



# Ageing: the Biosocial Perspective

October 2023

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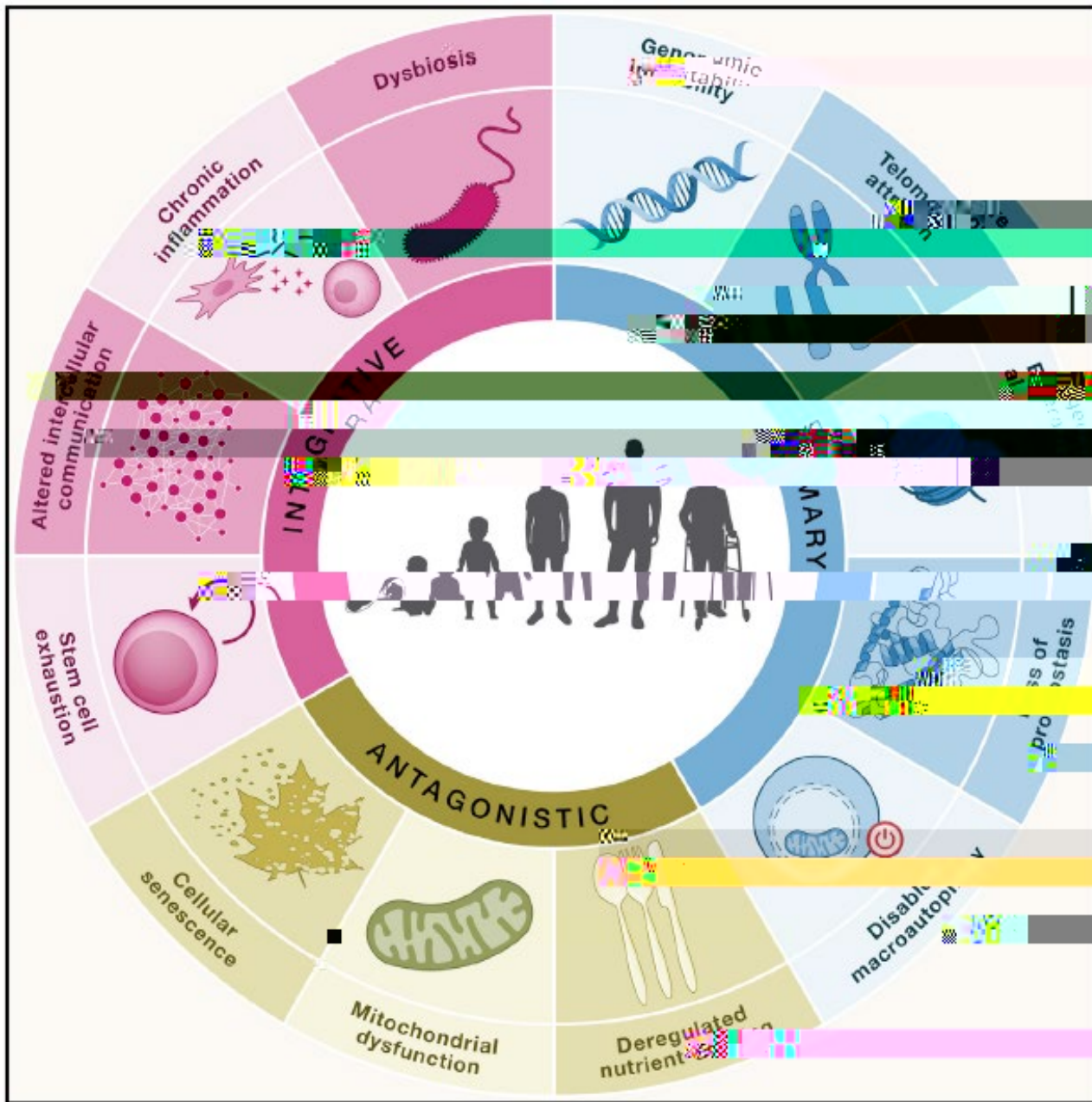




above the reading eye as there are with eyes below

# Biosocial factors and ageing

- Biogerontological and population perspectives on ageing
- Disease vs ageing processes; 'biological ageing'
- Biosocial processes at older ages – methods of study
- Positive emotional wellbeing and health at older ages



Lopez-Ortin et al  
Cell, 2023











Fauja Singh, retired from  
marathon running at age  
101

David Attenborough  
Aged 97



# Challenges in ageing

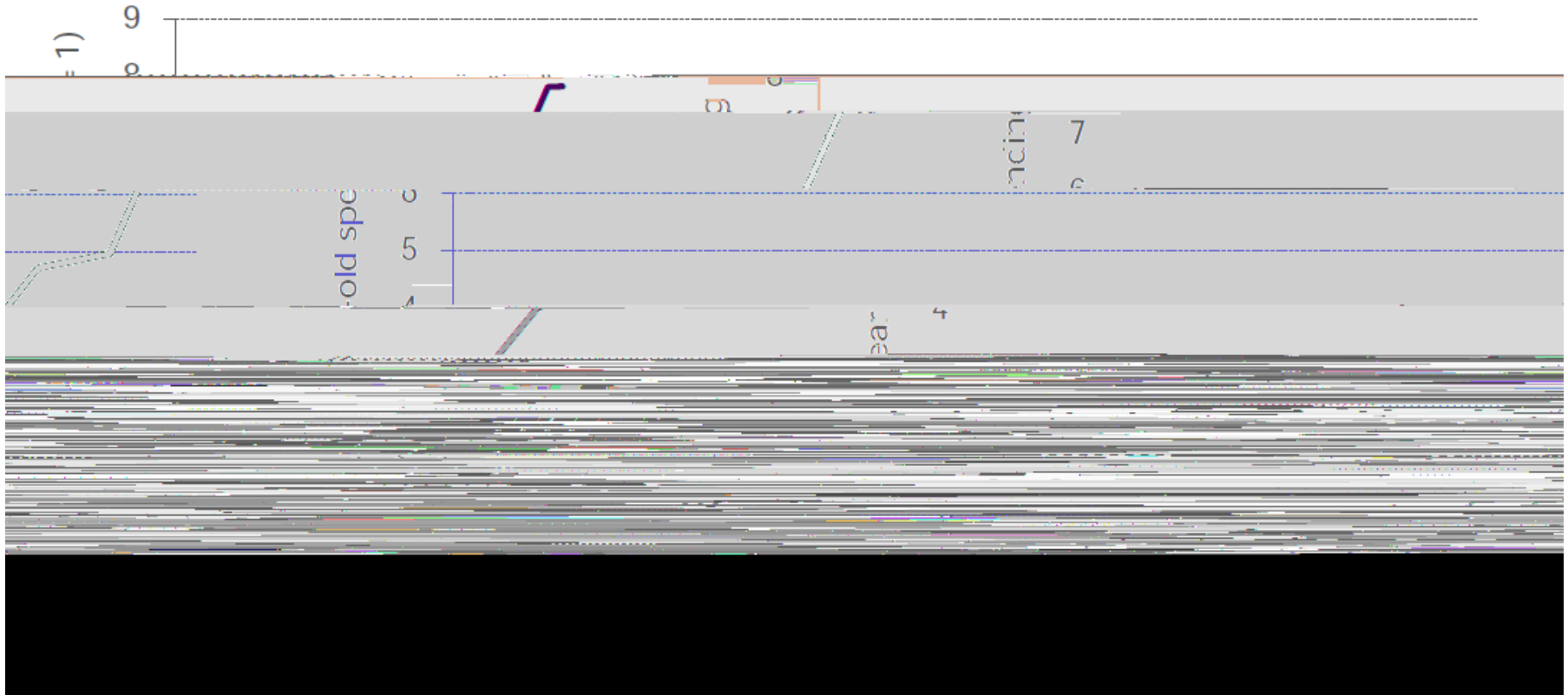
- Health issues

- $\frac{3}{4}$  Living with long-term conditions; increased prevalence of dementia; socioeconomic inequalities; terminal care

