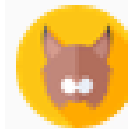


< Ph.D. supervisor



12/24/2022

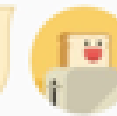


Cancel your christmas, I
need your ms asap, it
better be good

12:17

12:18

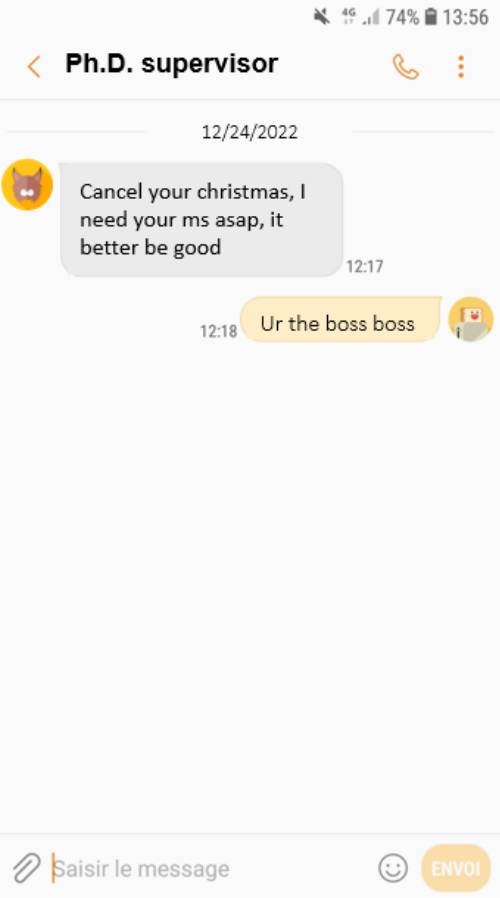
Ur the boss boss

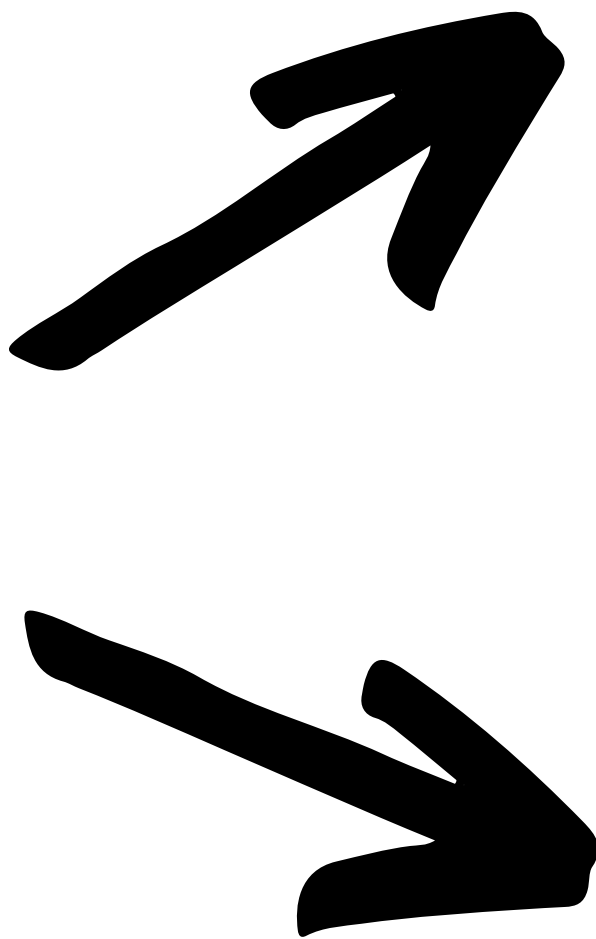
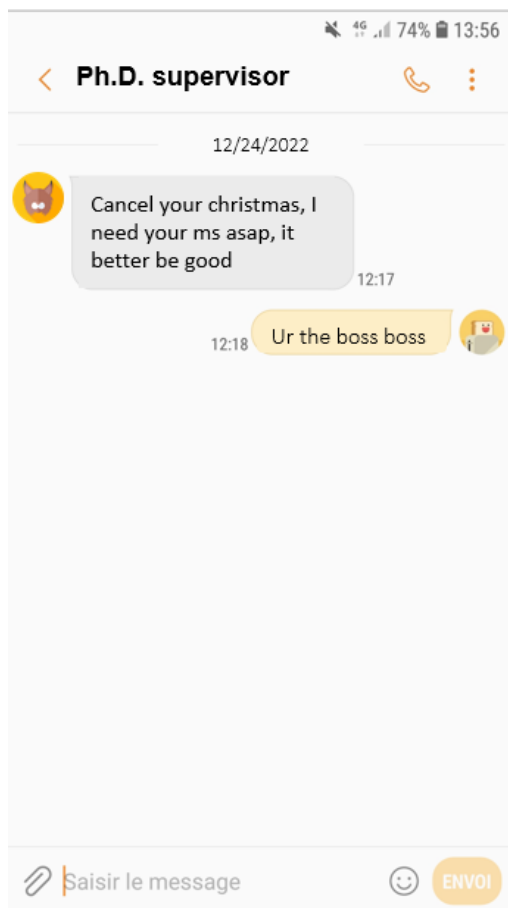


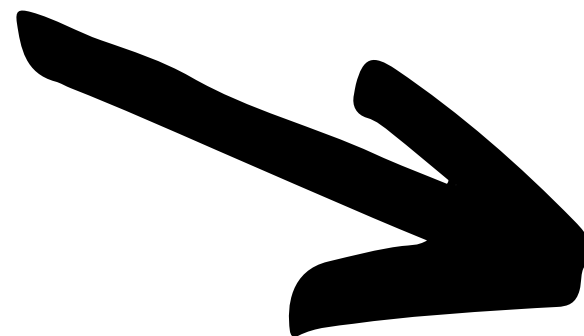
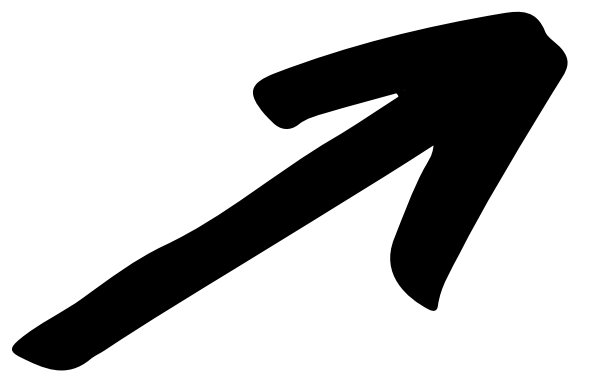
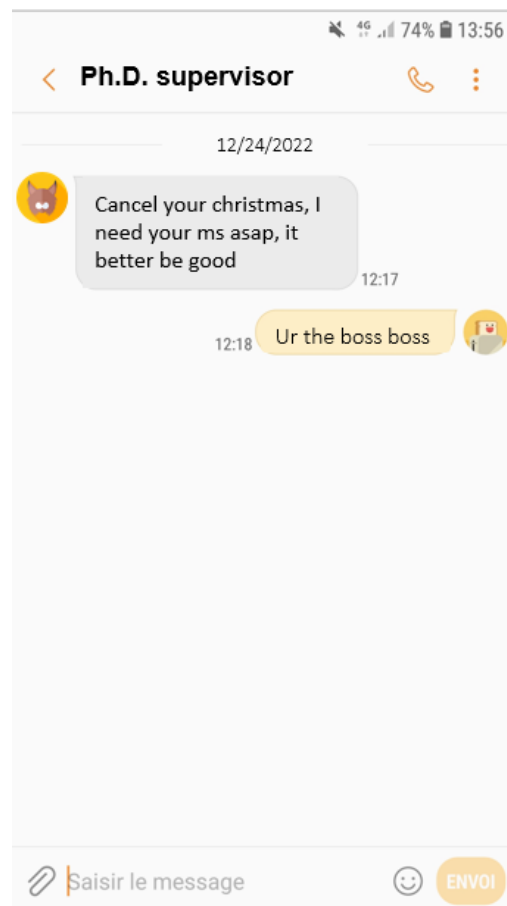
Saisir le message

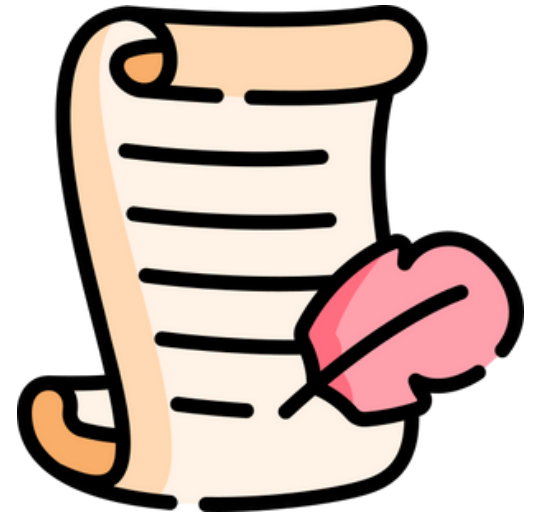
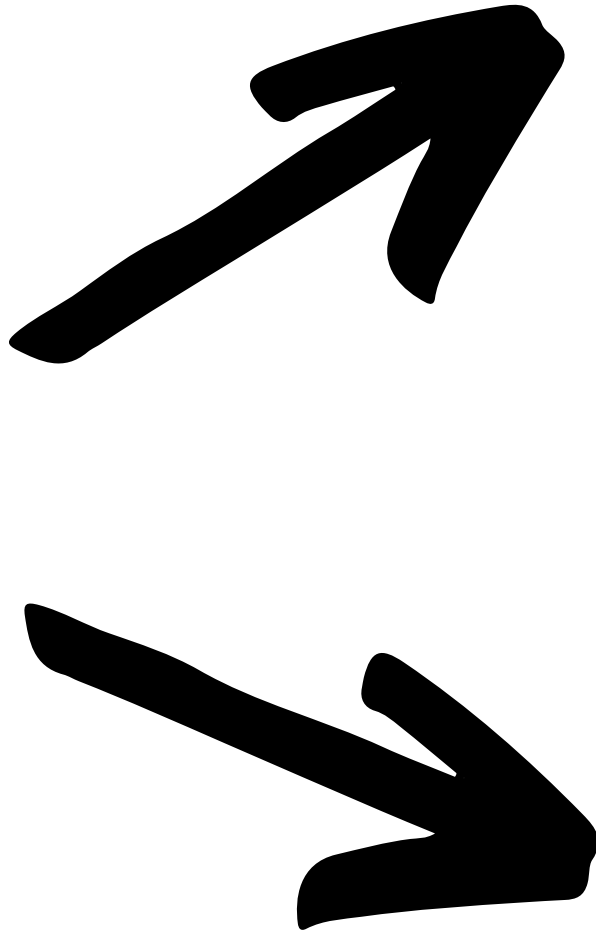
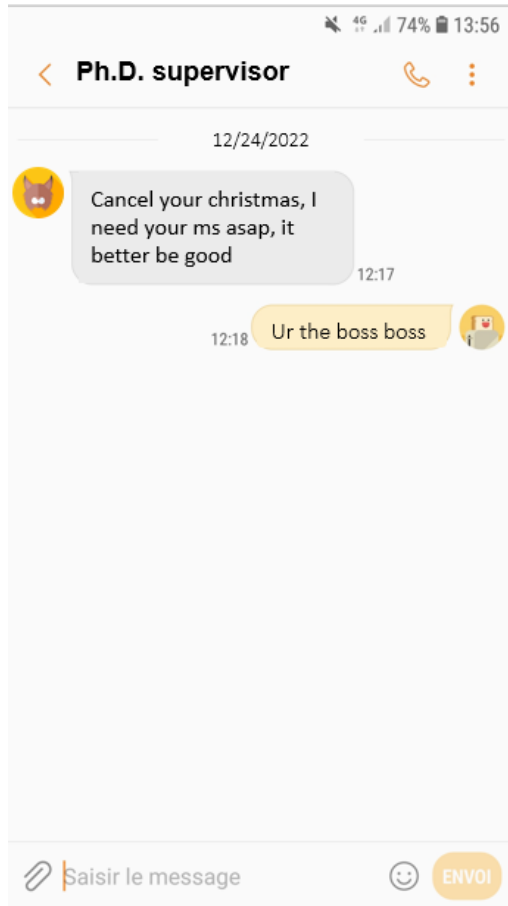


ENVOI





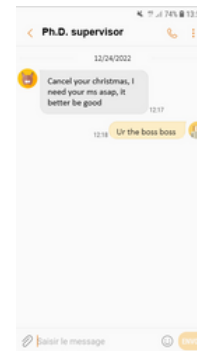




The stress response

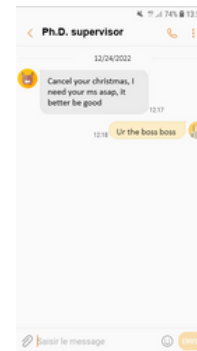
The stress response

In a fluctuating environment, animals must constantly adjust to face unpredictable events

