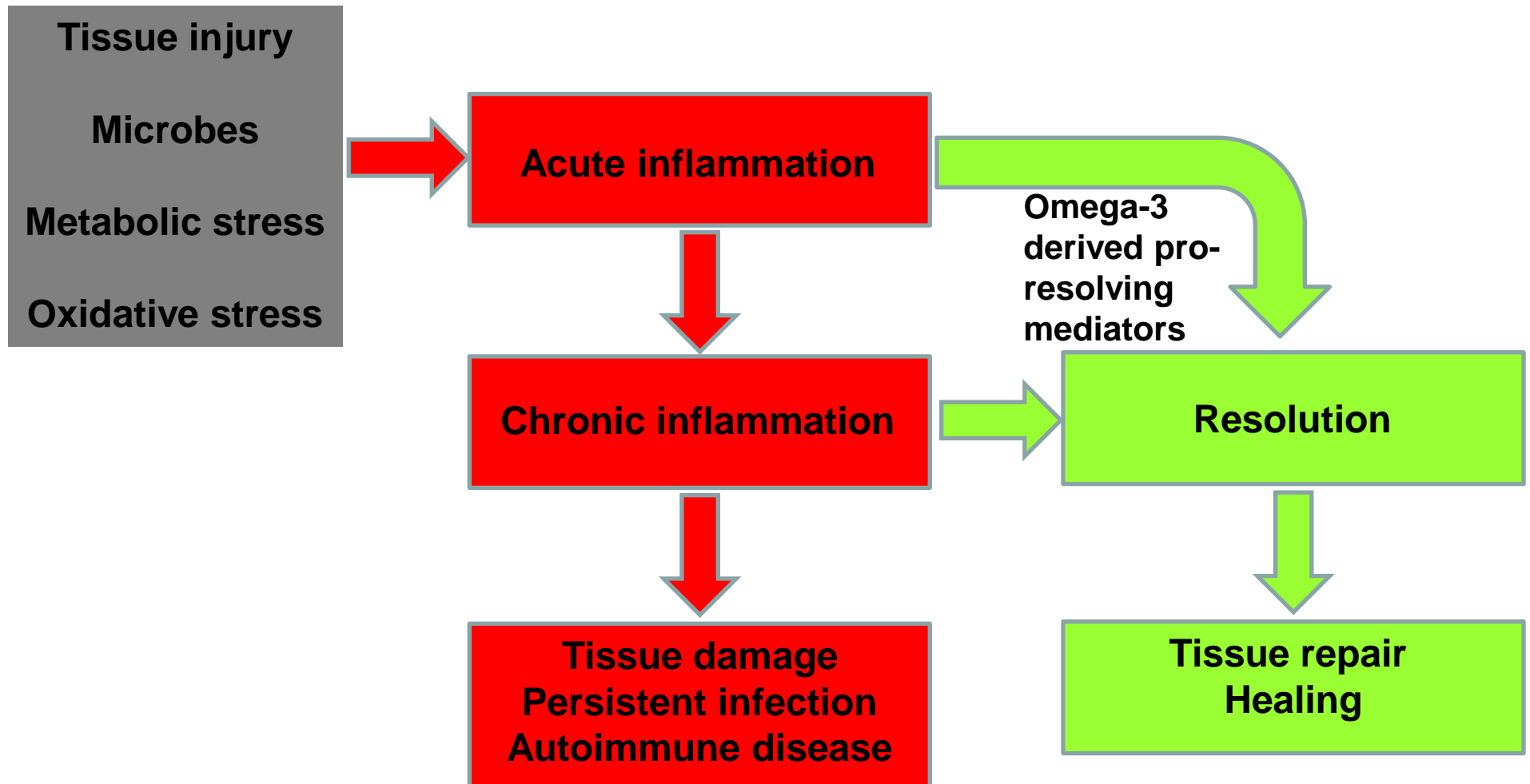
New families of lipid mediators identified:

- Resolvins**
- Protectins**
- Maresins**

**Called “specialised pro-resolution mediators”
[SPMs]**

Omega-3 fatty acids (EPA and DHA) are metabolic precursors of pro-resolving lipid mediators (resolvins, protectins, maresins)

