

The aging process

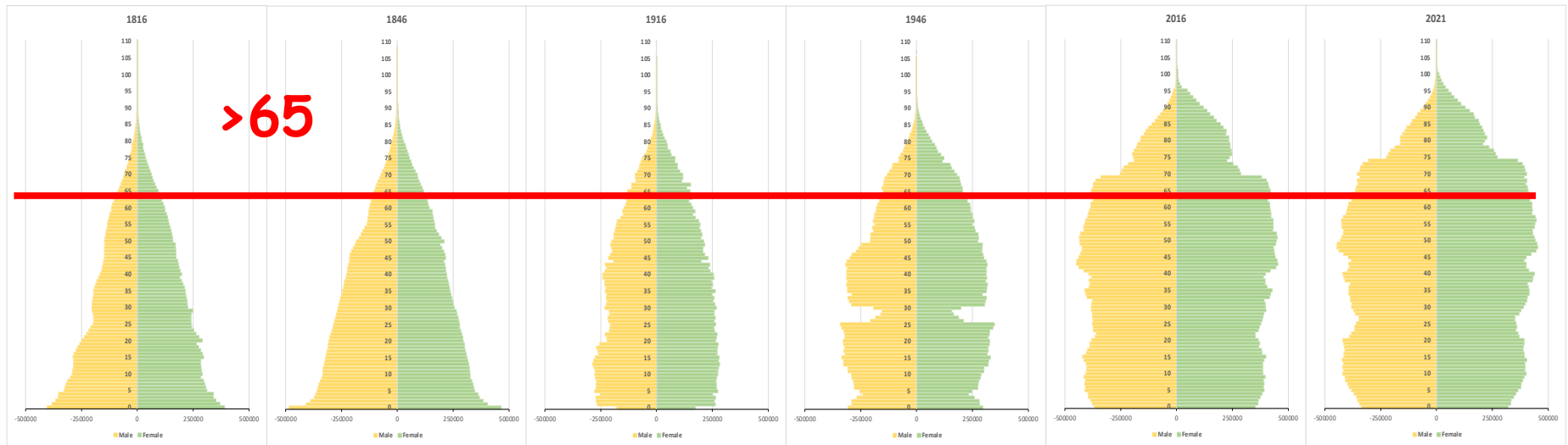
- **Some figures**
- **Biology of aging**
- **Measurement of health during aging**

**Alain Fischer, french Academy of Science
S7 meeting, March 7th, 2023**

Aging, a few figures

- >65 1.6 billion in 2050 (X2 /2022)
- life expectancy + 20 y. since 1960, half in good health
- 1950 11.7 working-age people / 1 >65
- 2023 7
- 2040 4.4
- Expected health expenses (countries with high income)
 - 2016 10.8% GDP
 - 2050 13.1% (Lancet ,2019,393)