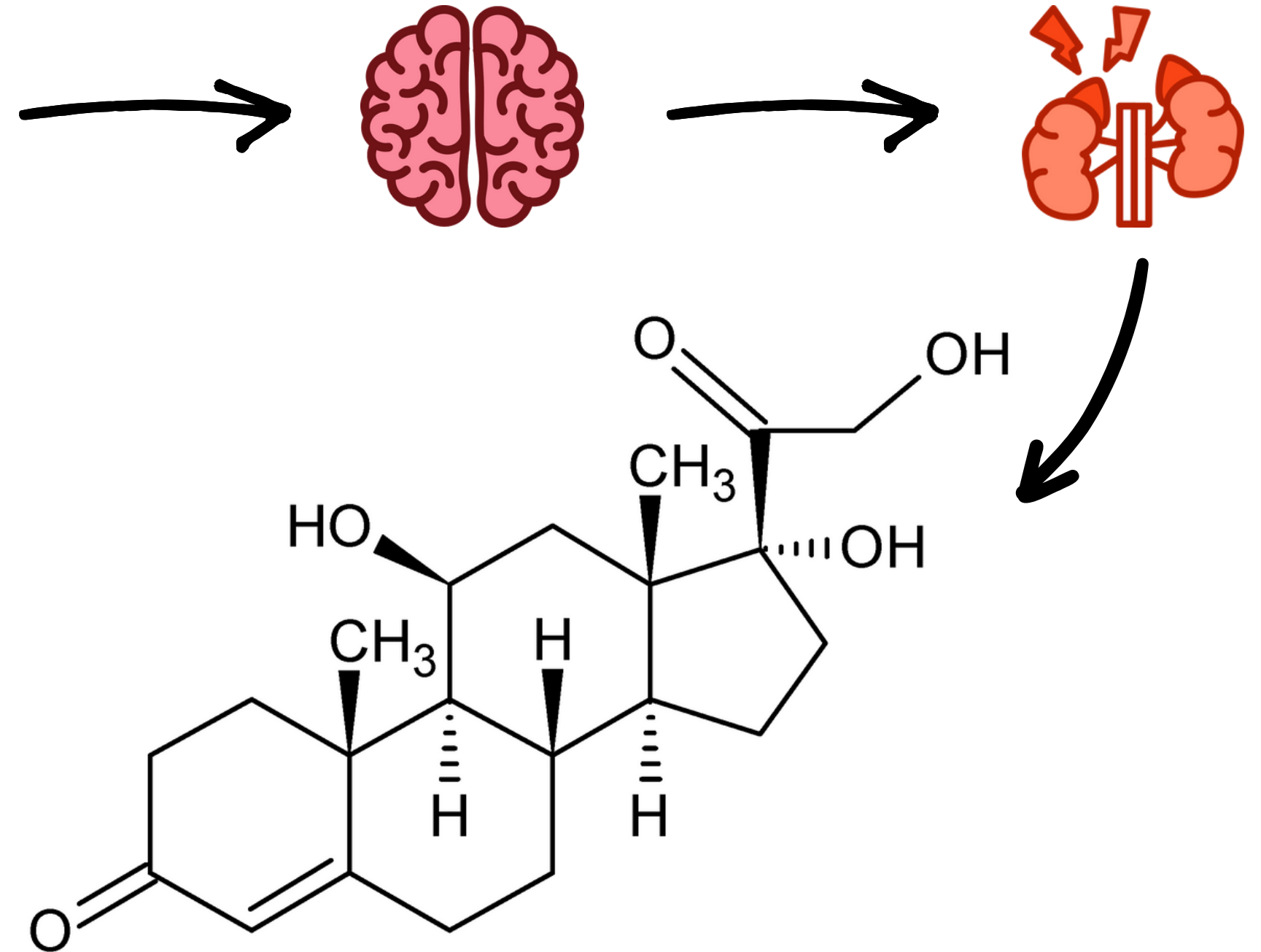


The stress response

In a fluctuating environment, animals must constantly adjust to face unpredictable events



When facing a stressor, the stress response activates and results in the production of glucocorticoids (GCs)





Is stress impacting the way you get old ?

Lucas Lalande

**Supervised by Emmanuelle Gilot-Fromont
& Pauline Vuarin**

EMPSEB 28 05/29-06/03/2023



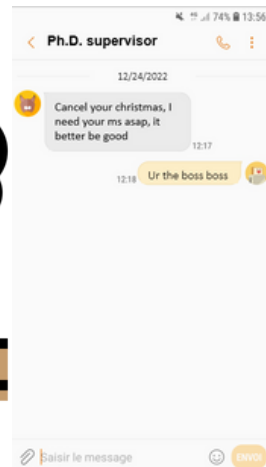
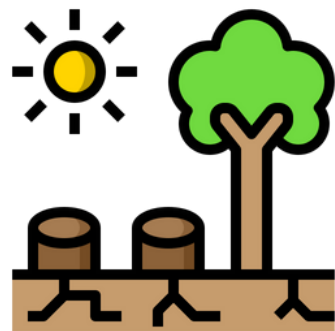
Role of GCs

To maintain an organism's energy balance according to current demands
and they are always present at baseline levels

Role of GCs

To maintain an organism's energy balance according to current demands

CHRONIC STRESS



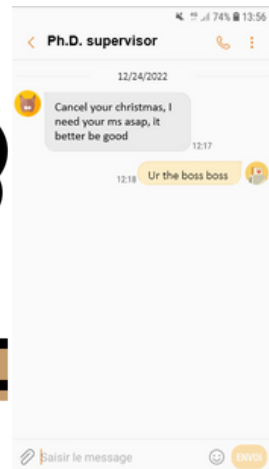
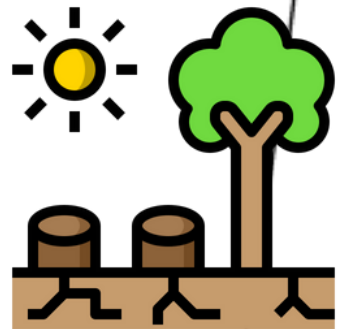
LONG-TERM

(days–weeks)

Role of GCs

To maintain an organism's energy balance according to current demands

CHRONIC STRESS



LONG-TERM
(days-weeks)

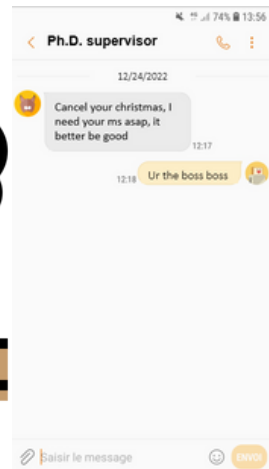
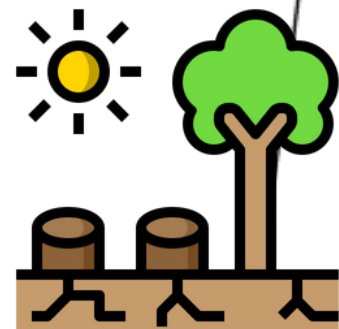
GCs level

time (days)

Role of GCs

To maintain an organism's energy balance according to current demands

CHRONIC STRESS



LONG-TERM
(days-weeks)

Chronically or repeatedly stressed individuals display higher baseline GC levels

time (days)

Role of GCs

To maintain an organism's energy balance according to current demands

Resource allocation to non-essential functions interrupted

Growth



Immunity

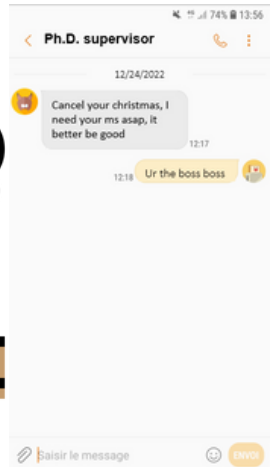
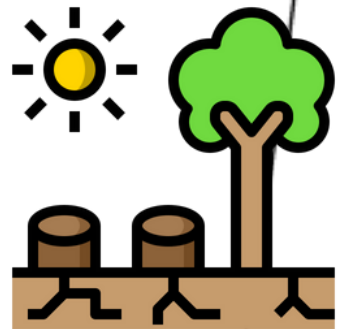


Reproduction



Chronically or repeatedly stressed individuals display higher baseline GC levels

CHRONIC STRESS



LONG-TERM
(days-weeks)

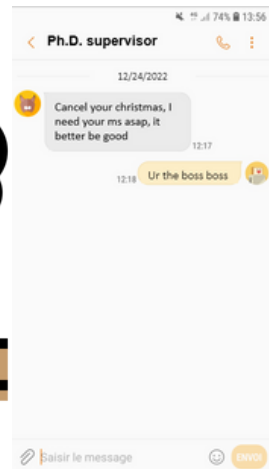
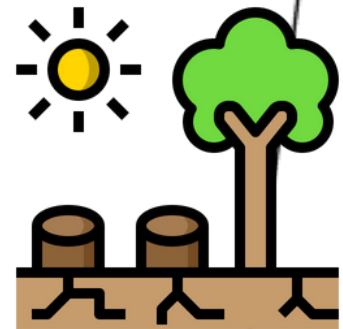
time (days)

Role of GCs

To maintain an organism's energy balance according to current demands

GCs level

CHRONIC STRESS



LONG-TERM
(days-weeks)

Resource allocation to non-essential functions interrupted

Growth



Immunity



Reproduction



Resource towards functions allowing to cope with a threat

Habitat research



Foraging



Chronically or repeatedly stressed individuals display higher baseline GC levels

0

1

2

3

4

5

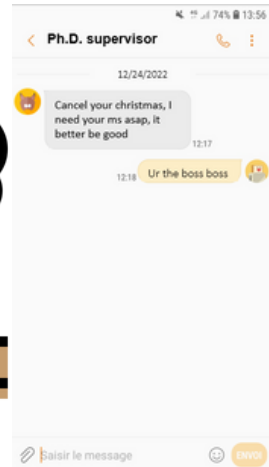
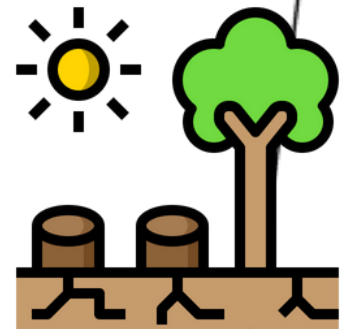
time (days)

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LONG-TERM
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Growth



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Reproduction



Resource towards functions allowing to cope with a threat

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Foraging



Chronically or repeatedly stressed individuals display higher baseline GC levels

ADVERSE CONSEQUENCES ON FITNESS

Growth inhibition, disruption of immune functions, weakening of body condition, ...

0

1

2

3

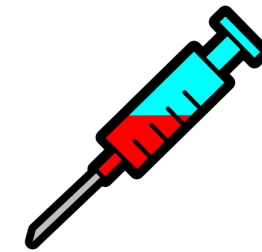
4

5

time (days)

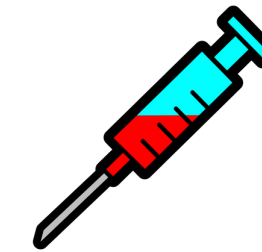
GCs, FGMs and Stress

- GCs level is a widely used proxy of the stress response
- Blood GCs must be sampled within minutes to not reflect the acute stress-response of the capture or manipulation of an individual
- GCs can be measured in other matrices such as hair, feathers or **faeces**



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Faecal Glucorticoid Metabolites (FGM)



- Integrative measure of the recent exposure to stressors
- Arguably a measure of baseline GC levels