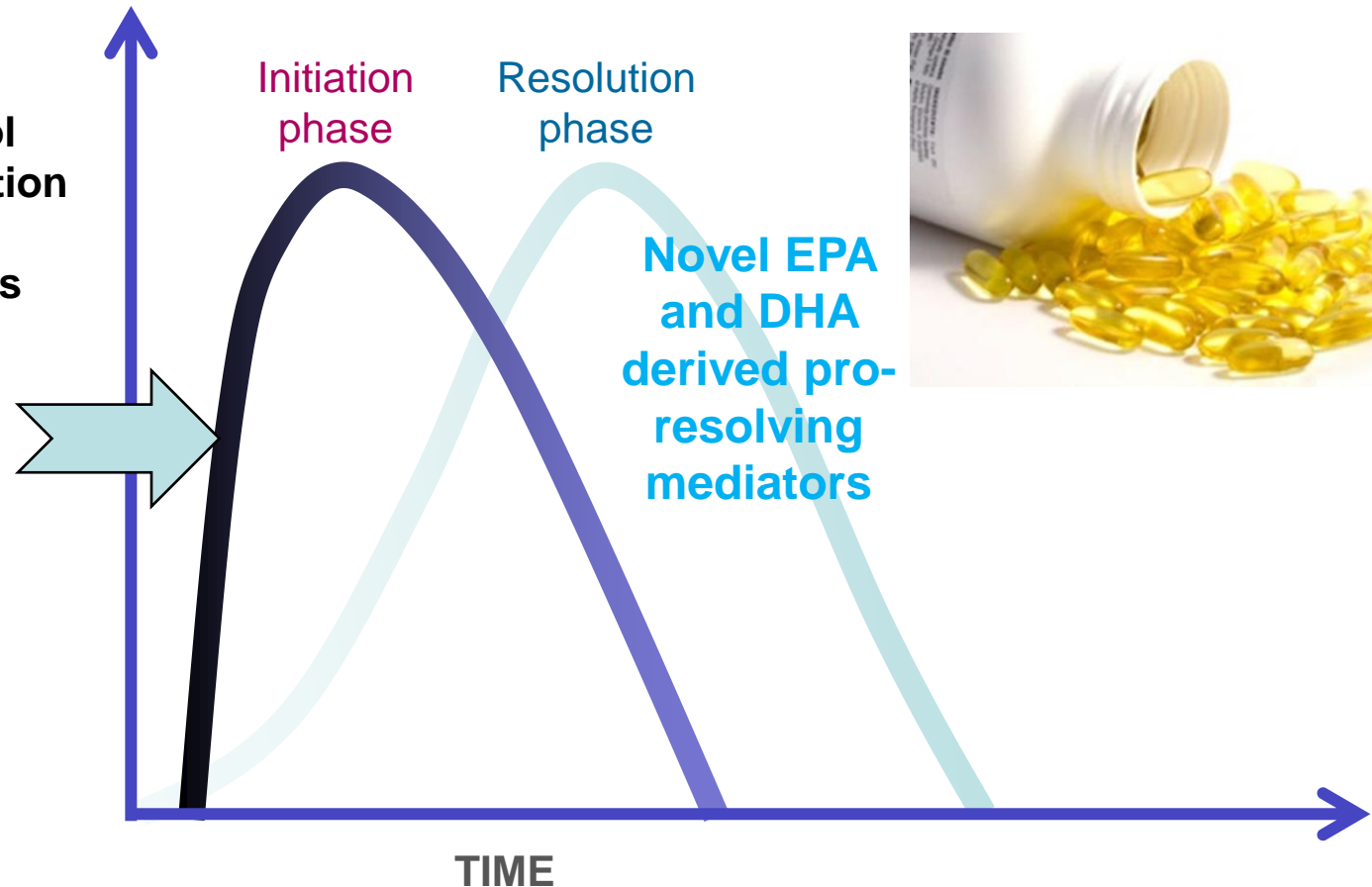




Inflammation has two phases: Initiation and resolution

Several nutrients control the initiation & propagation of inflammation – these are referred to as “anti-inflammatory”:

- Vitamin C
- Vitamin D
- Vitamin E
- Carotenoids
- Omega-3 FA
- Several minerals



Summary

- **Immunity, inflammation and metabolic health are interlinked**
- **Inflammation underlies (drives) poor metabolic health**
- **Inflammation contributes to morbidity and mortality**
- **Specific nutritional strategies can target inflammation to improve metabolic health**
- **These same strategies target immunity**
- **The role of omega-3 (EPA+DHA) in promoting resolution of inflammation is an exciting development**