- Economic issues

- $\frac{3}{4}$  Ensuring adequate incomes; costs of health and social care; employment at older ages; transport and access

Figure 5.9. Age profile of public health spending in the UK (relative to 20-year-olds)







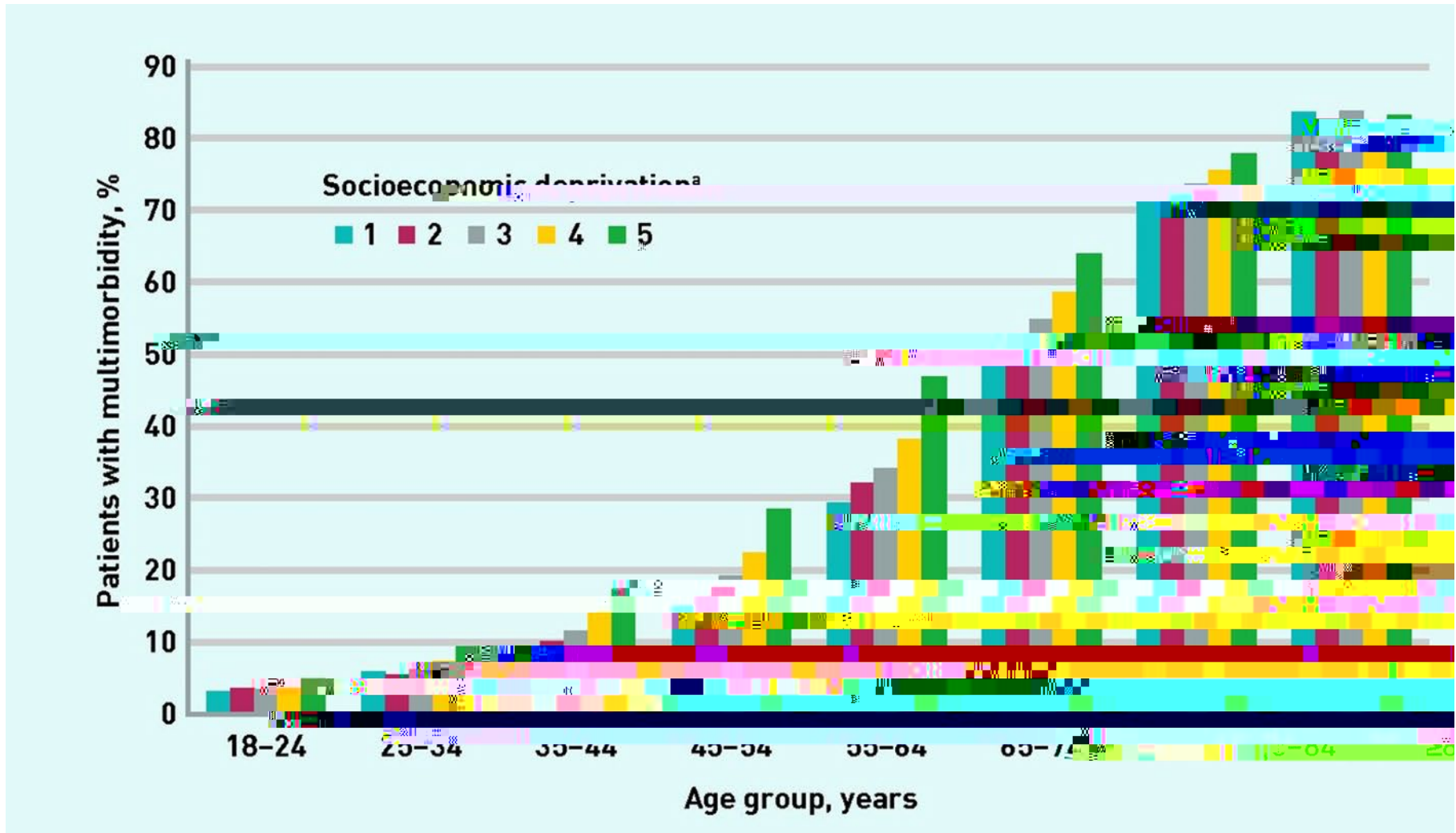
# Population ageing longitudinal cohorts

- **English Longitudinal Study of Ageing (ELSA)**
  - <sup>3</sup>/<sub>4</sub> Nationally representative sample of men and women aged 50+ living in the community
  - <sup>3</sup>/<sub>4</sub> Started in 2002, typically assessed every 2 years
  - <sup>3</sup>/<sub>4</sub> Four sets of biomarker assessment so far
  - <sup>3</sup>/<sub>4</sub> Sample periodically refreshed (c19,000)
- **Health and Retirement Study (HRS)**
  - <sup>3</sup>/<sub>4</sub> Nationally representative sample of men and women aged 50+ living in the USA
  - <sup>3</sup>/<sub>4</sub> Started in 1992, typically assessed every 2 years
  - <sup>3</sup>/<sub>4</sub> Biomarkers assessed once so far
  - <sup>3</sup>/<sub>4</sub> Sample periodically refreshed (c43,000)

# Biosocial factors and ageing

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- **Disease vs ageing processes; ‘biological ageing’**
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# Prevalence of multimorbidity by age and deprivation