Immune system

Costly to develop, maintain and use → energy allocation trade-offs



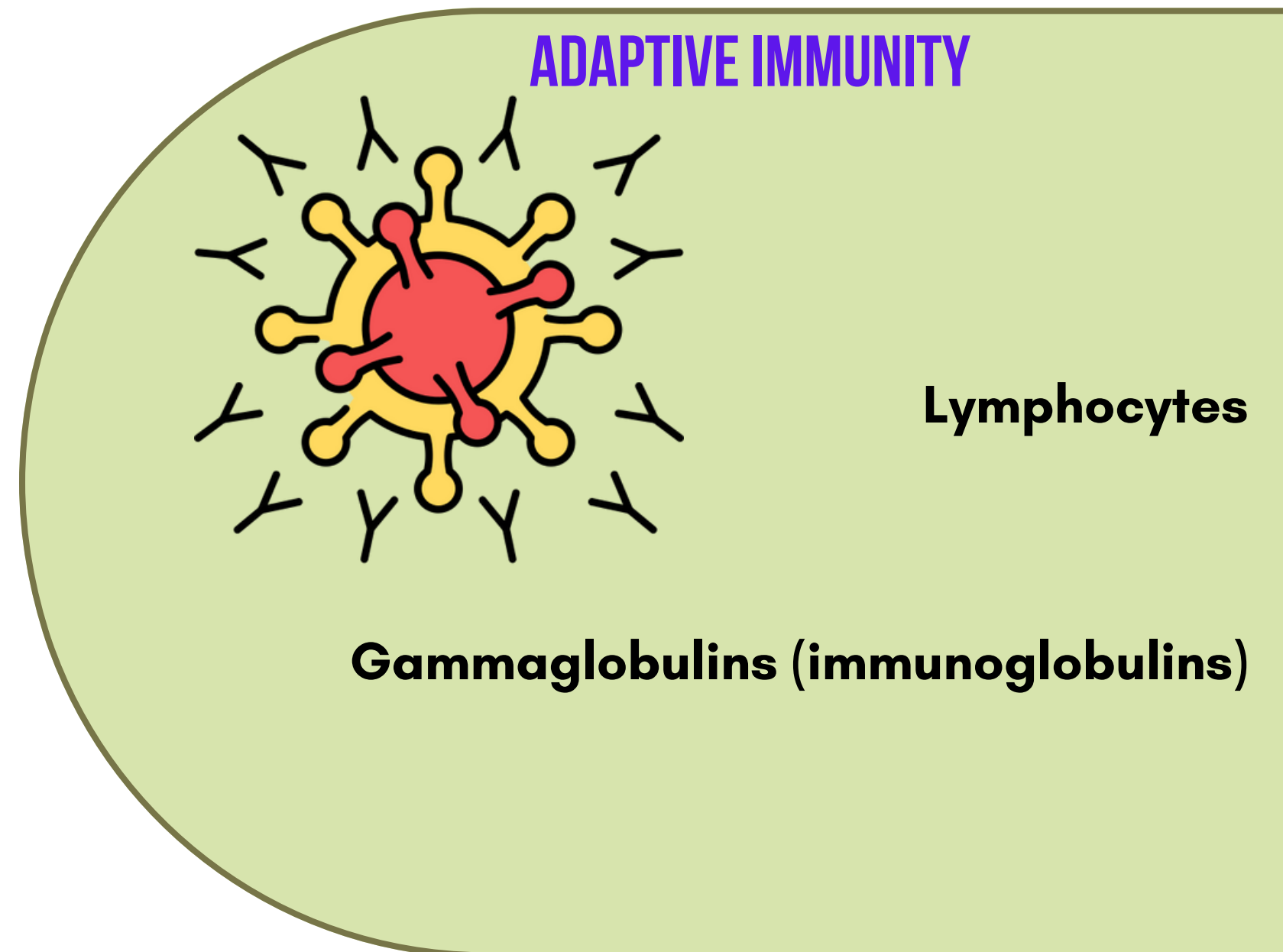
A key component of **health and viability**

Immune system

Costly to develop, maintain and use → energy allocation trade-offs



A key component of **health and viability**



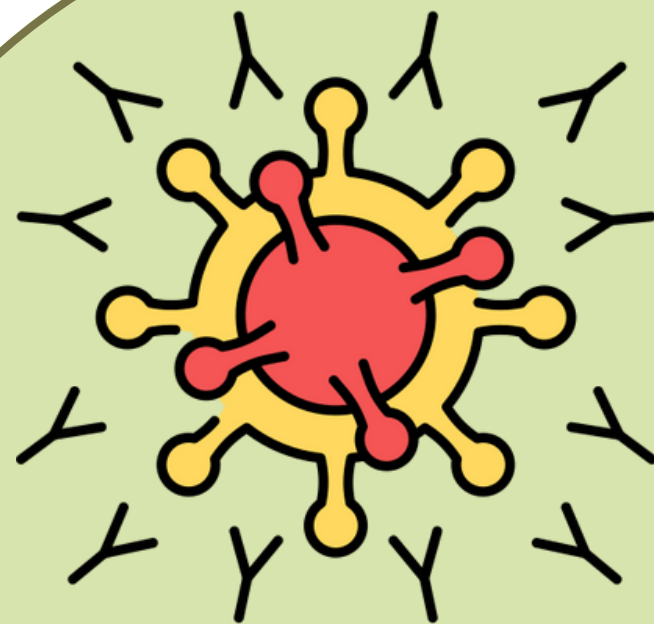
Immune system

Costly to develop, maintain and use → energy allocation trade-offs



A key component of **health and viability**

ADAPTIVE IMMUNITY



Lymphocytes

Gammaglobulins (immunoglobulins)

INNATE IMMUNITY

Neutrophils
Monocytes
Eosinophils
Basophils

Hemagglutination score
Hemolysis score

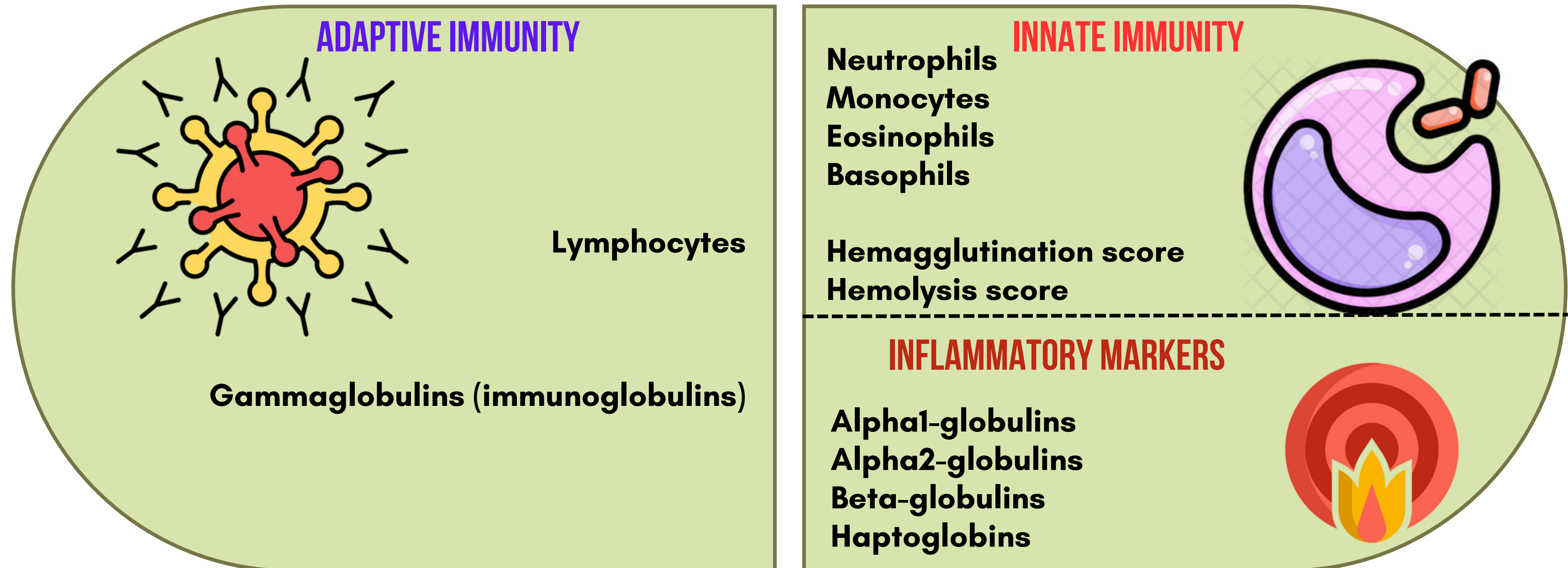


Immune system

Costly to develop, maintain and use → energy allocation trade-offs



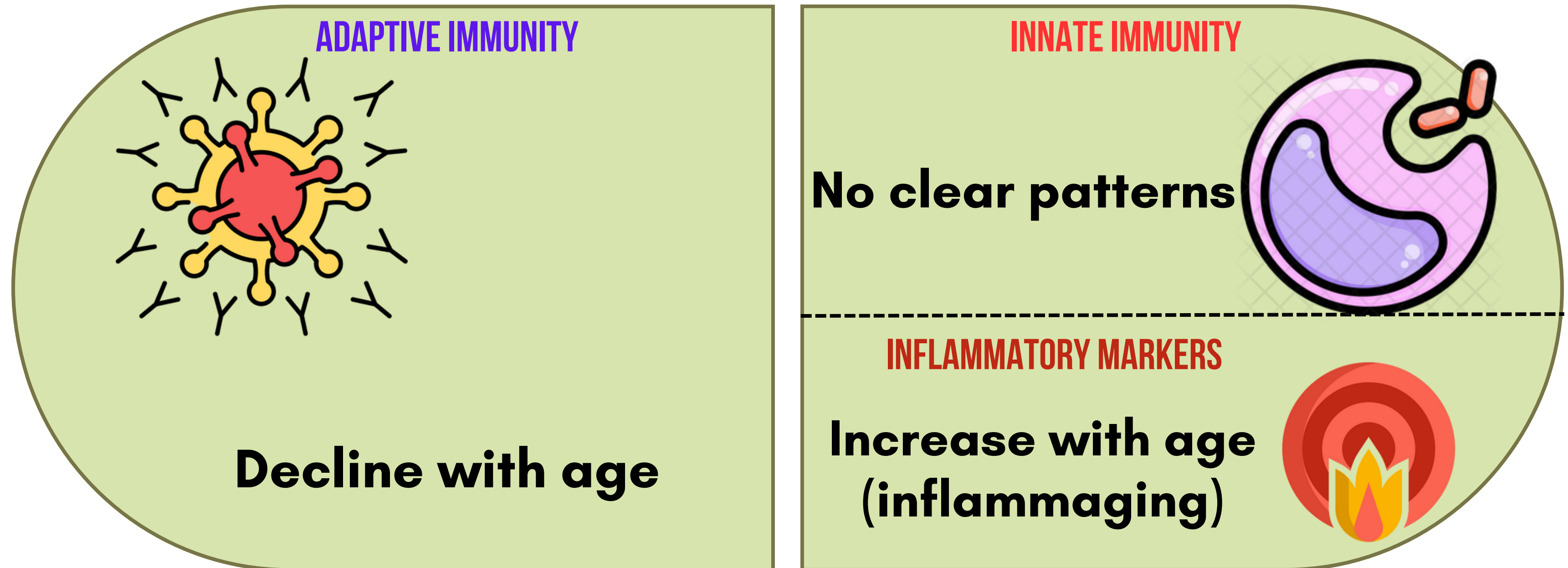
A key component of **health and viability**



Immune system

IMMUNOSENESCENCE:

A **progressive decline** in immune functioning with advancing age

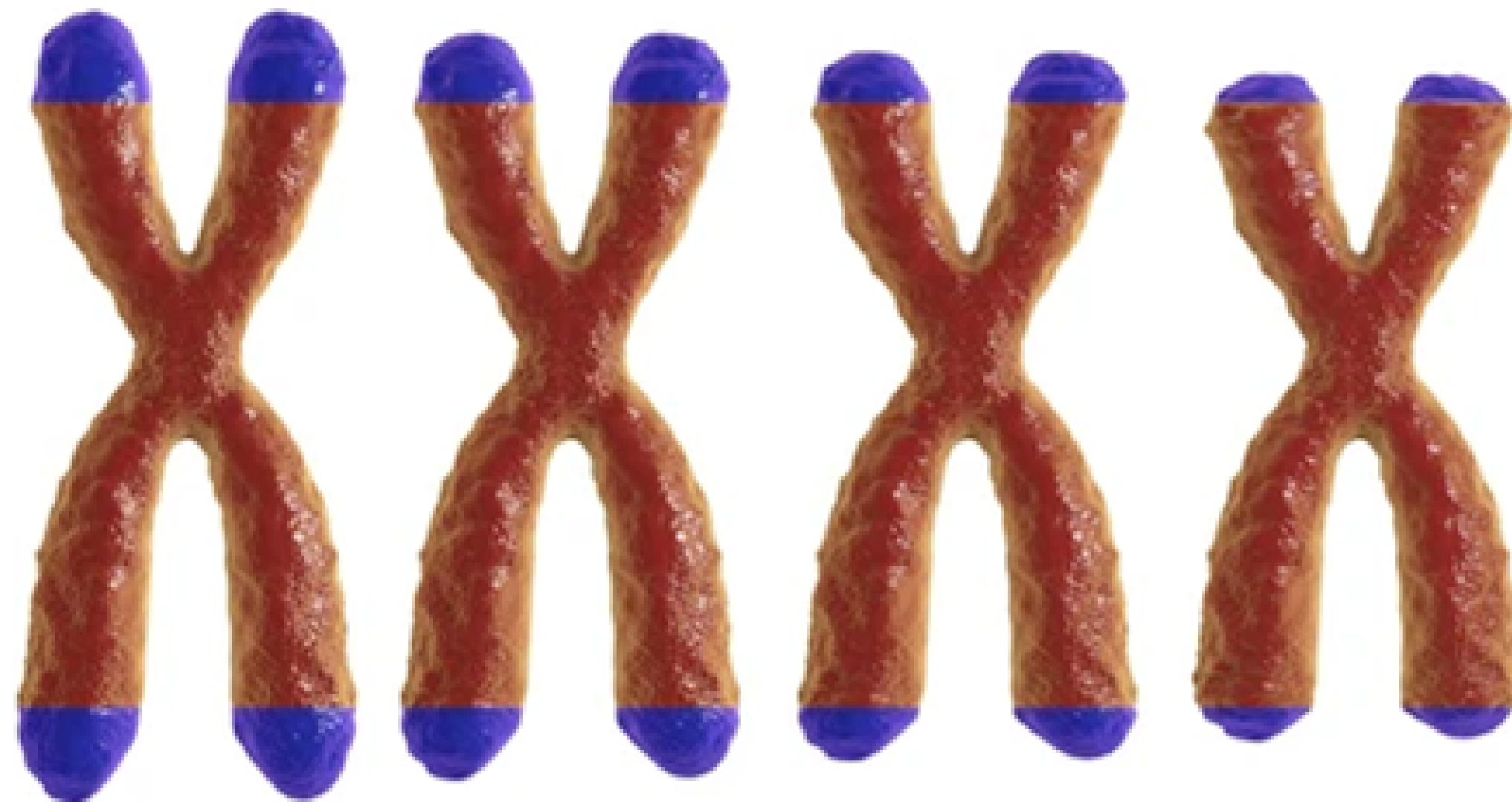


What's the link between GCs and immunosenescence?

