Biomarkers, Health, and Subjective Well-Being

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Policy interest in wellbeing

Commission on the Measurement of Economic Performance and Social Progress (Stiglitz commission)

ONS Measuring National Wellbeing Programme

OECD, EU, United Nations

NAS: Panel on Measuring Subjective Well-Being in a Policy Relevant Framework
### Subjective wellbeing

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td>Hedonic / affective</td>
<td>• Happiness, joy</td>
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<tr>
<td>Evaluative</td>
<td>• Life satisfaction</td>
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<tr>
<td>Eudemonic</td>
<td>• Sense of purpose, autonomy, self-realization</td>
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Subjective wellbeing

Physical illness
Subjective wellbeing
Physical illness
Survival
Enjoyment of life and survival in ELSA

- 9,025 core members of the English Longitudinal Study of Ageing (ELSA) aged 50 and over, followed for 9 years, 5 months
- 1,785 dated fatalities
- Enjoyment of life from CASP19
  - I enjoy the things that I do
  - I enjoy being in the company of others
- Cox proportional hazards regression
Enjoyment of life and survival in ELSA

Deaths
Lowest enjoyment: 28.8%
Second: 18.7%
Highest enjoyment: 9.9%

Age,gender:
HR 0.43 (.37 - .51)

Arch Intern Med, 2012
Deaths
Lowest enjoyment: 28.8%
Second: 18.7%
Highest enjoyment: 9.9%

Age, gender:
HR 0.43 (.37 - .51)

+ wealth, education, marital status, employment status, limiting long-standing illness, cancer, CHD, stroke, heart failure, diabetes, chronic lung disease
HR 0.63 (.53 - .75)
Enjoyment of life and survival in ELSA

Deaths
Lowest enjoyment: 28.8%
Second: 18.7%
Highest enjoyment: 9.9%

Age, gender:
HR 0.43 (.37 - .51)

+ wealth, education, marital status, employment status, limiting long-standing illness, cancer, CHD, stroke, heart failure, diabetes, chronic lung disease
HR 0.63 (.53 - .75)

+ depressive illness, elevated symptoms of depression, smoking, physical activity, alcohol intake
HR 0.70 (.58 - .84)

Arch Intern Med, 2012
Hedonic wellbeing and mortality

Positive associations of wellbeing with mortality

• Confounding
• Selective survival before baseline assessment
• Reverse causality
Enjoyment of life and survival in ELSA

Deaths
Lowest enjoyment: 25.2%
Second: 16.7%
Highest enjoyment: 8.8%

Age, gender:
HR 0.45 (.37 - .53)
Wellbeing and survival

Measurement of wellbeing

Rocollected wellbeing
- Standard questionnaire measures

Experienced wellbeing
- Ecological momentary assessment
- Day reconstruction method
Ecological momentary assessment

- 4,732 participants in wave 2 (data from 4,258, 90%)
- Mean age 64.39, range 52 - 79
- Four assessments
  - Waking
  - 30 minutes after waking
  - 7:00 pm
  - Bedtime
- 4-point ratings (1 = not at all; 4 = extremely)
  - Happy, excited, content
  - Anxious, worried, fearful
  - Tired
Deaths
Lowest PA: 7.3%
Second: 4.6%
Highest PA: 3.6%

Age, gender:
HR 0.50 (.35 - .72)

+ demographics & health indicators
HR 0.56 (.38 - .82)

+ depression and health behaviour
HR 0.65 (.44 - .96)

PNAS 2011
Biological correlates of subjective wellbeing

- Sophisticated biological measures
- Control of confounders
- Experimental control
Positive affect and cortisol responses to stress

- Study of 40 women aged 21-45 years
- Measures of emotional state over the previous day collected on 7 evenings
  - Positive emotional style (happy, cheerful, lively, full of pep, calm, at ease)
  - Negative emotional style (sad, unhappy, angry, hostile, tense, on edge)
- Blood pressure, heart rate and cortisol responses to two challenging laboratory tasks
Positive affect and cortisol responses to stress

![Graph showing cortisol levels over time for different levels of positive affect (PA)].

- **Baseline**: Cortisol levels are relatively low.
- **Post-task**: Cortisol levels increase for both higher and lower PA groups, but the increase is more pronounced for lower PA.
- **Recovery**: Cortisol levels decrease over time, but remain higher for lower PA compared to higher PA.

**Legend**:
- Green diamonds: Higher PA
- Red squares: Lower PA

**Note**: PNEC, 2011
Biological correlates of subjective wellbeing

- Reduced cortisol responses to stress
- Quicker BP recovery following stress
Biological correlates of subjective wellbeing

Experimental studies
- Reduced cortisol responses to stress
- Quicker BP recovery following stress

Naturalistic monitoring
- Ecological validity
- Aggregate measures
- Patterns over the day
Saliva sampling
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
Measurement of positive affect

• Sampling every 20 minutes from morning (07:30 – 09:30 start) until evening (22:30) on a working day

• Happiness on 5-point scale:
  1 = very low to 5 = very high
  Divided into 1-3 vs 4-5 (high or very high)

• Proportion of happy ratings (4-5) over the day
Salivary cortisol – working day

8 samples (08:00 – 22:30)
Adjusted for gender, age, occupational grade, smoking, BMI, and GHQ

P = .009

Steptoe et al, 2005 PNAS
Biological correlates of subjective wellbeing

Experimental studies
- Reduced cortisol responses to stress
- Quicker BP recovery following stress

