Ageing: the Biosocial Perspective

September 2021

Andrew Steptoe
Department of Behavioural Science and Health
University College London
http://www.ucl.ac.uk/psychobiology/
Median Age, 2015

The median age divides the population in two parts of equal size: that is, there are as many persons with ages above the median age as there are with ages below the median ages.

Source: UN Population Division (Median Age) (2017)
Note: 1950 to 2015 show historical estimates. From 2016 the UN projections (medium variant) are shown.
Median Age, 2035

The median age divides the population in two parts of equal size: that is, there are as many persons with ages above the median age as there are with ages below the median ages.

Source: UN Population Division (Median Age) (2017)
Note: 1950 to 2015 show historical estimates. From 2016 the UN projections (medium variant) are shown.
Median Age, 2050

The median age divides the population in two parts of equal size: that is, there are as many persons with ages above the median age as there are with ages below the median age.

Source: UN Population Division (Median Age) (2017)
Note: 1950 to 2015 show historical estimates. From 2016 the UN projections (medium variant) are shown.
Global age profile in 2012

UN Population Fund, 2012
Projected global age profile in 2050

UN Population Fund, 2012
Challenges in ageing

- Health issues
  - Living with long-term conditions; increased prevalence of dementia; socioeconomic inequalities; terminal care

- Economic issues
  - Ensuring adequate incomes; costs of health and social care; employment at older ages; transport and access

- Social and psychological issues
  - Maintenance of psychological wellbeing; loneliness and isolation; age discrimination; social / cultural engagement
Biosocial factors and ageing

• Biogerontological and population perspectives on ageing

• Disease vs ageing processes

• Links between mental and physical health outcomes in ageing

• Biosocial processes and health conditions at older ages
Characteristics of ageing - population

- Sensory loss (sight, hearing, taste)
- Declining physical capability
- Disability and impaired activities of daily living
- Cognitive impairment
- Reductions in social / cultural participation
Characteristics of ageing - population

- Sensory loss (sight, hearing, taste)
- Declining physical capability
- Disability and impaired activities of daily living
- Cognitive impairment
- Reductions in social / cultural participation
- Increased risk of CHD, diabetes, cancers, arthritic conditions, frailty, and dementia
Ageing and long-term health conditions

MacNee et al. Eur Respir J 2014;44:1332-1352
Prevalence of multimorbidity by age and deprivation

Cassell et al. Br J Gen Pract 2018
Figure 5.8. Age profile of public health spending in the UK (relative to 30-year-olds)

Institute for Fiscal Studies, 2017
Fauja Singh, retired from marathon running at age 101

David Attenborough
Aged 95
Biosocial factors and ageing

• Biogerontological and population perspectives on ageing

• Disease vs ageing processes

• Links between mental and physical health outcomes in ageing

• Biosocial processes and health conditions at older ages
• Disease vs ageing processes
  ➢ Long-term and life threatening conditions become more common with age (CHD, diabetes, cancers, arthritis, chronic lung disease, etc)
  ➢ What changes at the functional and phenotypic levels are due to ageing per se and to the effects of age-related health problems?
The Metrics of Aging

Functional Aging (impact on daily life)
- Cognitive Function
- Physical Function
- Mood
- Mental Health

Phenotypic Aging (phenotypes that change)
- Body Composition
- Energetics
- Homeostatic Mechanisms
- Brain health

Biological Aging (root mechanisms)
- Molecular Damage
- Defective Repair
- Energy Exhaustion
- Signal/Noise Reduction
• Disease vs ageing processes
  - Long-term and life threatening conditions become more common with age (CHD, diabetes, cancers, arthritis, chronic lung disease, etc)
  - What changes at the functional and phenotypic levels are due to ageing *per se* and to the effects of age-related health problems?
  - Are age-related changes influenced by psychosocial factors?
Biosocial factors and ageing

• Disease vs ageing processes
  ➢ Long-term and life threatening conditions become more common with age (CHD, diabetes, cancers, arthritis, chronic lung disease, etc)
  ➢ What changes at the functional and phenotypic levels are due to ageing per se and to the effects of age-related health problems?
  ➢ Are age-related changes influenced by psychosocial factors?
    Example of socioeconomic status
## Socioeconomic indicators