GCs play a major role in the **allocation of an organism available resources** and can reallocate resources away from the maintenance of immune functions

GCs have **immunodepressive effects**

GCs are linked to **telomere length shortening** through oxidative stress

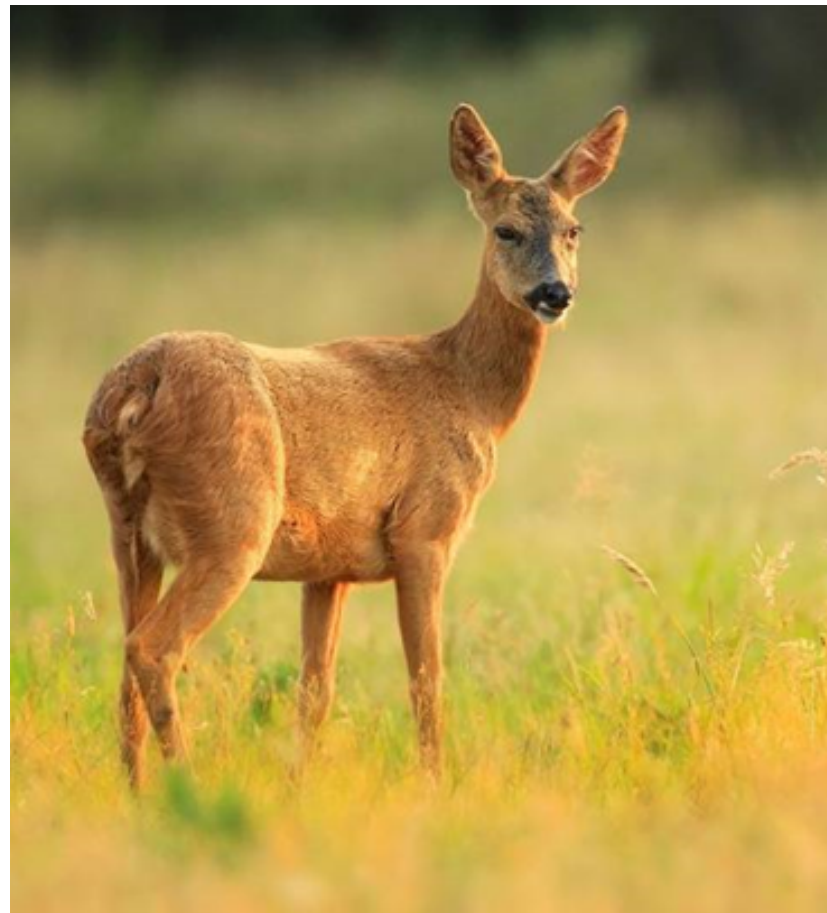
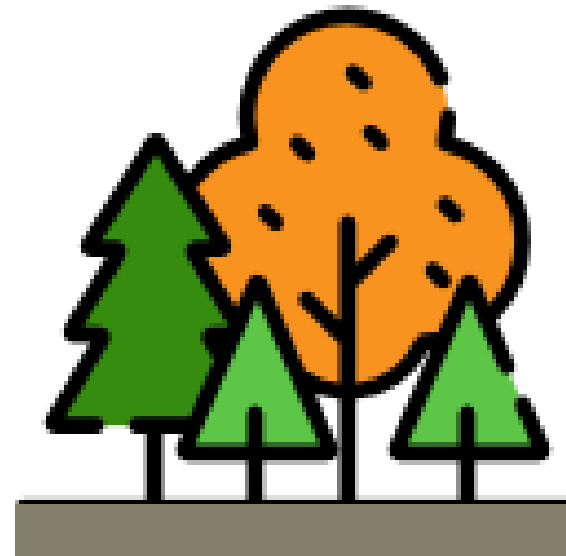


IS EARLY-LIFE STRESS IMPACTING THE SENESCENCE OF IMMUNITY?

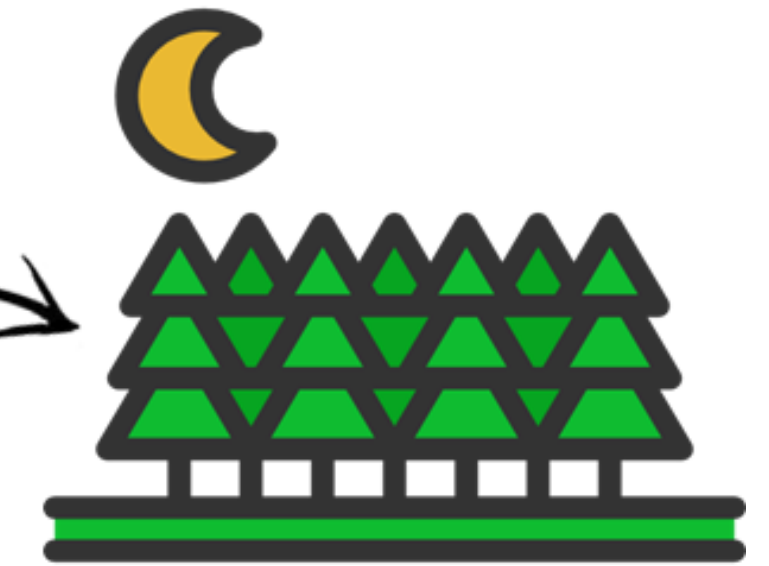
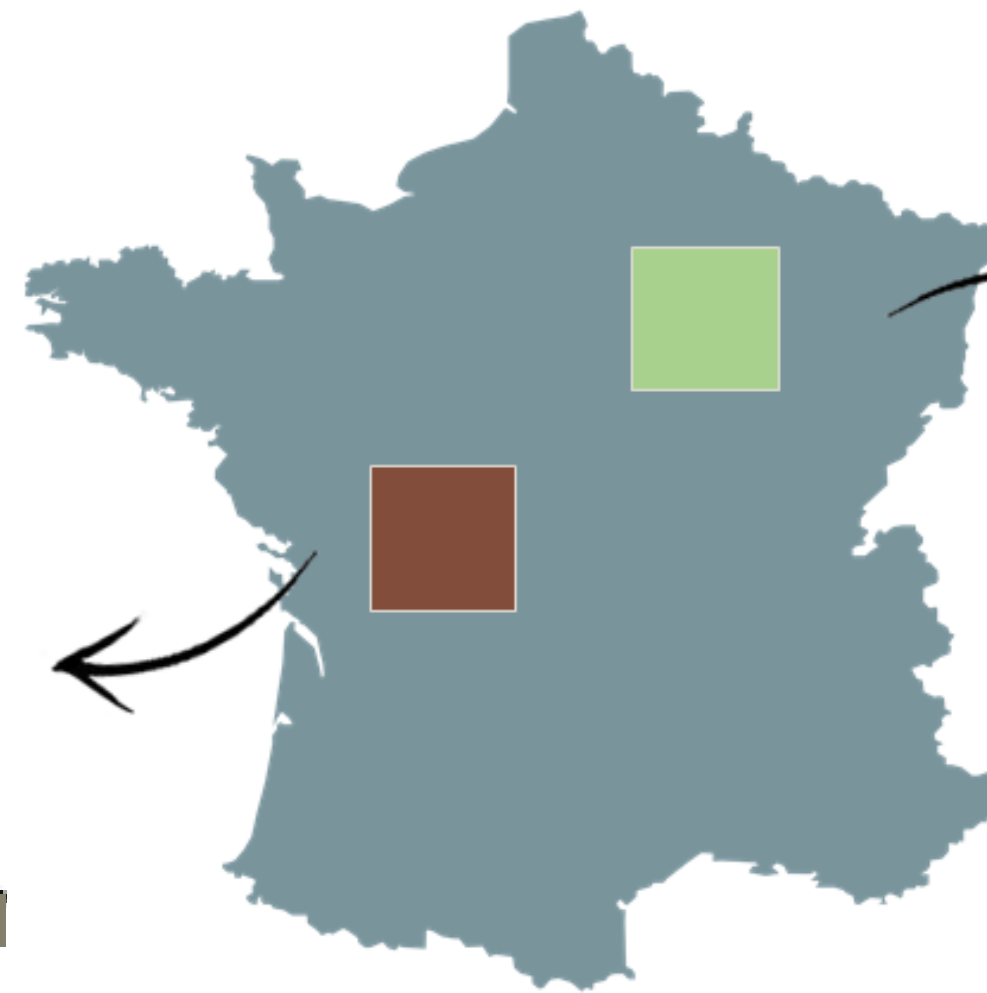
A high early-life baseline GC levels should result in an accelerated rate and/or earlier onset of immunosenescence

Study sites

Poor-quality habitat
Chizé (CH)