Age distribution of the french population 1816-2021



5.8 %



20.9 %

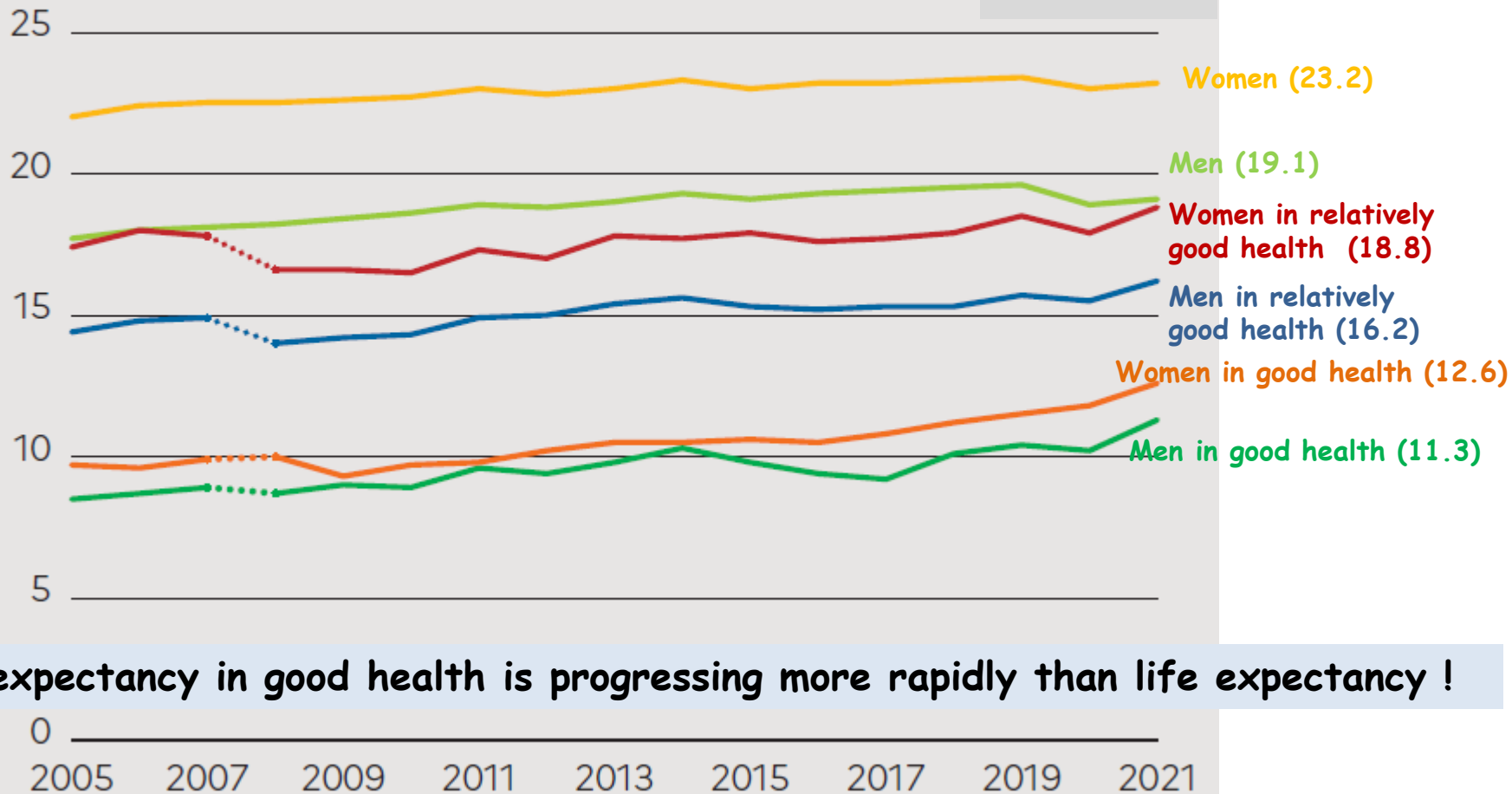
>85 .2 %



3.4%

Life expectancy at 65 in France

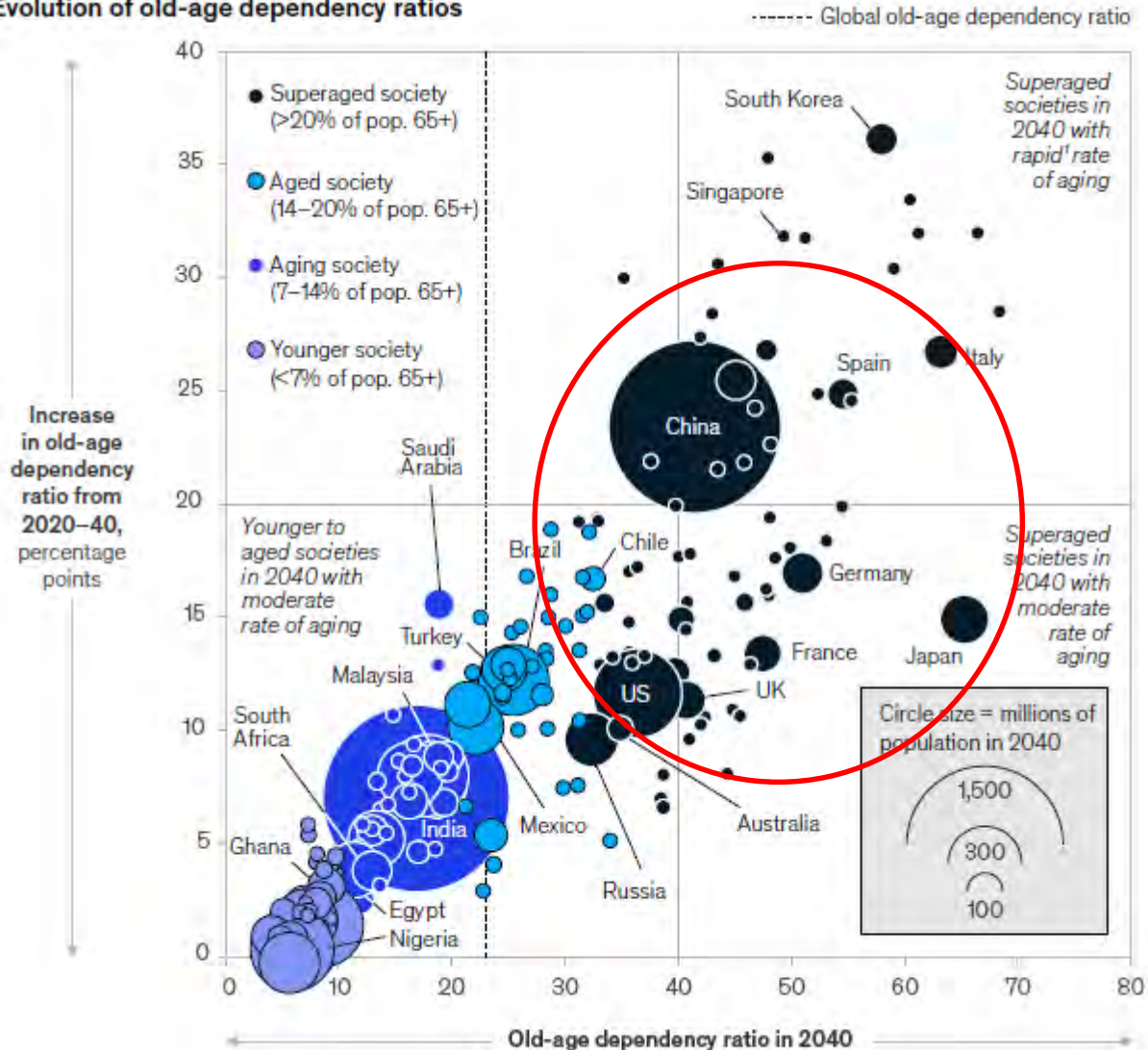
years



Life expectancy in good health is progressing more rapidly than life expectancy !

Evolution of old-age dependency ratio

Evolution of old-age dependency ratios



¹Increase of old-age dependency ratio from 2020–40 is >20 percentage points.
Source: World Population Prospects 2022, United Nations