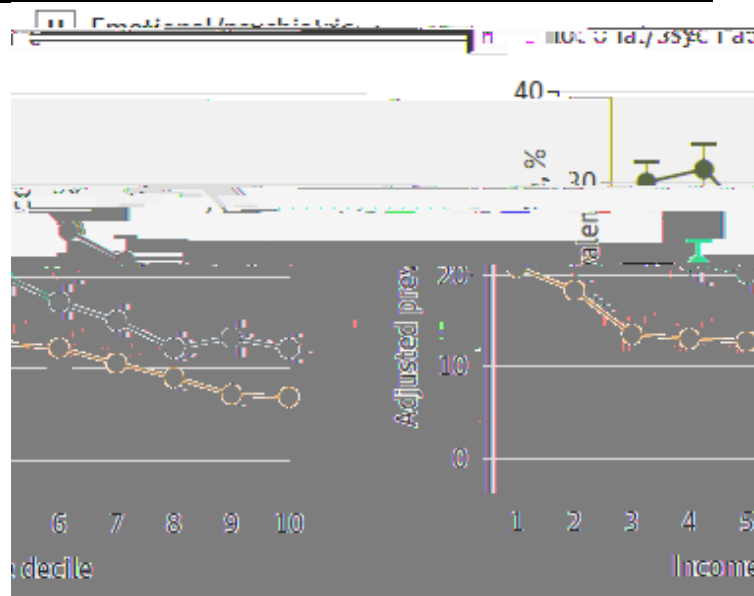
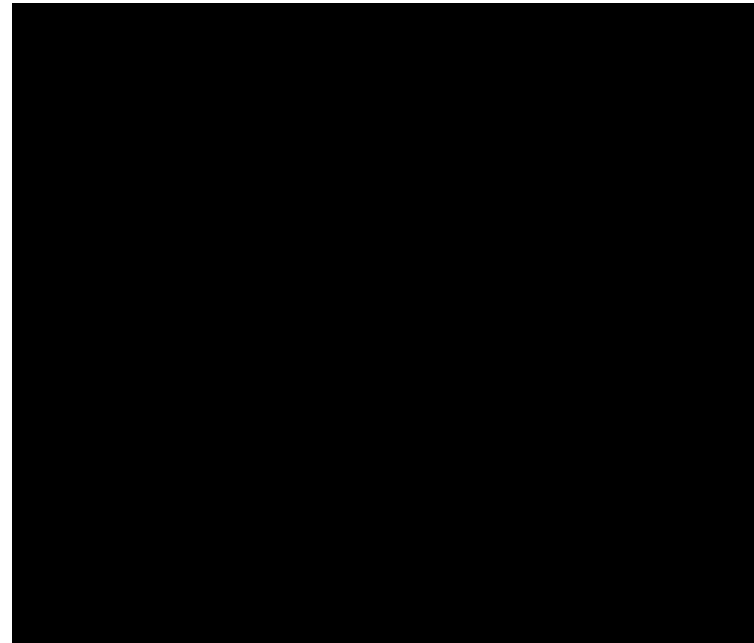
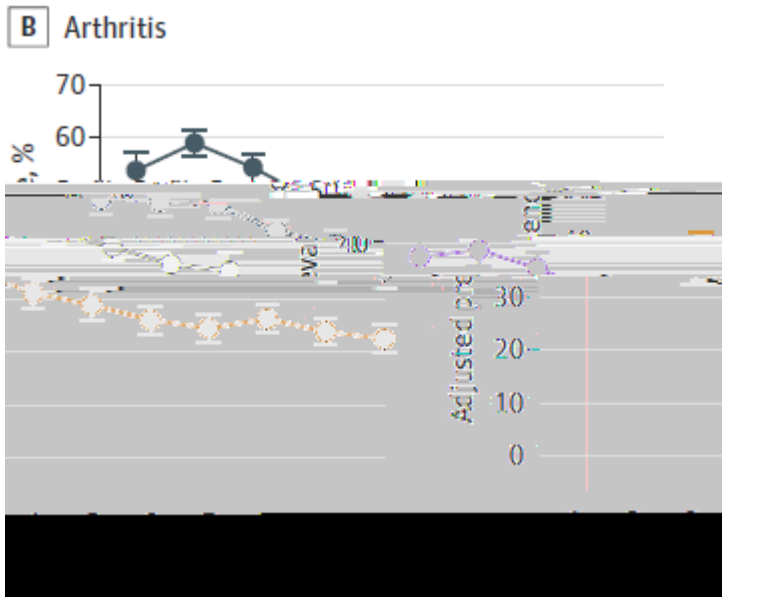


Comparison of adults aged 55-64 from the HRS and ELSA in 2008-2016  
46,887 person-years of observations

Annual income divided into deciles

Adjusted for age, sex, country of birth, race, household size and marital status

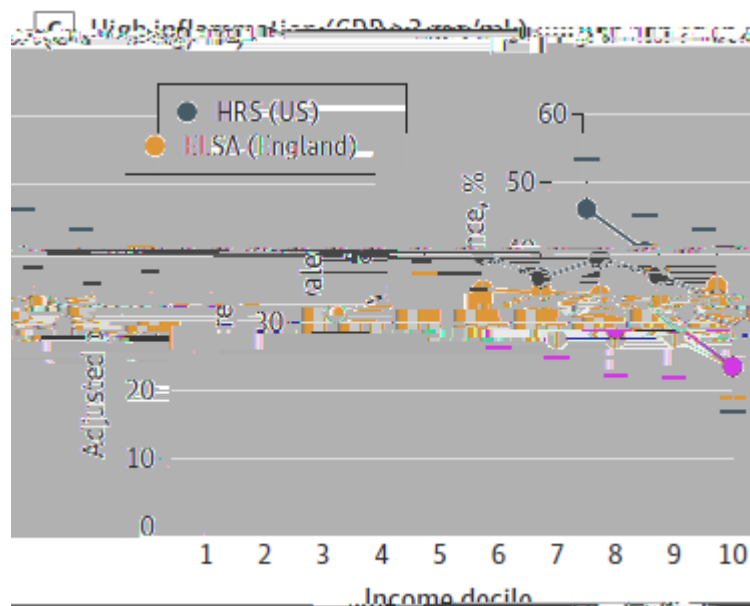
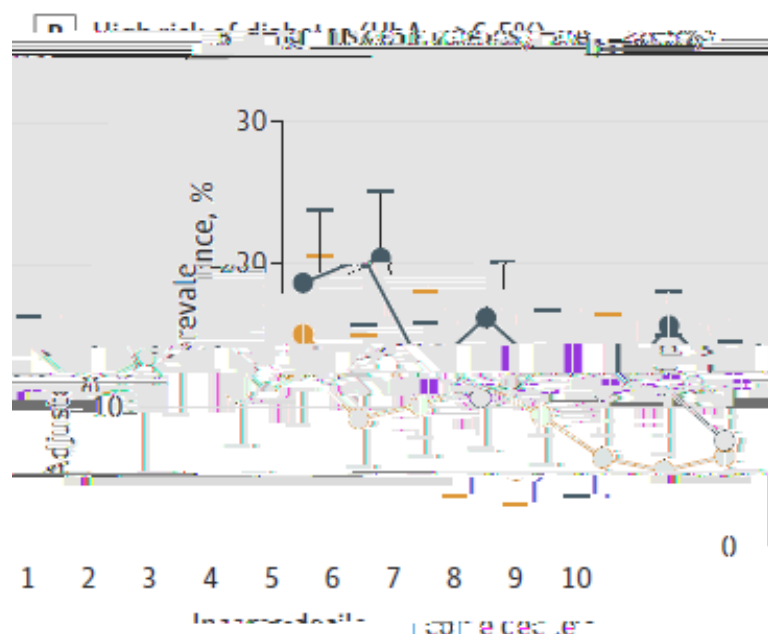
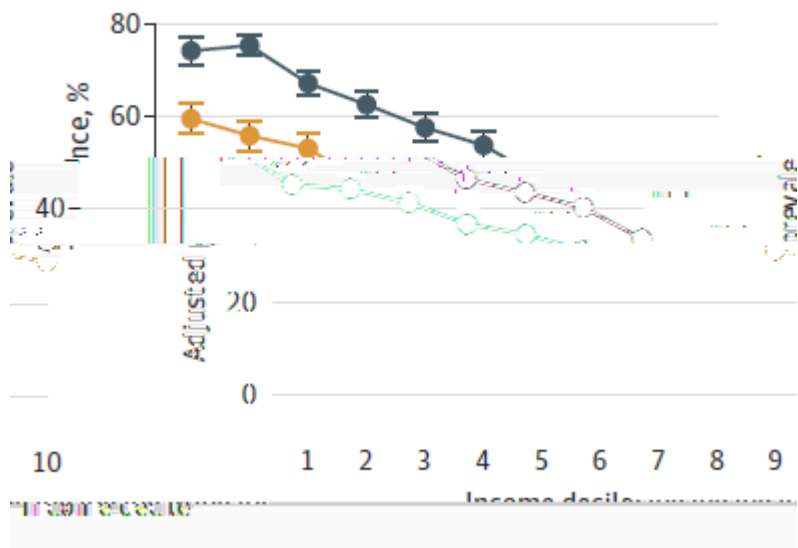
# Income and health outcomes



Adjusted for age, sex, country of birth, race, household size and marital status  
Choi et al, JAMA Intern Med, 2020

# Income and health outcomes

**A** Functional limitation



Adjusted for age, sex, country of birth, race, household size and marital status  
Choi et al, JAMA Intern Med, 2020

# SES and aging

- Lower SES related to earlier onset of age-related health problems
- Is SES also associated with aging processes independently of health?