<table>
<thead>
<tr>
<th>Birth / Childhood</th>
<th>Adolescence</th>
<th>Early adult life</th>
<th>Mid adult life</th>
<th>Older age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental education and occupation</td>
<td>Own education, Parental education and occupation</td>
<td>Own education, Occupational status, income</td>
<td>Occupational status, Income</td>
<td>Accumulated wealth, Income</td>
</tr>
</tbody>
</table>
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
  ➢ Physical capability
  ➢ Sensory function
  ➢ Physiological function
  ➢ Cognitive function
  ➢ Emotional wellbeing
  ➢ Social functioning

Steptoe & Zaninotto
Proc Nat Acad Sci USA, 2020
Changes in walking speed

Changes in physical activity

Adjusted for age, gender, ethnicity, education and long-term conditions
Changes in lung function

Incident poor sight

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

Adjusted for age, gender, ethnicity, education and long-term conditions
SES and 8 year change in...

Enjoyment of life

Incident depressive symptoms

Adjusted for age, gender, ethnicity, education and long-term conditions
Changes in membership of organisations

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

- Biogerontological and population perspectives on ageing
- Disease vs ageing processes
- Links between mental and physical health outcomes in ageing
- Biosocial processes and health conditions at older ages
Mental and physical health at older ages

- Levels of depression and distress are raised in people with chronic diseases of older age.
Depression in chronic illness

Gold et al, 2020, *Nature Reviews Disease Primers*
Mental and physical health at older ages

- Levels of depression and distress are raised in people with chronic diseases of older age
- Multimorbidity associated with higher levels of depression and distress
Mental and physical health at older ages

- Levels of depression and distress are raised in people with chronic diseases of older age
- Multimorbidity associated with higher levels of depression and distress
- Depression and distress can be both a predictor and a consequence of chronic disease
## Depression as a risk factor for incident CHD

<table>
<thead>
<tr>
<th>Meta-analysis</th>
<th>Number of studies</th>
<th>Number of participants</th>
<th>Odds ratio or relative risk (95% CI) of CHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rugulies (2002)(^{31})</td>
<td>11</td>
<td>36,549</td>
<td>1.64 (1.29–2.08)</td>
</tr>
<tr>
<td>Cuijpers &amp; Smit (2002)(^{29})</td>
<td>25</td>
<td>106,628</td>
<td>1.81 (1.58–2.07)</td>
</tr>
<tr>
<td>Wulsin &amp; Singal (2003)(^{33})</td>
<td>10</td>
<td>NR</td>
<td>1.64 (1.41–1.90)</td>
</tr>
<tr>
<td>Nicholson et al. (2006)(^{30})</td>
<td>21</td>
<td>124,509</td>
<td>1.81 (1.53–2.15)</td>
</tr>
<tr>
<td></td>
<td>11*</td>
<td>NR</td>
<td>• 2.08 (1.69–2.55) unadjusted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1.90 (1.48–2.42) adjusted</td>
</tr>
<tr>
<td>Van der Kooy et al. (2007)(^{32})</td>
<td>16(^{‡})</td>
<td>659,991</td>
<td>1.57 (1.36–1.81)</td>
</tr>
<tr>
<td>Gan et al. (2014)(^{34})</td>
<td>30</td>
<td>893,850</td>
<td>1.30 (1.22–1.40)</td>
</tr>
</tbody>
</table>

CHD, coronary heart disease. *Studies that included unadjusted and adjusted analyses. †Includes only those studies of participants without CHD at baseline.

---

Carney & Freedland
2017, *Nature Rev Cardiology*
Depression and disability incidence

6 year incidence of disability among initially non-disabled people aged 65+, independently of age, gender, education, income, and medical conditions. 