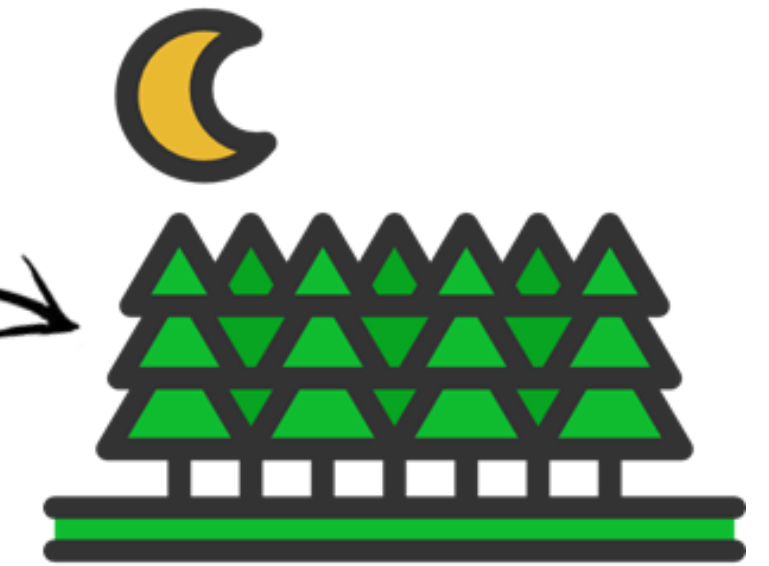
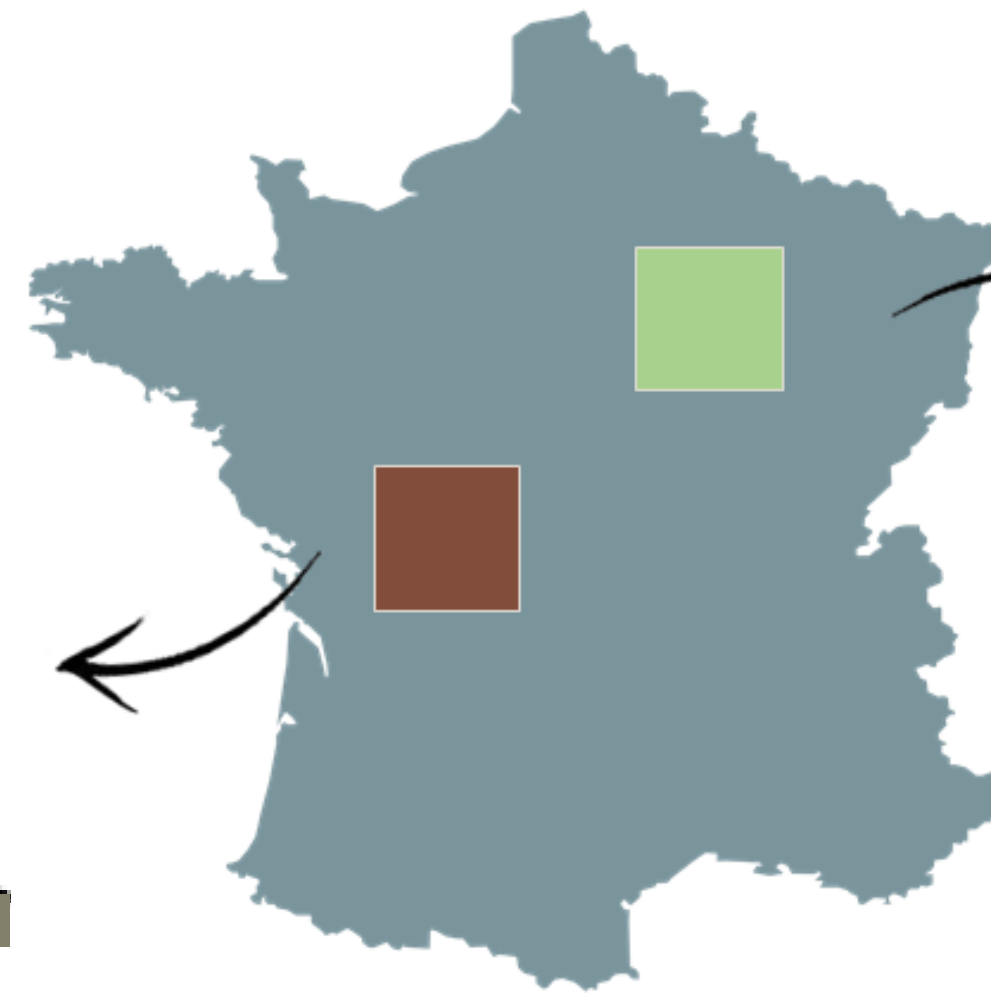
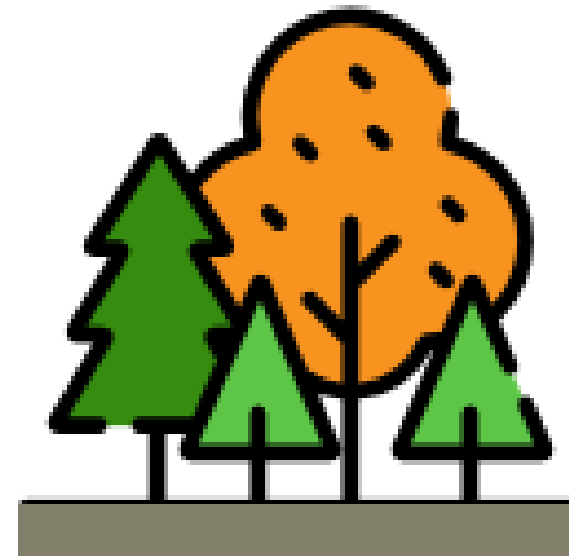
Roe deer (*Capreolus capreolus*)



Good-quality habitat
Trois-Fontaines (TF)

Study sites

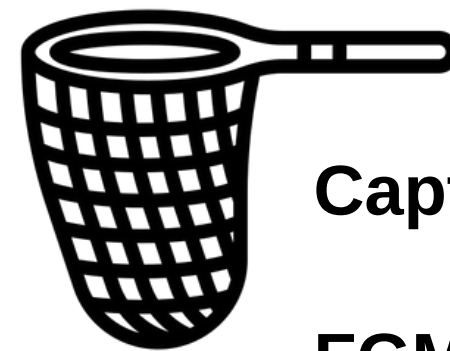
Poor-quality habitat
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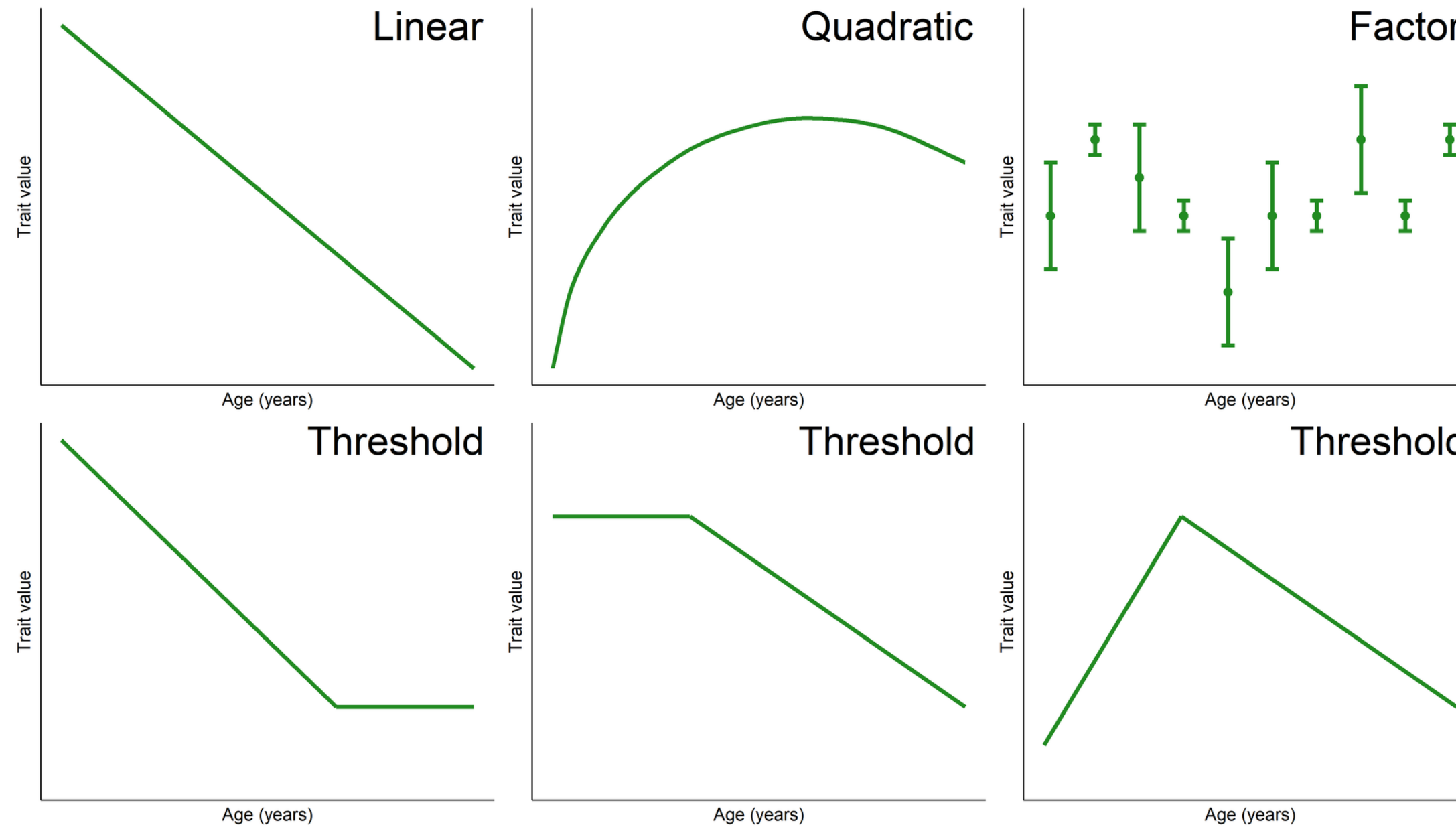
Capture-Mark-Recapture program since 1976 - Net-driving captures

FGM and immune data collected since 2009

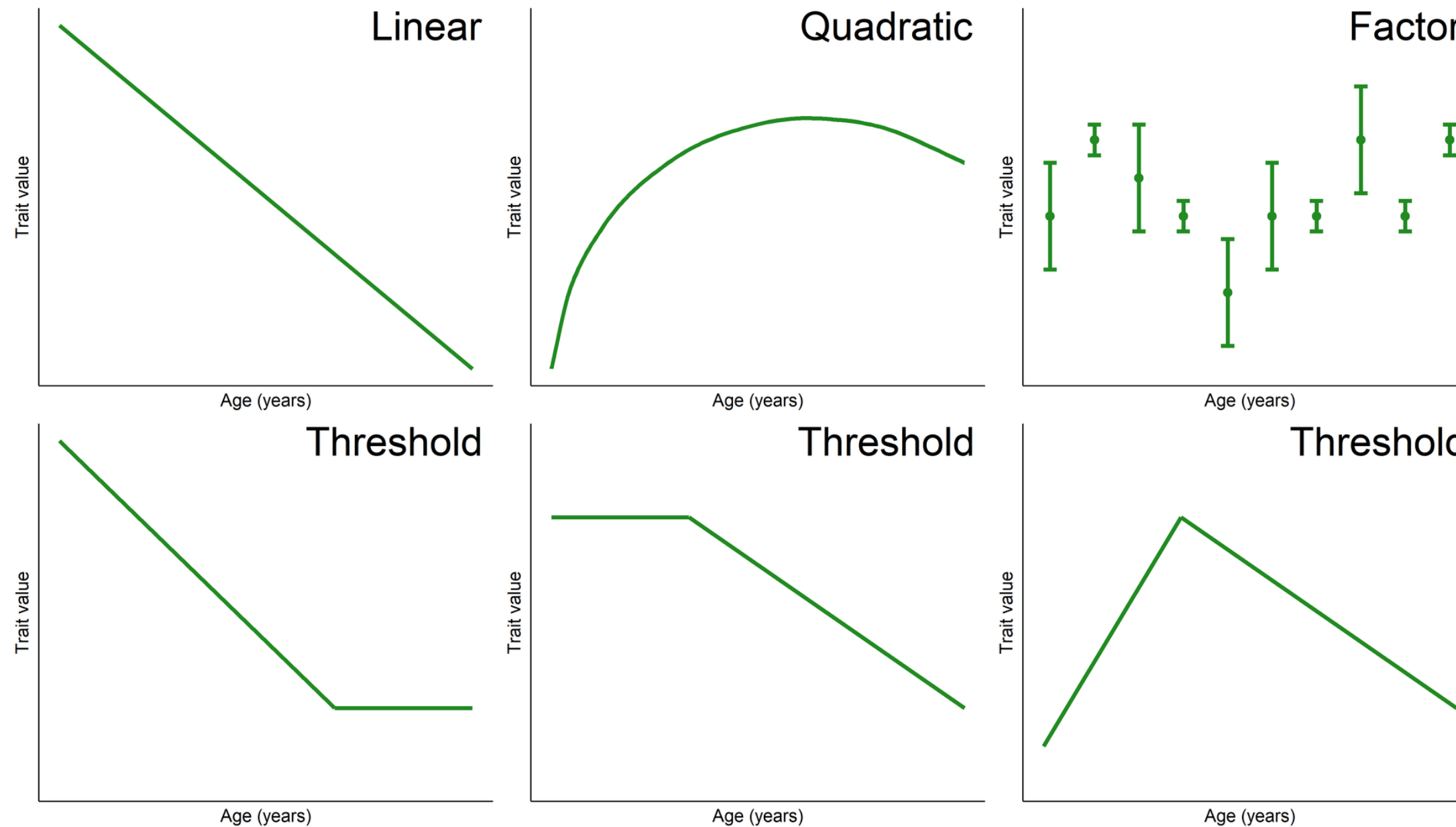
Immune data (12 traits): ~1100 observations/traits on ~500 individuals among which, **early-life FGMs:** ~ 300 observations on ~150 individuals

1. Testing ageing trajectories

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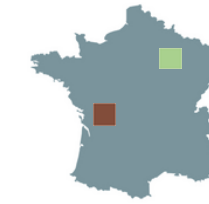


1. Testing ageing trajectories



Accounting for:

- Population



- Sex



- Cohort



- Age at last observation



- Mass



- Julian day of capture

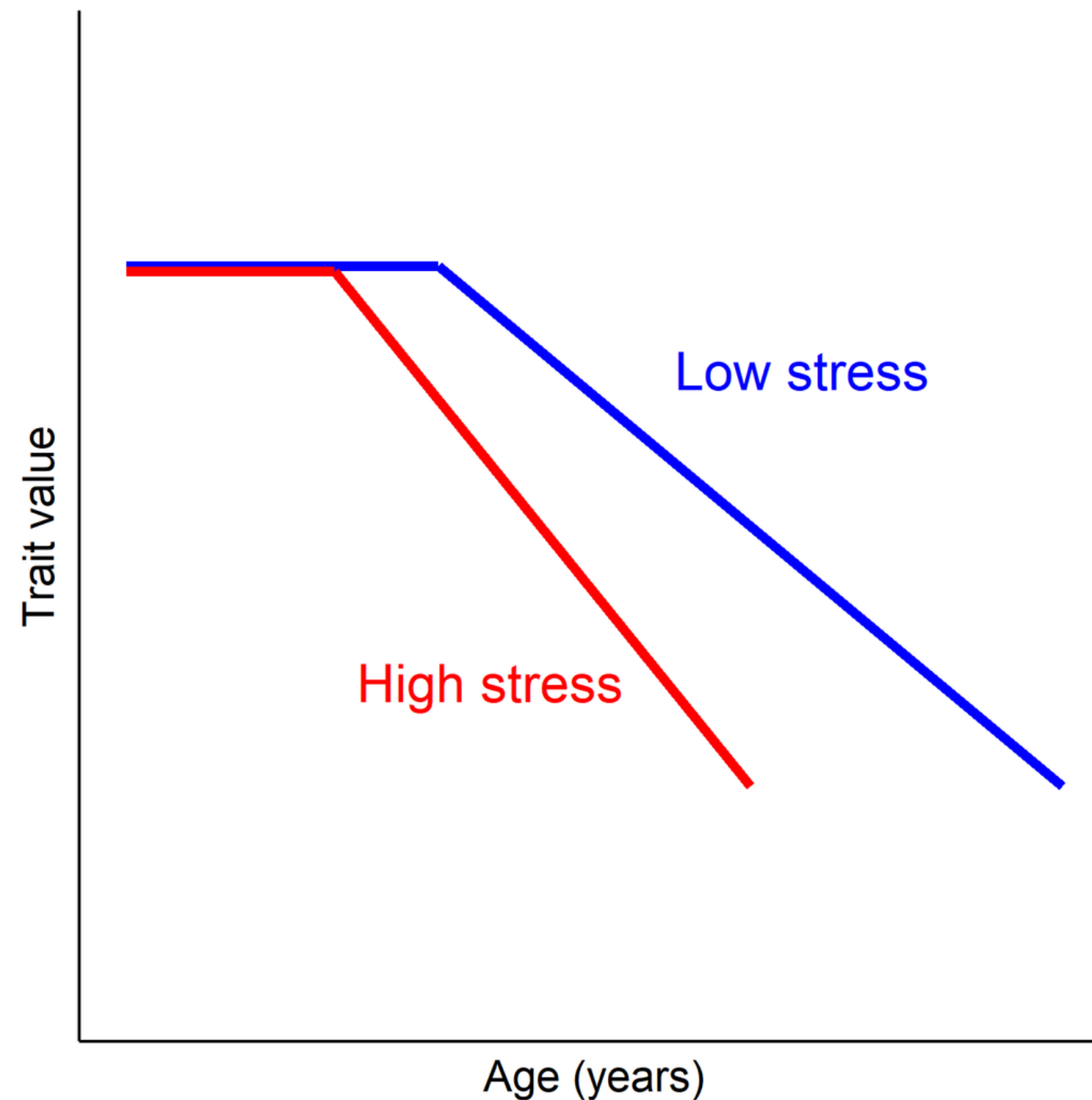


- Time between capture and sampling



2. Testing the effect of FGMs on ageing trajectories

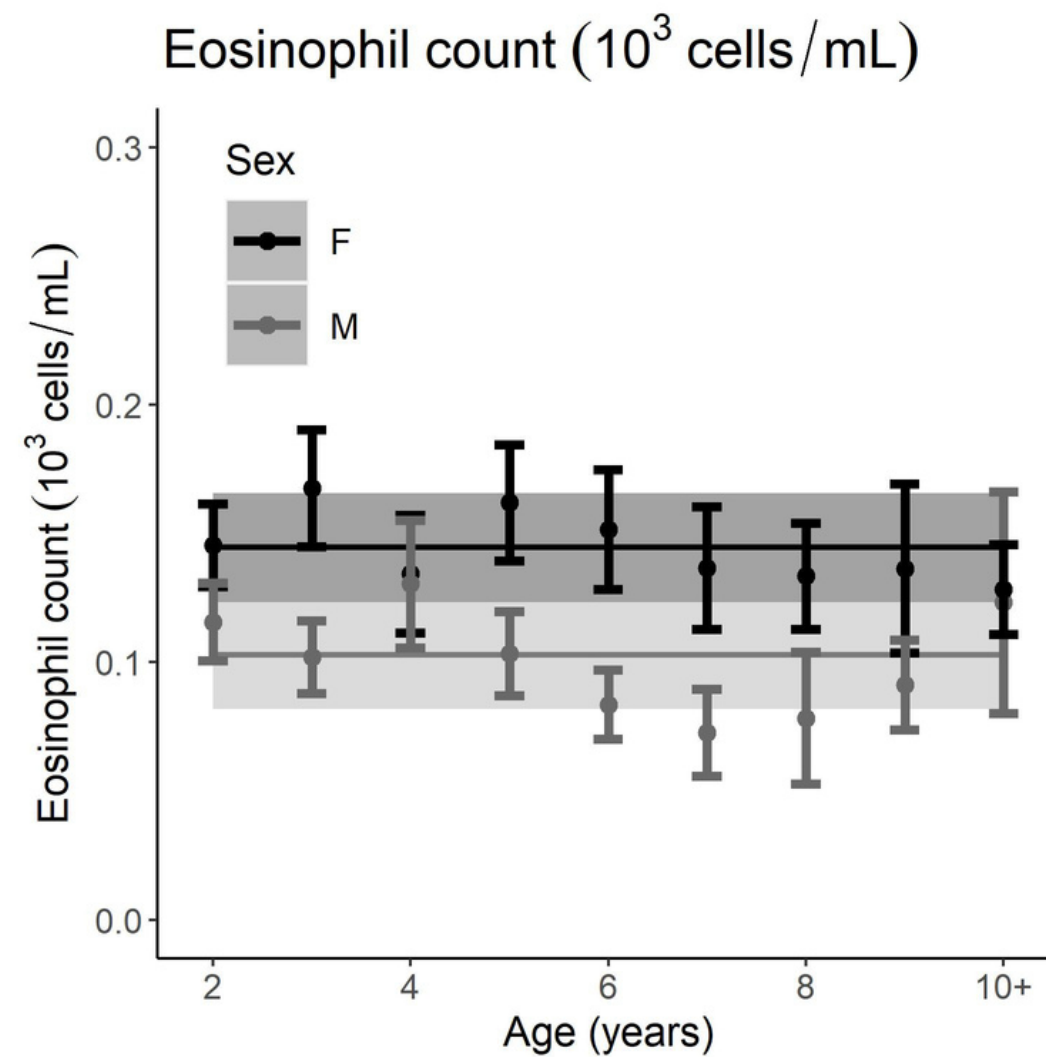
2. Testing the effect of FGMs on ageing trajectories



We test for the interaction between FGMs and age terms of the retained ageing trajectories