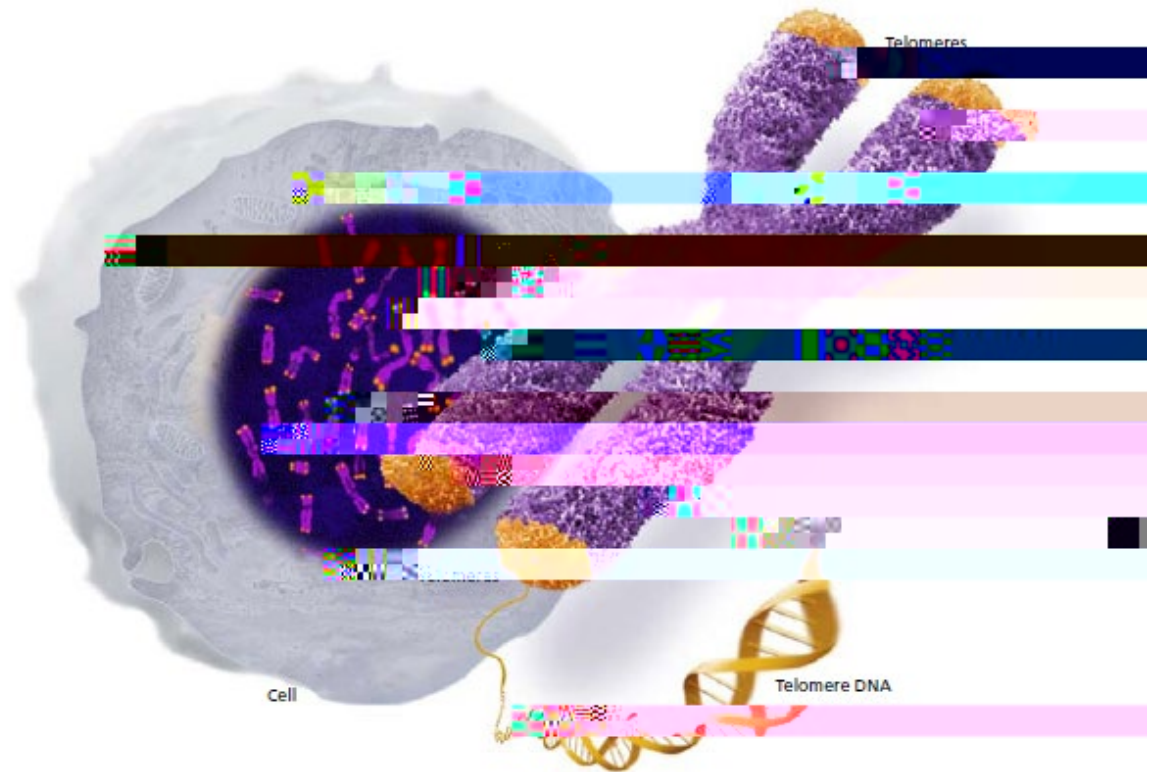
# Chronological vs biological ageing

## Chronological age

- Age in years since birth

## Biological age

- Age based on changes in biological processes
  - $\frac{3}{4}$  Telomere length
  - $\frac{3}{4}$  Epigenetic biological clocks
  - $\frac{3}{4}$  Phenotypic indices

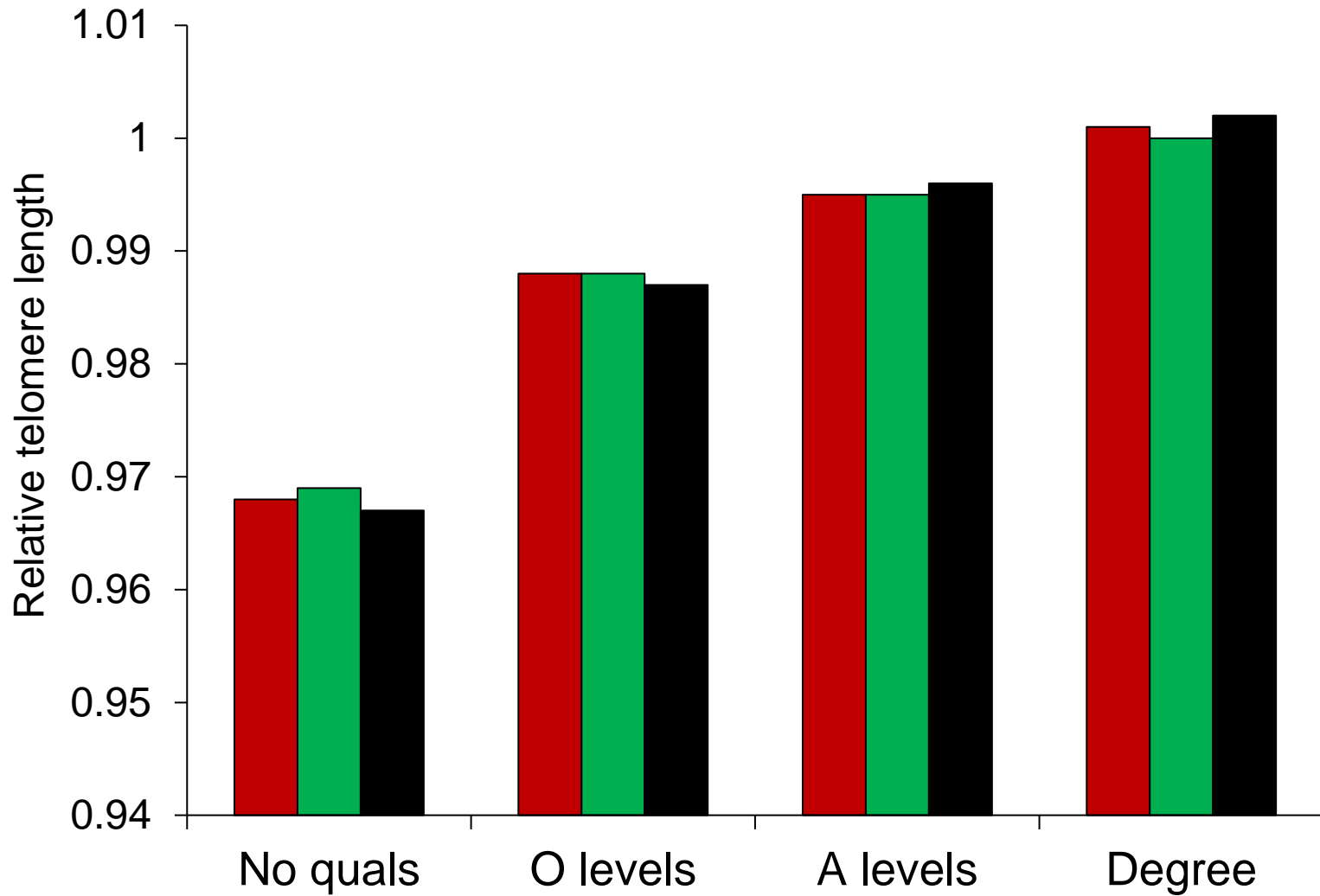


### The telomere

Chromosomes contain the long strands of DNA that are at the ends of the chromosomes.