Penninx et al, 1999
Mental and physical health at older ages

• Levels of depression and distress are raised in people with chronic diseases of older age
• Multimorbidity associated with higher levels of depression and distress
• Depression and distress can be both a predictor and a consequence of chronic disease
• Depression and distress predict adverse outcomes in chronic diseases of older age
## Depression and mortality in chronic illness

<table>
<thead>
<tr>
<th>Study</th>
<th>N studies</th>
<th>Health condition</th>
<th>Hazard ratio / relative risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinquart, 2010</td>
<td>76</td>
<td>Cancer</td>
<td>1.22 (1.14 – 1.30)</td>
</tr>
<tr>
<td>Atlantis, 2013</td>
<td>7</td>
<td>COPD</td>
<td>1.83 (1.00 – 3.36)</td>
</tr>
<tr>
<td>van Dooren, 2013</td>
<td>16</td>
<td>Type 2 diabetes</td>
<td>1.46 (1.29 – 1.66)</td>
</tr>
<tr>
<td>Sokoreli, 2016</td>
<td>26</td>
<td>Heart failure</td>
<td>1.40 (1.22 – 1.60)</td>
</tr>
<tr>
<td>Meijer, 2011</td>
<td>29</td>
<td>Coronary heart disease</td>
<td>2.25 (1.73 – 2.93)</td>
</tr>
<tr>
<td>Pan, 2011</td>
<td>8</td>
<td>Stroke</td>
<td>1.55 (1.25 – 1.93)</td>
</tr>
</tbody>
</table>

Steptoe, 2018, Handbook of Psychosocial Epidemiology
Mental and physical health at older ages

- Levels of depression and distress are raised in people with chronic diseases of older age.
- Multimorbidity associated with higher levels of depression and distress.
- Depression and distress can be both a predictor and a consequence of chronic disease.
- Depression and distress predict adverse outcomes in chronic diseases of older ages.
- Depression and distress predict disability, while subjective wellbeing may be protective.
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
  - I enjoy the things that I do
  - I enjoy being in the company of others
- Division into quartiles of enjoyment
- Cox proportional hazards regression
Enjoyment of life and survival in ELSA

Deaths
Lowest enjoyment: 31.1%
Second: 23.7%
Third: 18.8%
Highest enjoyment: 10.9%

Age, sex:
HR 0.25 (.21 - .31)

Demographics:
HR 0.29 (.24 - .35)

Baseline health and mobility
HR 0.35 (0.29 – 0.43)

Emotional distress and health behaviour
HR 0.37 (0.31 – 0.46)
Psychosocial factors

Physical illness

Survival
Psychosocial factors

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

Protective factors
- Social connectedness
- Social support
- Positive wellbeing
- Optimism
Biosocial factors and ageing

• Biogerontological and population perspectives on ageing

• Disease vs ageing processes

• Links between mental and physical health outcomes in ageing

• Biosocial processes and health conditions at older ages
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
• Autonomic nervous system

• Neuroendocrine pathways

• Psychoneuroimmunological (PNI) pathways
Otte et al, 2016, Nat Rev Disease Primers
Psychobiological processes and health

A question of balance:

- Reduced activation
- Optimal activation
- Heightened activation
Some effects of cortisol

- Stimulation of glucose production in the liver
- Release of free fatty acids from fat stores
- Regulation of water balance
- Stimulation of anti-inflammatory responses
- Immune regulation
Some effects of high cortisol

Potentially damaging effects

- Increased lipid (LDL-cholesterol) in the blood
- Suppression of immune function
- Decalcification of bone
- Deposition of abdominal fat
- Damage to the hippocampus
- Muscle wasting
- Impaired reproductive function
1. Short-term fluctuations are necessary for responding to the environment
2. Excessive fluctuations can impair regulatory systems
3. This is manifest in progressive failure to maintain levels within normal operating ranges (both resting levels and response patterns)
4. Allostatic load is the cumulative physiological toll across multiple systems

McEwen, 2007
Physiol Rev
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
Psychosocial factors and inflammation

C-reactive protein, Interleukin (IL) 6, tumor necrosis factor (TNFα)

Coronary heart disease, depression, frailty, adiposity, autoimmune diseases, diabetes, trauma, infection
Psychosocial factors and inflammation

C-reactive protein, Interleukin (IL) 6, tumor necrosis factor (TNFα)

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

Heightened inflammation associated with

• Low socioeconomic status, chronic work stress, childhood adversity, social isolation, loneliness, depression
Ferrucci et al, 2018, Circulation Res