More chronic conditions with aging

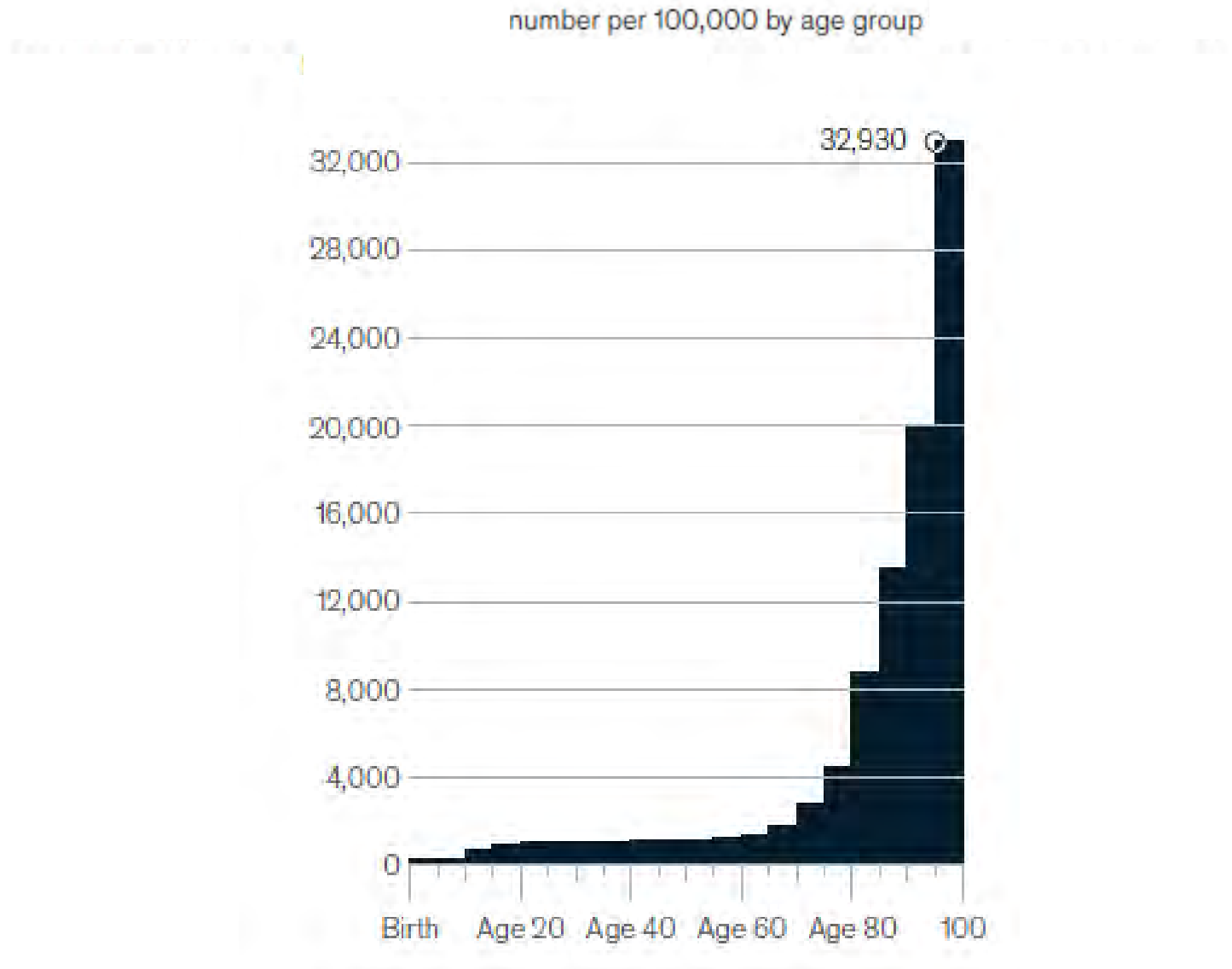
GROWING SICKNESS

Although people are living longer, they are also living with more chronic conditions, as seen here in data for the developed world.