Immunosenescence patterns

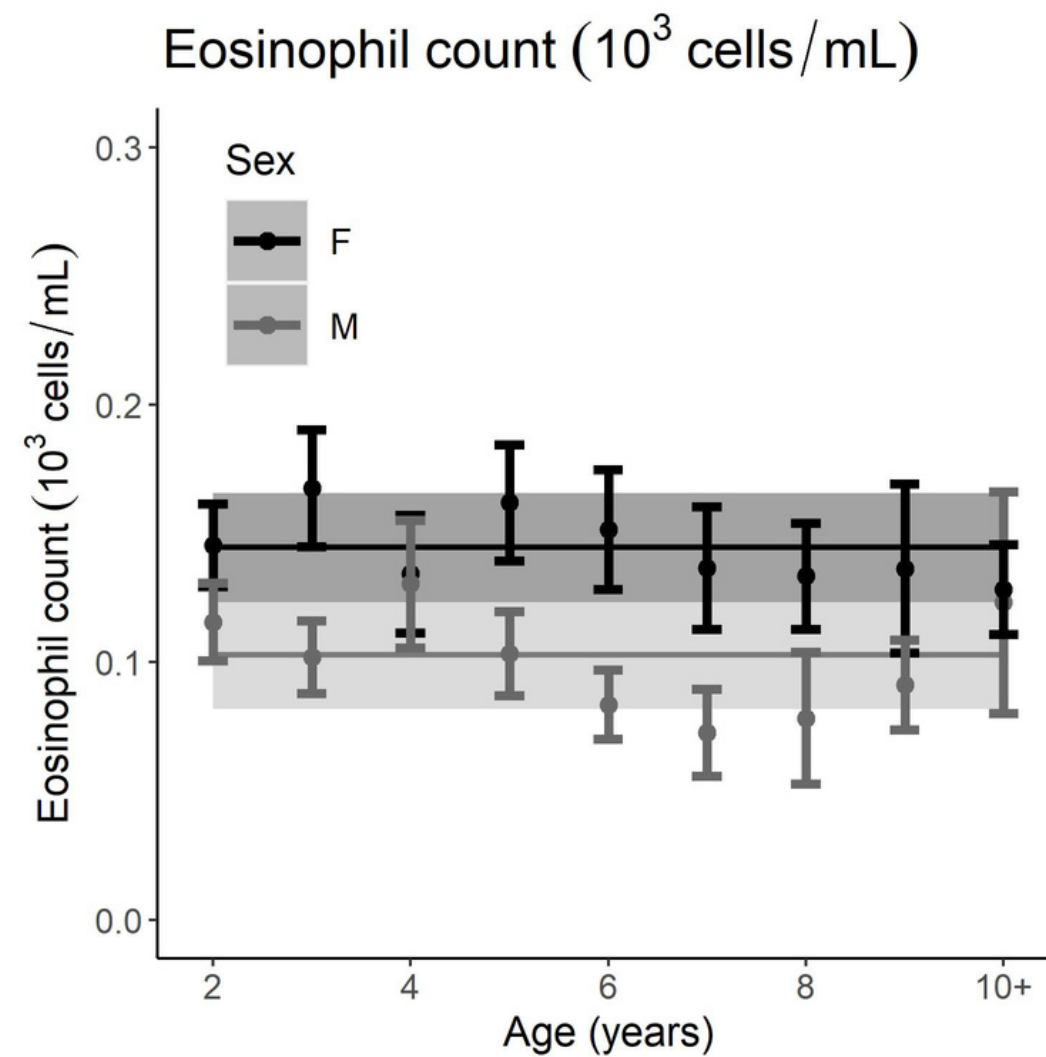
INNATE IMMUNITY



No clear pattern

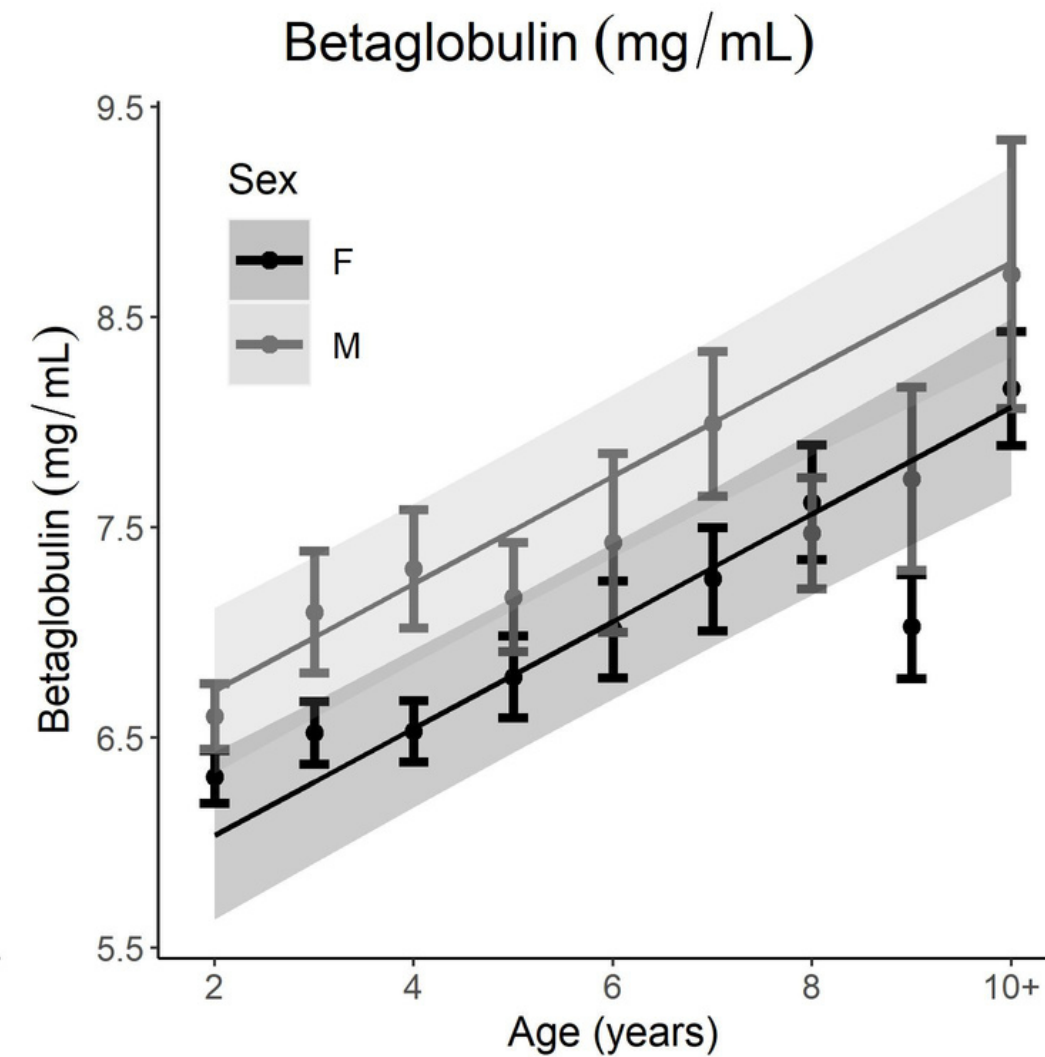
Immunosenescence patterns

INNATE IMMUNITY



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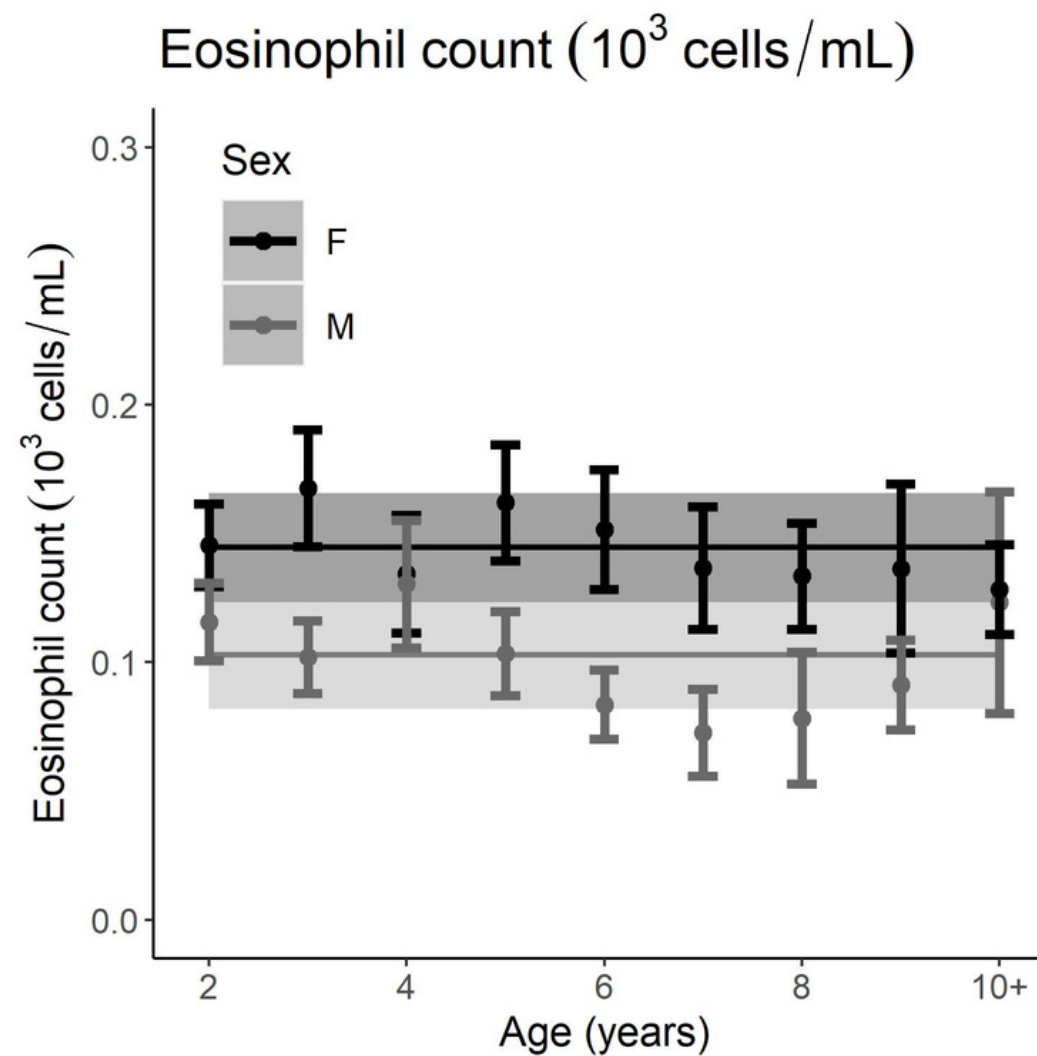
INFLAMMATORY MARKER



Increase of inflammatory marker with age

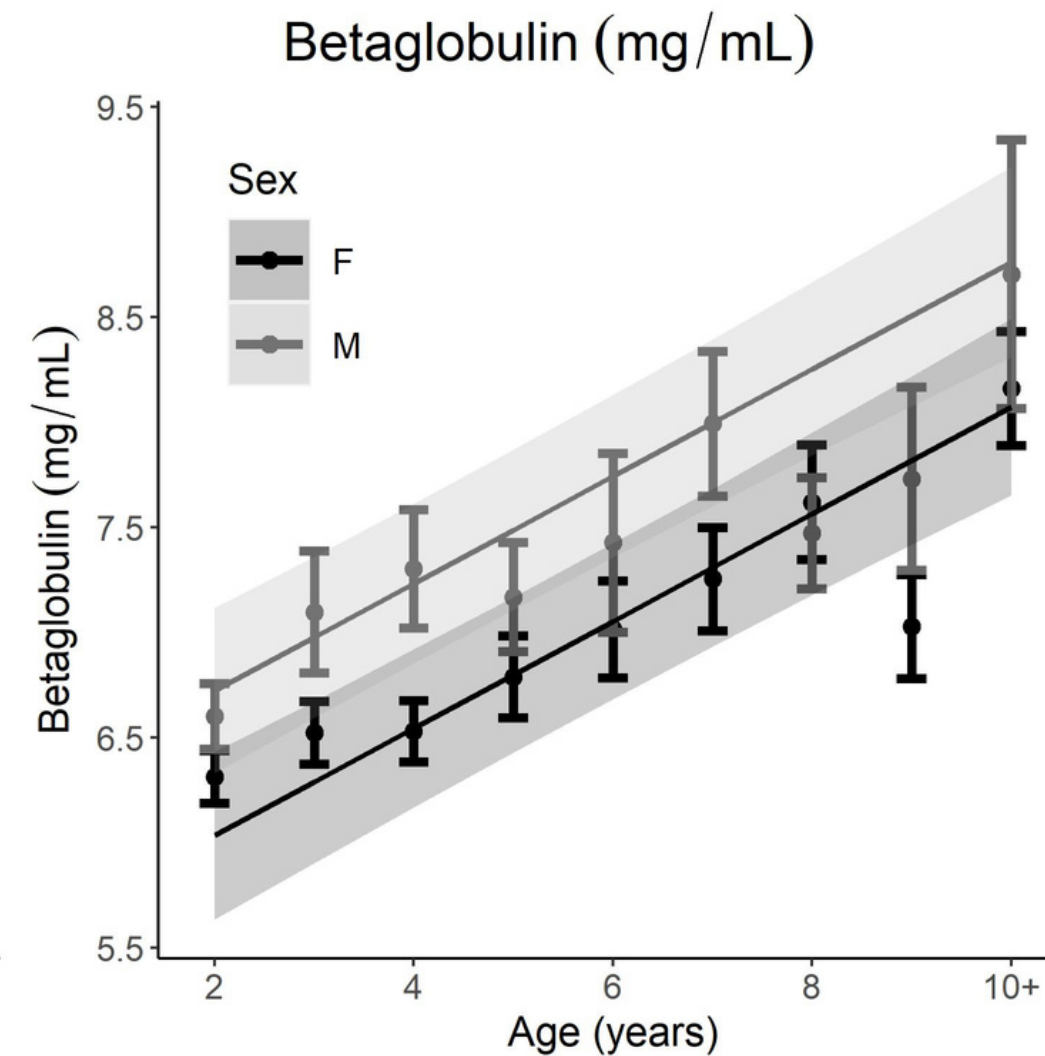
Immunosenescence patterns

INNATE IMMUNITY



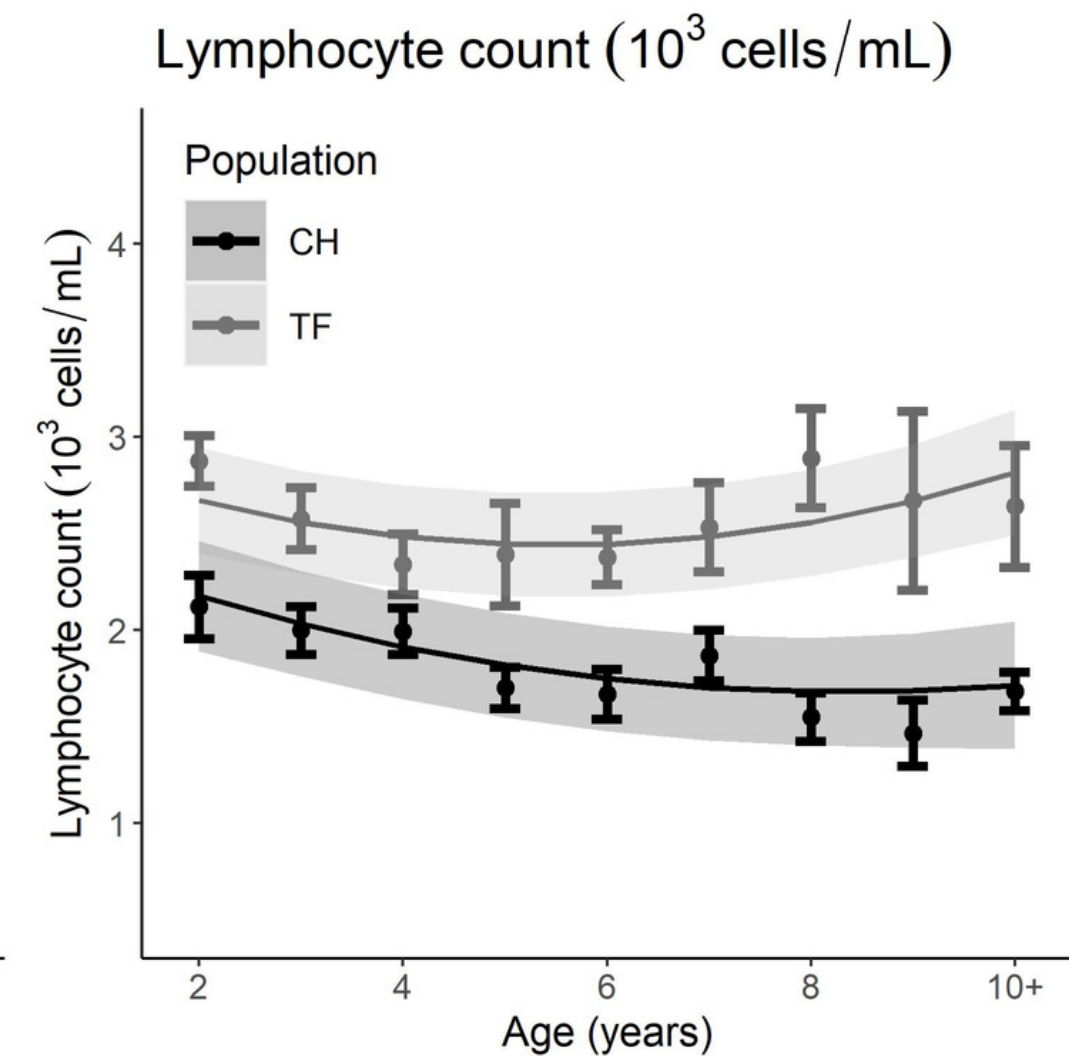
No clear pattern

INFLAMMATORY MARKER



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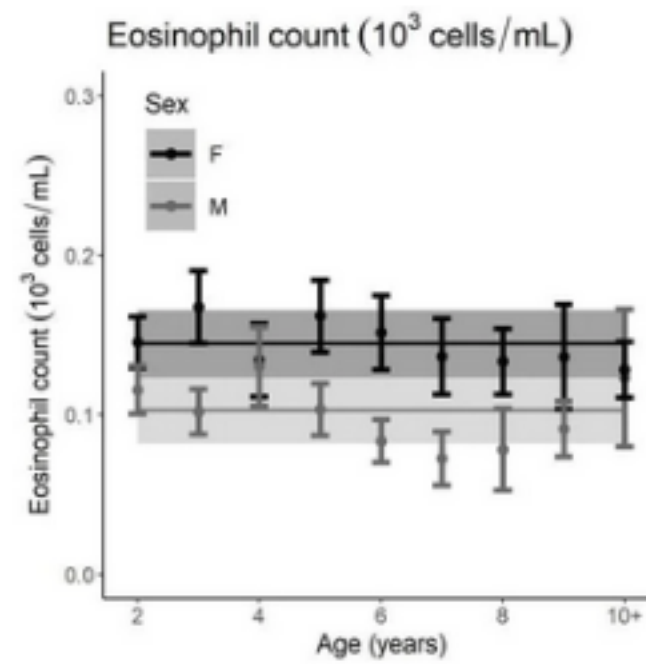
ADAPTIVE IMMUNITY