# Education and leukocyte e e telomere length





# Phenotypic biological ageing

- Measures of biological ageing based on changes in multiple biomarkers of diverse bodily systems
- Individual biomarkers regressed on age, then combined using principal components analysis (PCA) or similar
-

# Phenotypic ageing and childhood adversity

Figure 2. Phenotypic Age Acceleration by Type of Childhood Adversity

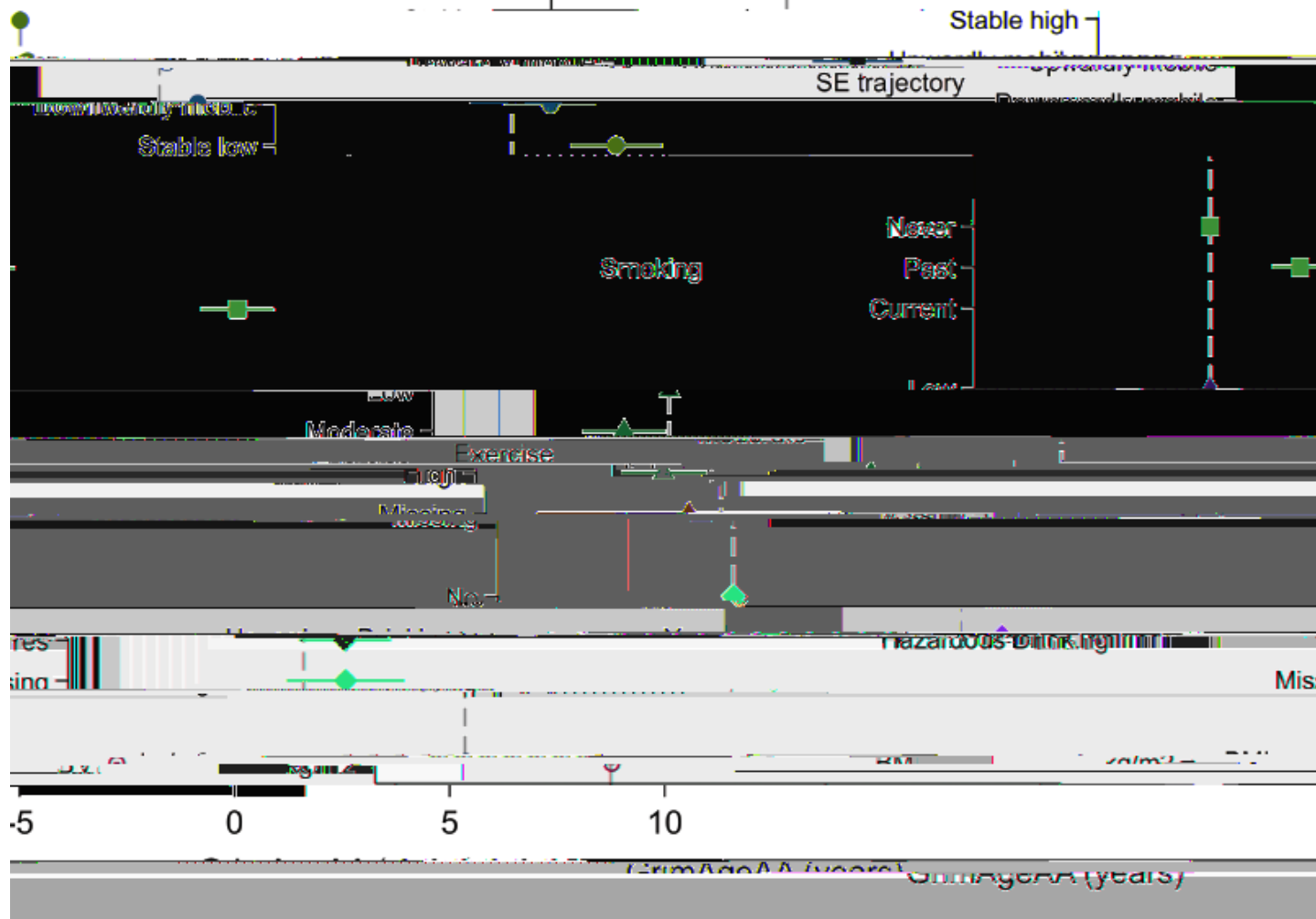


Analysis of UK Biobank, mean age 56.4, sd 7.7  
Yang et al, JAMA Network Open, 2022

# Epigenetic clocks

- Measures of biological ageing based on DNA methylation (methylation of CpG sites)
- Calibrated against phenotypes
- Correlated with chronological age, but discrepancies reflect biological age
- Multiple clocks: GrimAge, PhenoAge, DunedinPACE, Horvath, Hannum

# Epigenetic clocks and SES



# Socioeconomic indicators

Birth / Childhood	Adolescence	Early adult life	Mid adult life	Older age
Parental education and occupation	Own education, Parental education and occupation	Own education, Occupational status, income	Occupational status, Income	Accumulated wealth, Income

# Low socioeconomic status and the acceleration of aging

- Does lower socioeconomic status promote more rapid decline in age-related processes independent of health status?
- Wealth as indicator of SES
- Adjustment for age, gender, ethnicity, education and long-term health conditions
- ‘Outcome-wide’ epidemiological analysis
  - $\frac{3}{4}$  Physical capability
  - $\frac{3}{4}$  Sensory function
  - $\frac{3}{4}$  Physiological function
  - $\frac{3}{4}$  Cognitive function
  - $\frac{3}{4}$  Emotional wellbeing
  - $\frac{3}{4}$  Social functioning



SES and 8 year  
change in...

Changes in lung function

Incident poor sight

Adjusted for age, gender, ethnicity,  
education and long- term conditions



# SES and 8 year change in...

Changes in memory

Processing speed

Adjusted for age, gender, ethnicity,  
education and long- term conditions

SES and 8 year

Enjoyment of life

Incident depressive  
symptoms

Adjusted for age, gender, ethnicity,  
education and long- term conditions

SES and 8 year  
change in...