Number of conditions ■ 0 ■ 1-2 ■ 3-4 ■ 5-6 ■ 7-8 ■ ≥ 9



Neurological disorder daily as a function of aging



Source: Global burden of disease, 2019, Institute for Health Metrics

Specific vulnerability

- Pandemics
- Heatwaves
- Other expositions

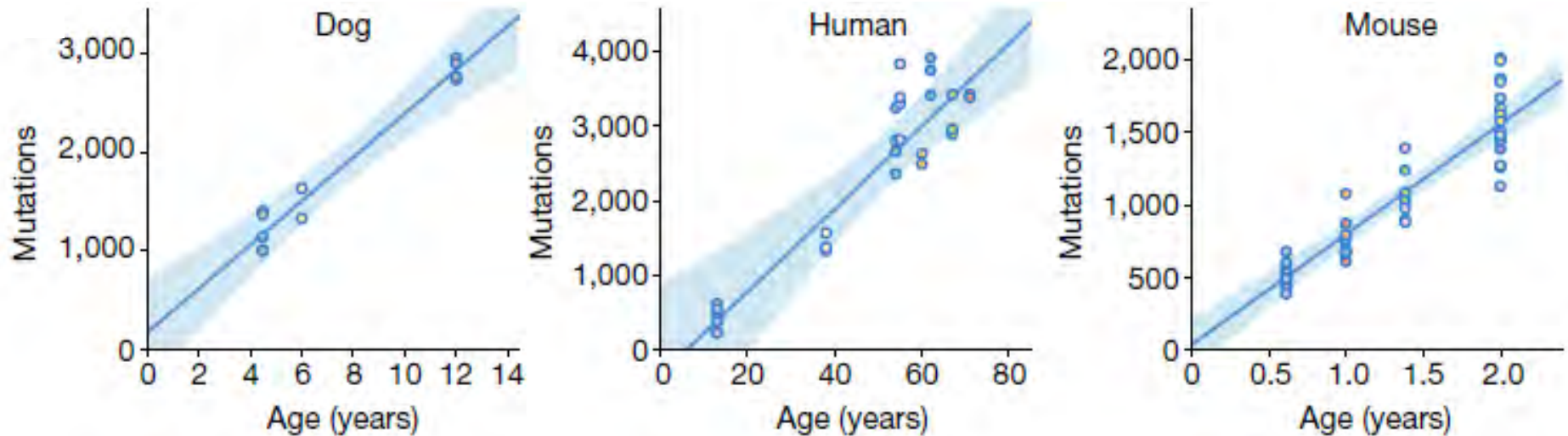
made worse by poverty

Biology of aging

- **genomic instability**
 - accumulation of somatic mutations**
 - accumulation of DNA damage**