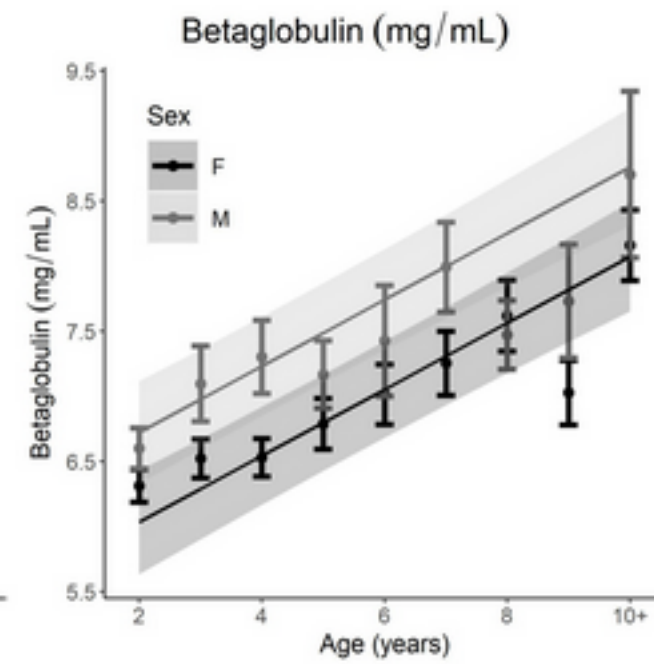
Decrease of cell counts with age in the poor-quality population / increase at the end of life in the good-quality population

Immunosenescence patterns are not modulated by FGM levels

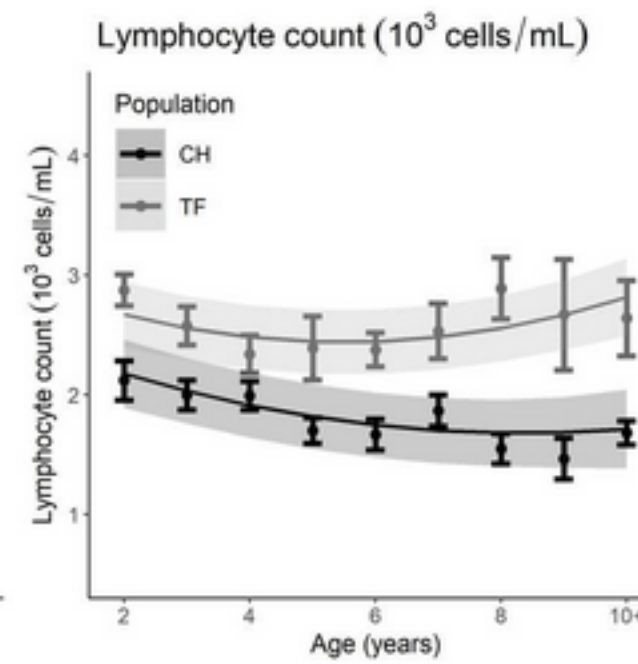
INNATE IMMUNITY



INFLAMMATORY MARKER



ADAPTIVE IMMUNITY

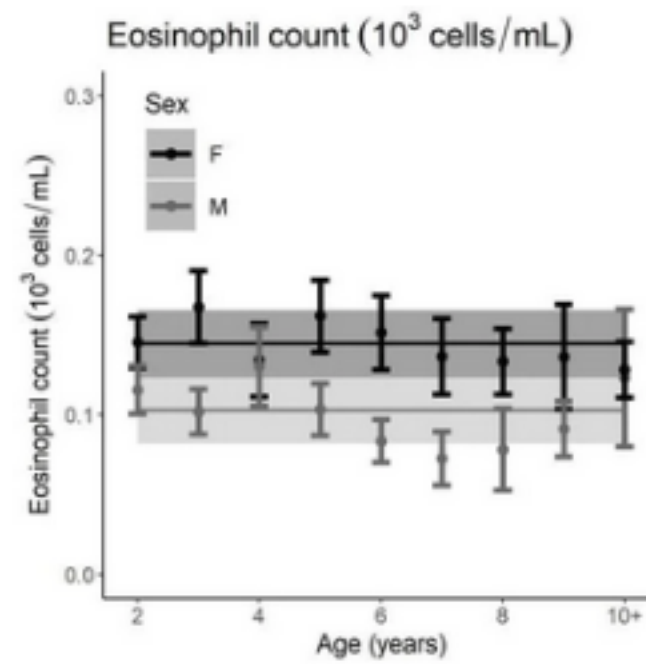


Contradictory to what found in the literature:

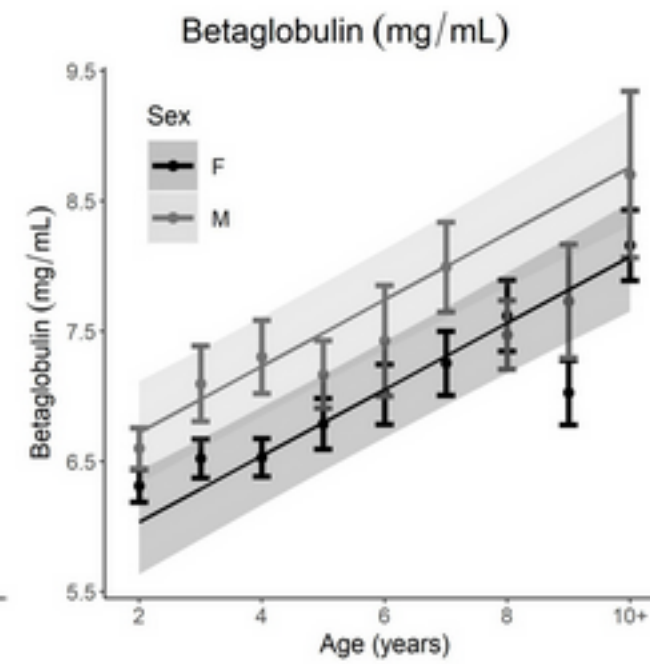
Social, psychological, physiological chronic stress accelerate or amplify immunosenescence (e.g. Garrido et al., 2022. *Expert Reviews in Molecular Medicine*; Bauer, 2008. *Neuroimmunomodulation*)

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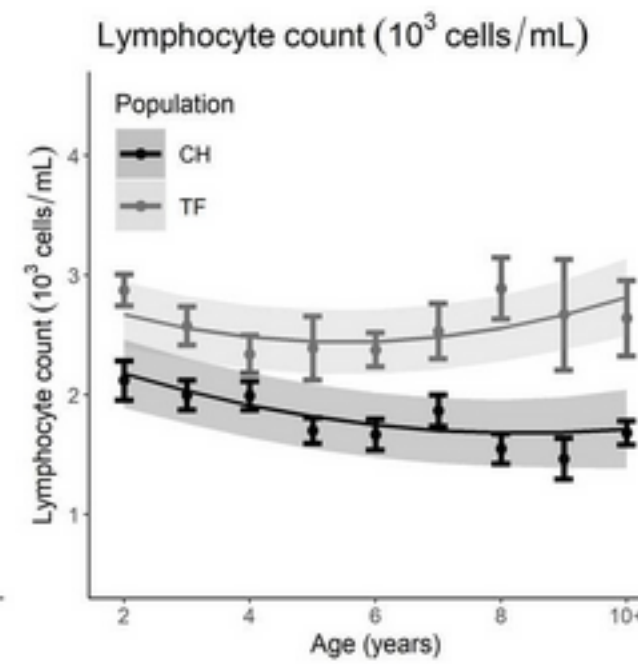
INNATE IMMUNITY



INFLAMMATORY MARKER



ADAPTIVE IMMUNITY



NO STUDY ON WILD MAMMALS



ONLY HUMAN AND LABORATORY RODENTS

(to my knowledge)

Contradictory to what found in the literature:

Social, psychological, physiological chronic stress accelerate or amplify immunosenescence (e.g. Garrido et al., 2022. *Expert Reviews in Molecular Medicine*; Bauer, 2008. *Neuroimmunomodulation*)

CONCLUSION

For the first time in a free-ranging mammal, we showed that GC levels during early-life do not modulate patterns of immunosenescence

It is contradictory to what is shown in biomedical research evidencing that high GCs levels promote a stronger immunosenescence



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However, these results do not concern early-late trade-offs like the present study

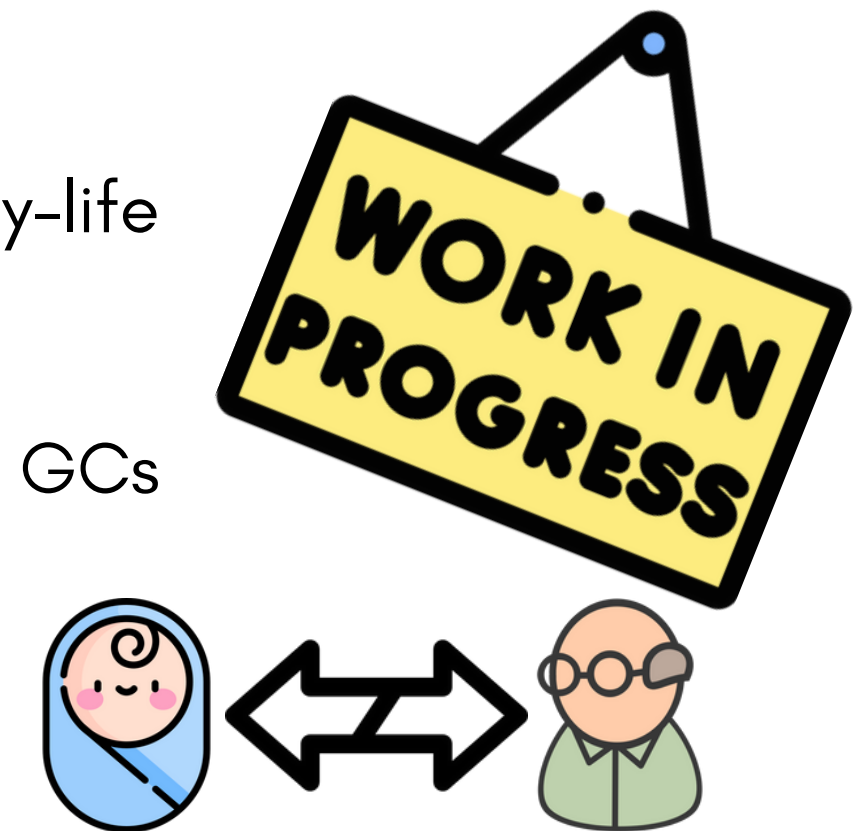


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Estimates goes in the sense of the literature! We cannot exclude that we do not have sufficient data to find significant relationships

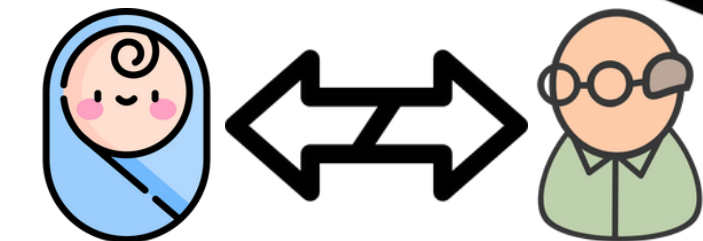


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PERSPECTIVES

GC levels and immune traits covary in this species (Carbillet et al., 2023. *Gen. Comp. Endocrinol.*)

The difficulty is to find a relevant metric encompassing an individual stress history

THANK YOU FOR YOUR ATTENTION!



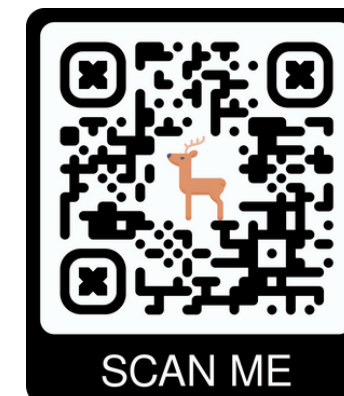
My supervisors:

Pauline Vuarin
Emmanuelle Gilot-Fromont



The Ph.D. team:

Solène Cambreling
Léa Bariod
Jessica Cachelou
Florentin Remot
...



Very talented people of the lab:

Benjamin Rey
Philippe Veber
Marie-Laure Delignette-Muller