Changes in membership of  
organisations

Cultural  
engagement

Adjusted for age, gender, ethnicity,  
education and long- term conditions

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# Psychosocial determinants of health: pathways

## Lifestyle

- Smoking, food choice, physical exercise, alcohol consumption, healthy weight, adherence to treatment

## Biology

- Modifications in neuroendocrine, cardiovascular, inflammatory, immunological and other physiological responses

# Social – Biological Interface

- Autonomic nervous system
  - <sup>3</sup>/<sub>4</sub> Blood pressure, heart rate, heart rate variability
- Neuroendocrine pathways
  - <sup>3</sup>/<sub>4</sub> Cortisol, adrenaline/noradrenaline
- Psychoneuroimmunological (PNI) pathways
  - <sup>3</sup>/<sub>4</sub> Innate immunity (inflammatory cytokines), humoral immunity (immunoglobulins), immune cell expression

**Central nervous system**

Altered neurotransmission, reduced plasticity and impaired neurogenesis

Altered connectivity, smaller regional brain volumes and neuroinflammation




McEwen, 2007



# Age-related biomarkers relevant to Soc-B programme

- Cortisol (saliva and hair)
- Inflammatory markers: C-reactive protein, IL-6, fibrinogen, white blood cell counts (blood)
- Metabolic markers: HbA1c, fasting glucose (blood)
- Cardiovascular markers: blood pressure, heart rate, heart rate variability
- Telomere length and epigenetic alterations



C-reactive protein, Interleukin (IL) 6, tumor  
necrosis factor (TNF .), fibrinogen

Coronary heart disease, depression, frailty, adiposity,  
autoimmune diseases, diabetes, trauma, infection

C-reactive protein, Interleukin (IL) 6, tumor  
necrosis factor (TNF .), fibrinogen

Coronary heart disease, depression, frailty, adiposity,

# Psychobiological processes and health risk

## Levels of study

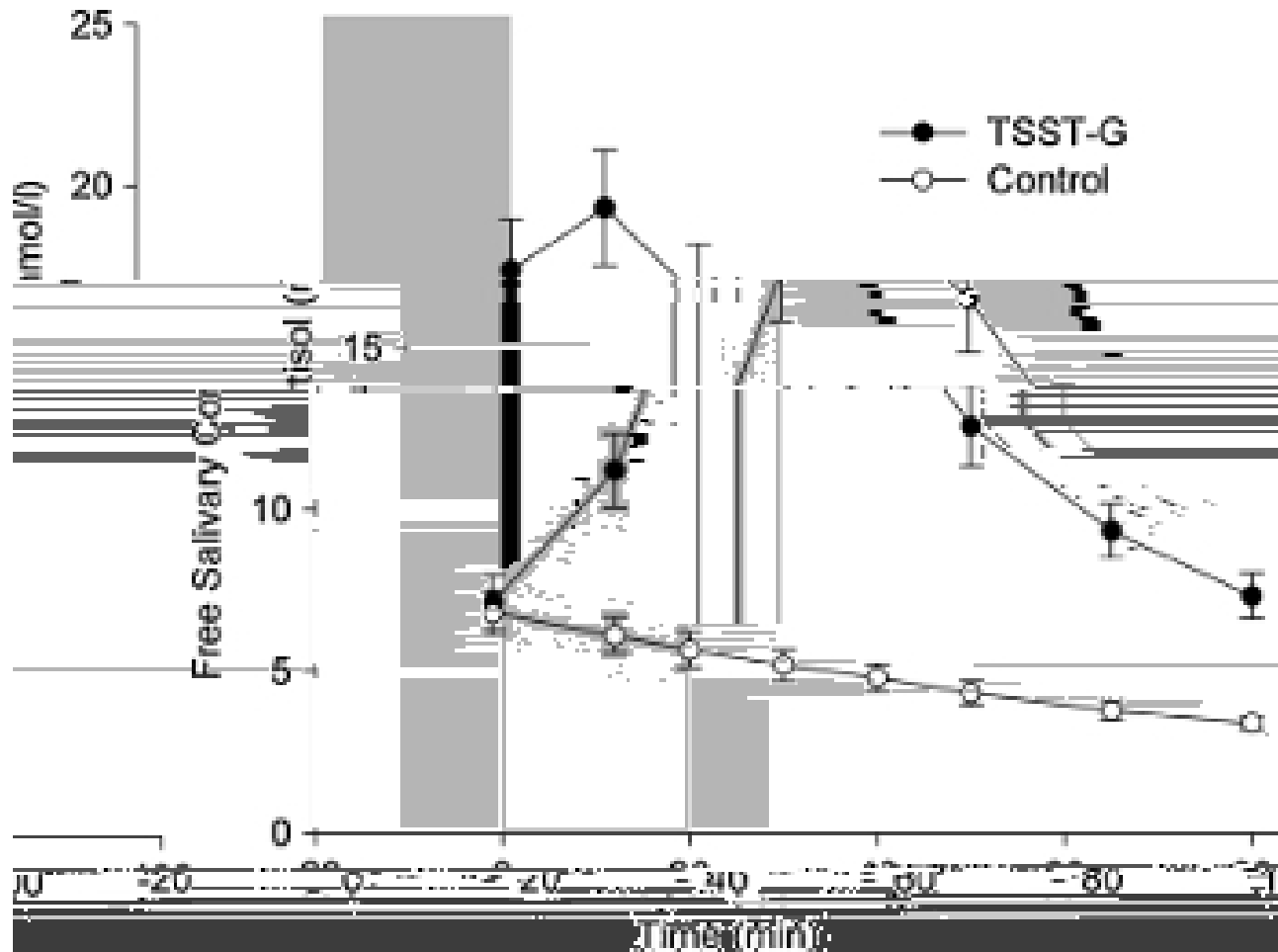
- Psychophysiological stress testing
- Naturalistic monitoring
- Epidemiological studies



# Saliva sampling



# Cortisol and Trier Social Stress Test



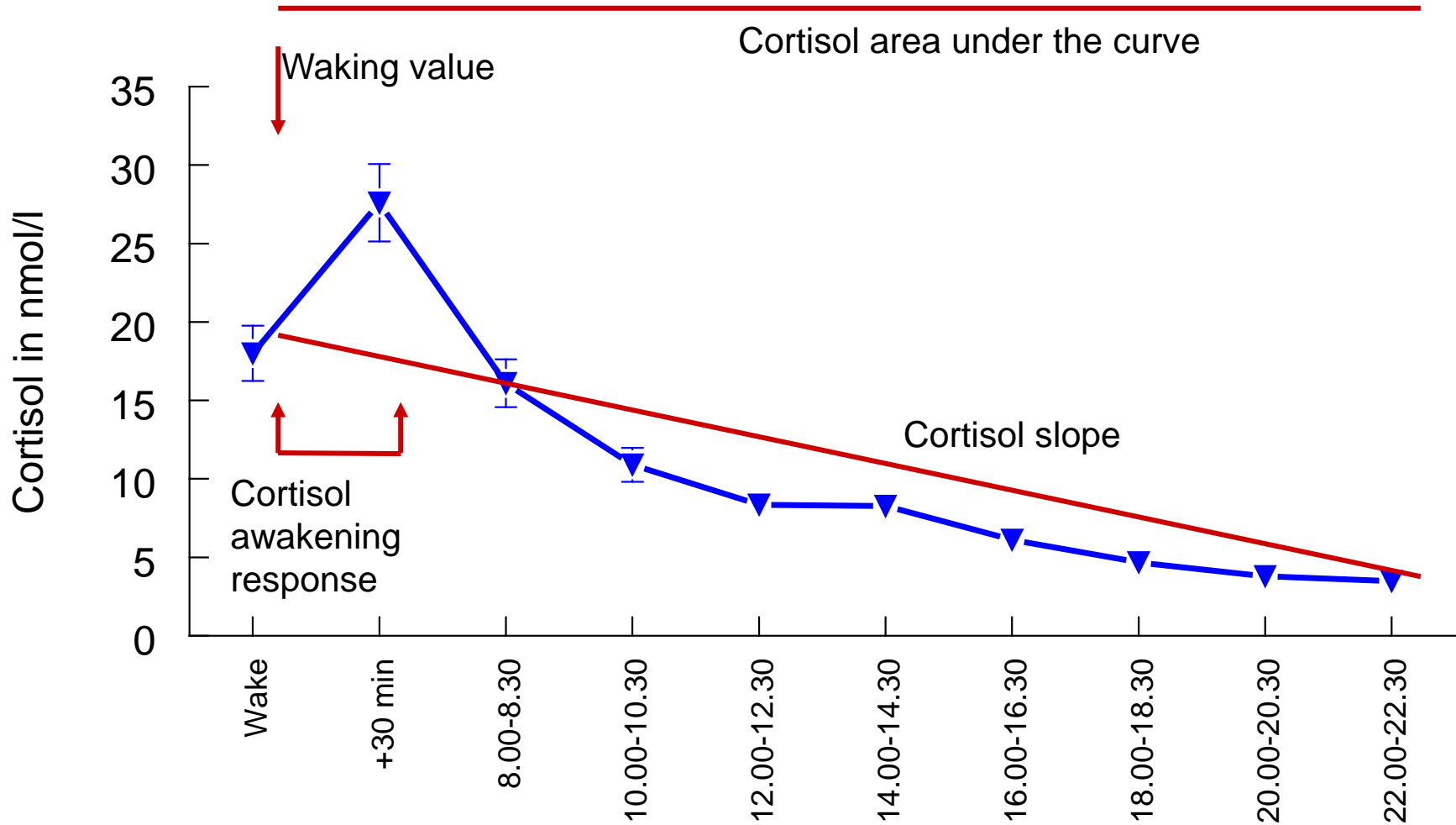
# Psychobiological processes and health risk