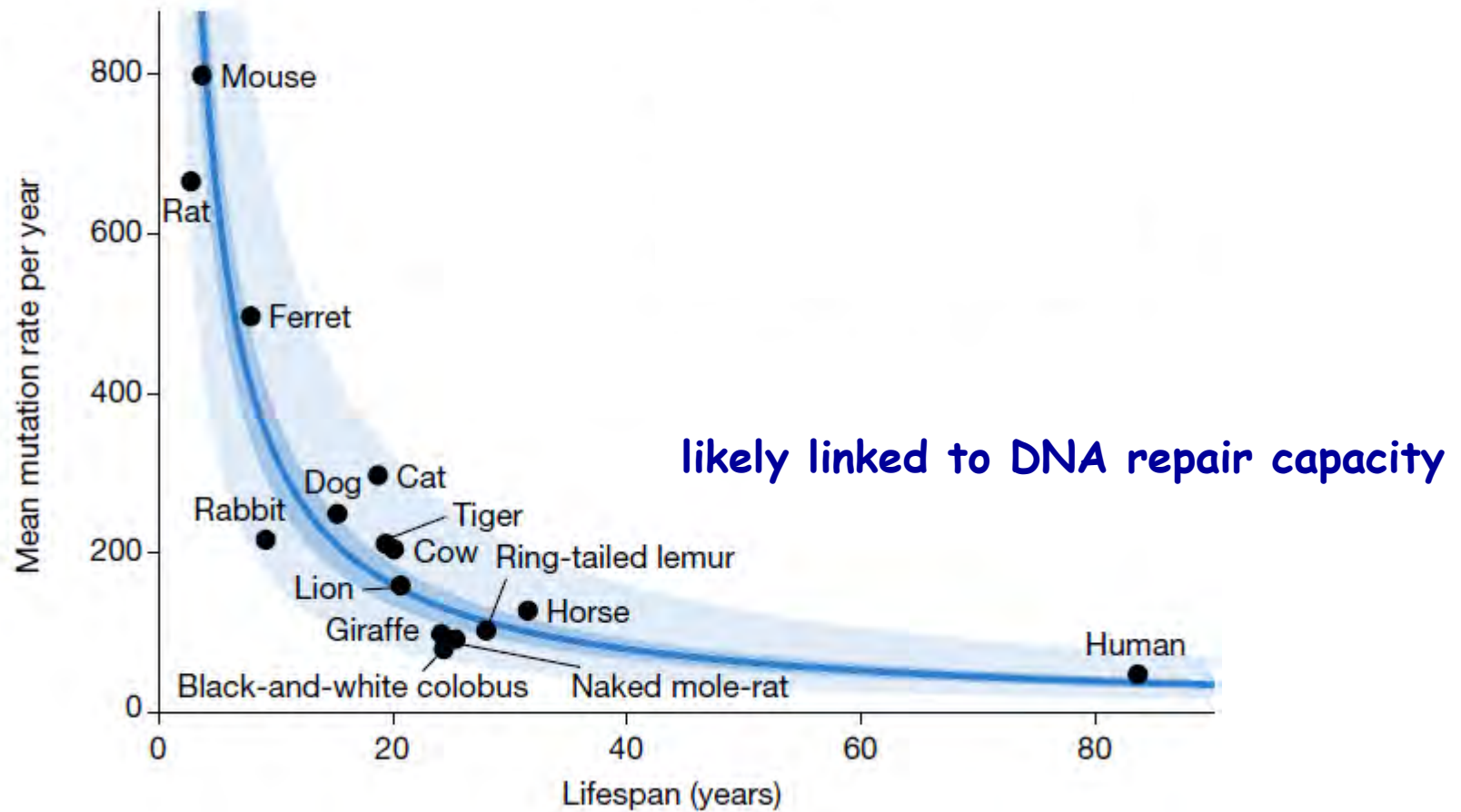
Somatic mutation burden

Colorectal crypts



Rate of mutations acquisition correlates with life expectancy

Correlation between somatic mutation rates and life history traits