Naturalistic monitoring
- Reduced cortisol output
- Greater heart rate variability
- Lower blood pressure?
Biological correlates of subjective wellbeing

**Experimental studies**
- Reduced cortisol responses to stress
- Quicker BP recovery following stress

**Naturalistic monitoring**
- Reduced cortisol output
- Greater heart rate variability
- Lower blood pressure?

**Epidemiological methods**
Inflammation
C-reactive protein
Interleukin-6
Fibrinogen

Autoimmune disease
Coronary Heart Disease
Obesity
Frailty
Diabetes
Depression
IL-6 and positive affect (women)

Adjusted for age, income, ethnicity, BMI, smoking, waist/hip ratio, employment, CES-D

P = .016

Am J Epidemiol, 2008
Affective wellbeing and inflammation in women

Adjusted for age, marital status, wealth, BMI, smoking status, limiting longstanding illness, arthritis, coronary heart disease, lipid medication, and depression

C-reactive protein (mg/L)
- Low
- Medium
- High

Fibrinogen (g/L)
- Low
- Medium
- High

Affective wellbeing and inflammation in women

Low
Medium
High

Psychosom Med, 2012
Dehydroepiandrosterone sulfate (DHEAS)

- Abundant endogenous ‘anti-ageing’ steroid
- Levels decline with age
- Some evidence for association with
  - Greater longevity in men
  - Reduced depression
  - Improved memory
- But evidence from trials is inconsistent
Wellbeing and DHEAS in men

Adjusted for age, marital status, wealth, BMI, smoking status, limiting longstanding illness, depression, arthritis, coronary heart disease, and lipid medication.

Tertiles of eudemonic and affective well-being
## Biological correlates of subjective wellbeing

<table>
<thead>
<tr>
<th>Method</th>
<th>Correlates</th>
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| **Experimental studies**    | • Reduced cortisol responses to stress
                               | • Quicker BP recovery following stress                                    |
| **Naturalistic monitoring** | • Reduced cortisol output
                               | • Greater heart rate variability                                           |
|                             | • Lower blood pressure?                                                    |
| **Epidemiological methods** | • Reduced inflammatory markers (women)
                               | • Greater DHEAS (men)
                               | • Favourable triglycerides                                                |
Subjective wellbeing and health

- There are bidirectional associations between subjective wellbeing and health
- Poor hedonic wellbeing predicts future health and functional impairments, and greater mortality risk
- Both direct biological and behavioural pathways may be involved
- Effects may be stronger for measures of experienced than recollected wellbeing
- Subjective wellbeing needs to be taken seriously in the health context
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Wellbeing and physical health

Priorities

• What are the causal relationships
• Interventions to test causal links
• Wellbeing → biology → health
• Types of wellbeing
• Understand importance of wellbeing in the broader context
Wellbeing and physical health

- Psychological wellbeing is multifaceted
- Relationship with physical health is bidirectional
- Psychological wellbeing is associated longitudinally with physical health outcomes
- Behavioural and biological processes may be involved
- Causal sequence has yet to be established
Measures in wave 5 of ELSA

- **Hedonic / affective**
  - Happiness, joy

- **Pleasure / enjoyment items from CASP19**
  - I enjoy the things I do
  - I enjoy being in the company of others

- **Positive affect scale from HRS**
  - 13 items on 4-point scales
  - Eg happy, enthusiastic, interested

- **CESD depression**
Psychological wellbeing

**Evaluative**
- Life satisfaction

**Diener SWLS**
- 5 item scale
- Eg I am satisfied with my life
Psychological wellbeing

**Eudemonic**
- Sense of purpose, autonomy, self-realization

**CASP19 items**
- I feel that my life has meaning
- I choose to do things that I have never done before
- I feel that what happens to me is out of my control (reversed)
Psychological wellbeing and health outcomes

- Wellbeing and the prediction of the development of health problems and disability over 6 years
- Wave 2 (2004/5) assessments of wellbeing and baseline function
- Development of impaired activities of daily living, reduced walking speed, impaired cognitive function, poor self-rated health and coronary heart disease in wave 5 (2010/11)
- Adjustment for age, sex and wealth
Wellbeing and new ADL disability

**Affective wellbeing**

- Low: 6%
- Medium: 4%
- High: 0%

**Life satisfaction**

- Low: 6%
- Medium: 2%
- High: 2%

**Adjusted OR**

- Medium: 3.04 (1.58 – 5.84)
- Low: 4.10 (2.17 – 7.74)

- Medium: 0.92 (0.58 – 1.47)
- Low: 1.68 (1.05 – 2.69)
Wellbeing and incident CHD

Affective wellbeing

Adjusted OR
Medium 1.40 (0.99 – 1.98)
Low 1.70 (1.23 – 2.36)

Life satisfaction

Adjusted OR
Medium 1.19 (0.88 – 1.63)
Low 1.30 (0.94 – 1.79)
Wellbeing and gait speed

**Affective wellbeing**

- Low
- Medium
- High

**Life satisfaction**

- Low
- Medium
- High

**Regession coeff**
- Medium: -0.05 (-0.07 – -0.02)
- Low: -0.05 (-0.07 – -0.03)

**Adjusted OR**
- Medium: -0.01 (-0.03 – 0.02)
- Low: -0.01 (-0.04 – 0.02)