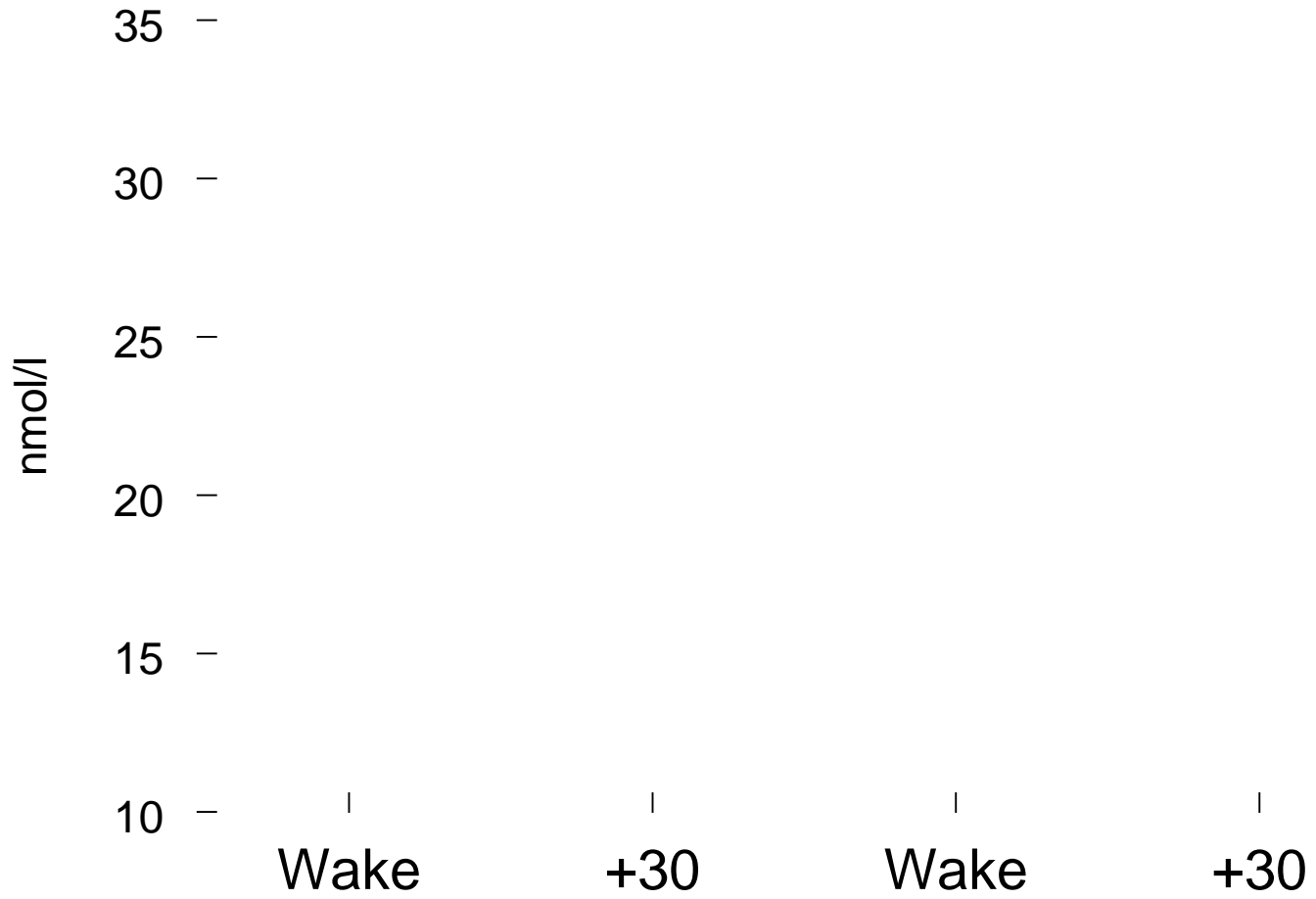
## Levels of study

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# Cortisol profile over the day