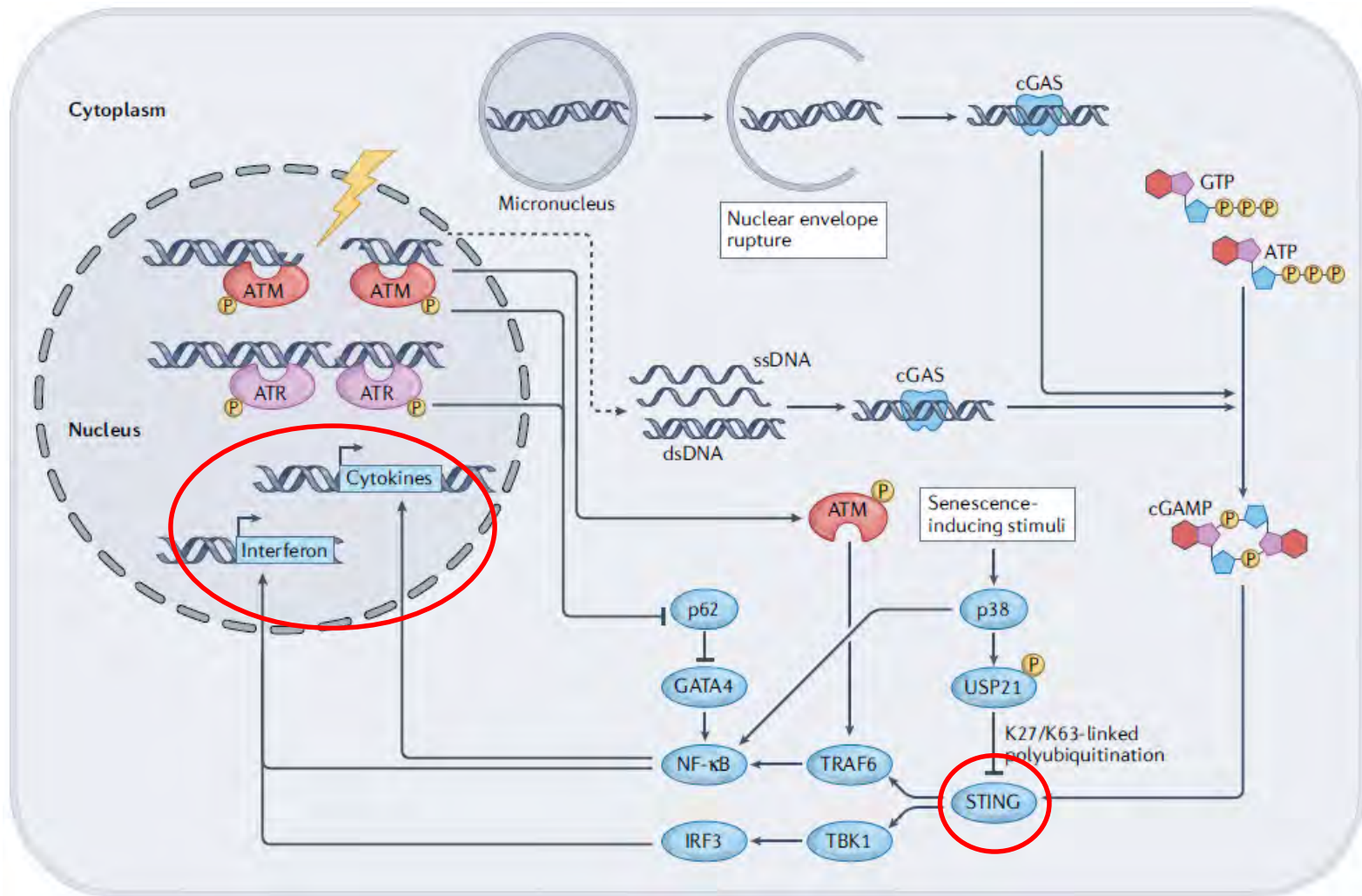
Biology of aging

- genomic instability
(accumulation of somatic mutations,...)
- shortening of telomeres
- epigenetic alterations
- mobilization of transposons
- loss of tissue elasticity