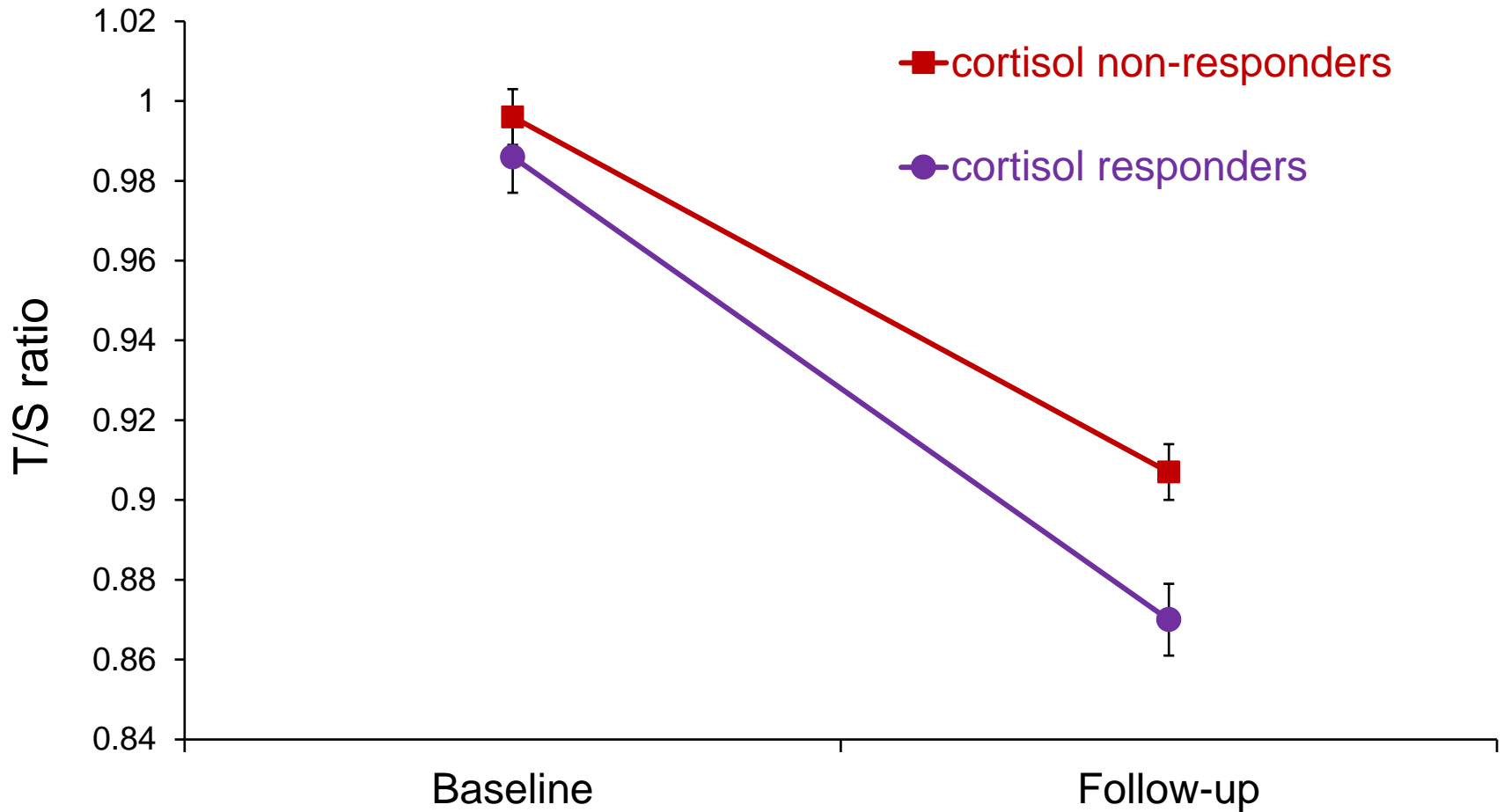


# Telomere length and biological responses to stress

- Do individual differences in stress-related responses predict greater telomere attrition over time?
- 493 healthy men and women aged 53-76 years
- Cortisol responses to standardized mental stress tests
- Leukocyte telomere length measured at baseline and 3 years later
- Cortisol 'responders' and 'non-responders' compared



# Telomere length and biological responses to stress



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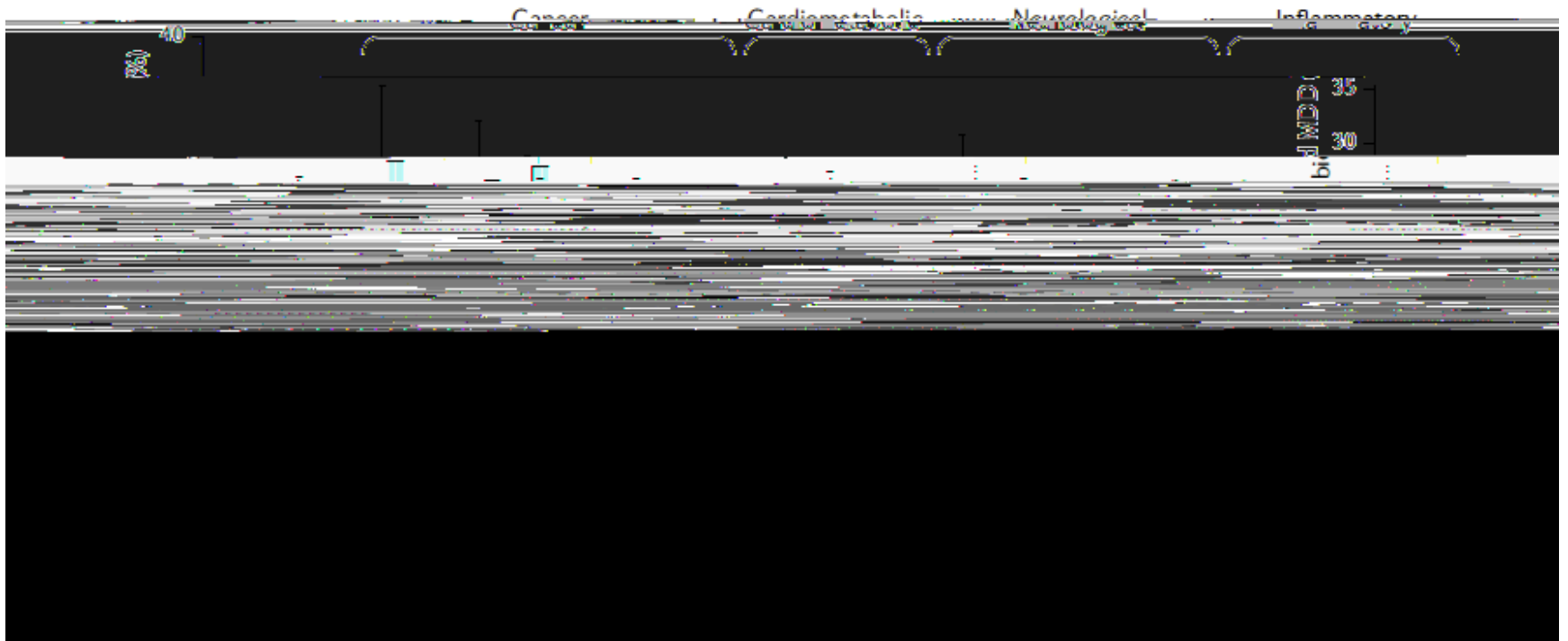
# Psychosocial factors

## Risk factors

- Low socioeconomic status
- Work stress
- Life events
- Chronic adversity
- Early life adversity
- Social isolation
- Depression, anxiety
- Hostility
- Loneliness
- Maladaptive coping



# Depression in chronic illness







# Positive psychological wellbeing

**Hedonic /  
affective**

- Feelings or moods such as happiness, sadness, and pleasure

**Evaluative**

- Evaluations of how satisfied people are with their lives

**Eudaimonic**

- Judgements about meaning and purpose in life

Steptoe, Deaton, and Stone  
Lancet, 2015

# Different types of positive wellbeing and mortality

- 6,028 publications screened, 113 evaluated in detail
- 90 studies of initially 'healthy' populations included in meta-analysis
- Follow-up periods of 2 to 20+ years  
52% had follow-up >10 years
- Protective association

Overall hazard ratio:	0.92 (95% CI 0.91-0.93)
Affective/experiential:	0.91 (95% CI 0.86-0.98)
Eudaimonic:	0.93 (95% CI 0.91-0.95)
Evaluative:	0.88 (95% CI 0.83-0.94)

# Enjoyment of life and survival in ELSA

- 9,387 core members of ELSA (aged 50+) followed for 10 years, 7 months
- 2,045 dated fatalities
- Enjoyment of life from CASP19
  - $\frac{3}{4}$  enjoy the things that I do
  - $\frac{3}{4}$  enjoy being in the company of others
- Division into quartiles of enjoyment
- Cox proportional hazards regression