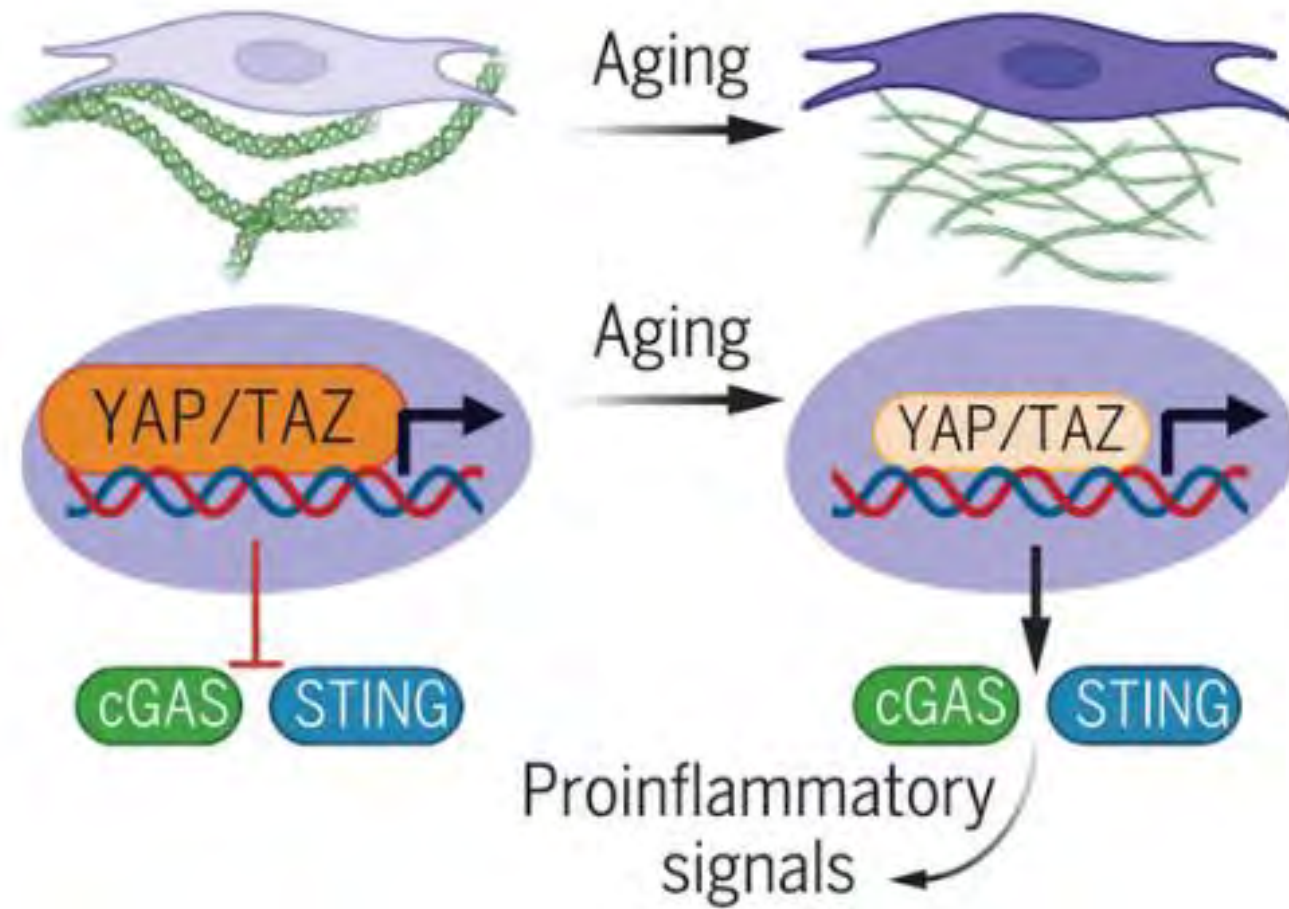


inflammation

DNA damage in aging and inflammation



Less elastic tissues promote an inflammatory response



Biology of aging

- genomic instability
(accumulation of somatic mutations, . . .)
- shortening of telomeres
- epigenetic alterations
- mobilization of transposons
- loss of tissue elasticity
- accumulation of senescent cells
- clonal hematopoiesis
- cancer



inflammation

Biological research on aging

- **Syndromes of accelerated aging**
- **Regulation of DNA damage in aging**
- **Pathways of “inflammaging”**
- **Senescence mechanism (cis/trans)**

Pharmaceutical targets

- Epigenome
SIRT6 activator
- Retrotransposon
reverse transcription inhibitors
- Inflammation (STING)
aspirin, specific inhibitors
- Inflammation (Interferons)
JAK inhibitors
metformin, rapamycin

Measurement of health

- Biomarkers: early detection of degenerative diseases
→ intervention
- Dependency
- Study of cohorts (large sample-size)

Prevention of diseases, protection of health

Today

Future

medical

- treatment of HTA, diabetes,...
- vaccination
- care of sensory impairment

- pharmacological intervention

non medical

- physical exercise
- cognitive engagement
- healthy diet
- stress reduction
- aging in place
- avoid social isolation
- maintain sleep
- leisure activities

- inclusive infrastructure
- consider "stage" rather than age
- adapted housing, transport
- access to digital technology (training)