Longevity evolution: international comparisons and future prospects. Analysis of Asia data

Dr Daria Ossipova
Head of R&D, Life related risks, SCOR Global Life

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Life expectancies have been diverging until 1950. Since then we observe a convergence to best-practice levels from the countries with low life expectancy but a divergence from those at the top of the distribution of the world population.

Source: Jim Oeppen (2006)
Mortality evolution: changing drivers

**Historical demographic regimes** (Europe: up to mid-XVIII century)
- Prevalence of infectious diseases
- Significant fluctuations due to epidemics, famines (bubonic plague - mid. XIV century)
  - High mortality

**Receding of infectious pandemics** (Europe: mid-XVIII century – beg. 1960’s)
- The epidemics become rare
- Infectious diseases back off
- Mortality declines, fluctuations decrease

**Cardio-vascular revolution** (Europe: from 1970s)
- Reduction infectious diseases contribute little to the increase of life expectancy
- Cardio-vascular diseases become the main driver of mortality decrease
- Society diseases make less deaths

**A new stage?** (mid 80-s + )
- Mortality reductions at increasingly older ages
- Treatment and prevention of cerebrovascular diseases
- Greater attention paid to the health of the elderly

A new stage? (mid 80-s + )
Evolution of best practice life expectancy

Period of stagnation
- Abundant agricultural and food production, smallpox vaccine

1750–1800
- $y = 0.005x + 29.956$
- $R^2 = 0.0014$

1800–1850
- Abundant agricultural and food production, smallpox vaccine

1850–1885
- $y = 0.1172x - 169.52$
- $R^2 = 0.7751$

1886–1960
- Pasteurization, spread of education, implementation of social insurance systems, antibiotics
- $y = 0.324x - 558.77$
- $R^2 = 0.9845$

1960–2005
- Cardiovascular revolution
- $y = 0.2269x - 369.42$
- $R^2 = 0.9877$

Cerebrovascular progress? Cancer cure?
Evolution of life expectancy – international comparison

Females
Life expectancy between 65 and 79 years of age

Females
Life expectancy at age 65
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Heterogeneity of life durations: age at death distribution

Switzerland:
1876-1880, 1929-1932, 1988-1993

Source: Cheung, Robine, Paccaud, 2005
Evolution of survival curve

1. Rectangularisation and mortality compression

2. Shifting mortality scenario - delay of ageing

3. An extension of limiting age and “de-rectangularisation”
Impact on the insurance industry

1. Rectangularisation
   - nearly no uncertainty as to the duration of human life:
     - pure saving products instead of insurance products;
   - possibly demand for accidental death cover or long term care protection in case the standardisation of human life durations is not accompanied by the standardisation of healthy life durations

2. Shifting mortality scenario
   - continuing uncertainty in the individual’s life duration and longer life spans:
     - demand for protection products at increasingly older ages
     - increasing demand for annuities and long-term care products
   - greater heterogeneity in life durations; a number of persons surviving much longer than average:
     - longevity insurance business facing a major shock
     - demand for protection products at increasingly older ages
     - increasing demand for annuities and long-term care products
     - depending on whether the longer life is predictable (ex. genetic predisposition) new insurance products might emerge

3. De-rectangularisation
From compression of mortality towards a shifting scenario?

Distribution of ages at death for women in Japan, 1950-54 to 2000-04, HMD data

Source: Cheung, Robine

Changes in the distribution of age at death:

- Modal age at death \( M \)
- Standard deviation of ages at death above the mode \( SD(M+) \)

Compression or/and shifting mortality scenario?
Many countries studied (Cheung, Robin\(^1\) et al.; recently Ouellette & Bourbeau\(^2\))

\( M \) is continuously increasing in all low mortality countries!

SD(M+) still decreasing for some populations \(^1,2\)

Stagnation of SD(M+) in Japan (since 1980-90) \(^1,2\), and for French, Canadian, US women recently \(^2\)

Individual life durations ending above the mode are compressed into a smaller age range above the mode, relative compression of mortality

The whole distribution of individual life durations ending above the mode is sliding proportionally to higher ages, shifting mortality scenario
Life durations in Japan: situation 2005

Shift to the right: people are living longer, same number of people survive to the modal age, which is increasing

Source: JM Robine, Longevity 11, 2015
Life durations in Japan: situation 2010, back to the relative compression

Source: JM Robine, Longevity 11, 2015
Life durations in the United States: Widening socioeconomic differences

- Life expectancy has risen markedly in the United States over the past century.
- According to the last report published by the National Academies of Sciences, Engineering, and Medicine (2015), five decades ago, average U.S. life expectancy was 67 years for males and 73 years for females. The averages are now 76 and 81, respectively.
- These increases have not been equally shared across the U.S. population.
- Longevity advantage for higher of socioeconomic status groups has been well established in the literature.
- Number of studies have found that the gradient in life expectancy by education and income has become steeper.
- These differentials between higher-income individuals and those lower on the socioeconomic distribution have been expanding.

Estimated and projected life expectancy at age 50 for males (left panel) and females (right panel) born in 1930 and 1960, by income quintile. SOURCE: National Academies of Sciences, Engineering, and Medicine (2015).

Shift to the right and the bell is *lower*: some people are living longer, and *less* people survive to higher ages.
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Colon cancer example: testing the survival improvement over time (USA data)

More than 7% improvement between 1988 and 2010

Survival

1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6

years

1973-1988
1988-1998
1999-2010

74.4%
69%
Colon cancer example: What about metastatic disease?

Progress in metastatic disease: new techniques in surgery, radiotherapy, supportive care, drugs, multidisciplinary care

Progress in treatment (x2 survival after 10 years)
Comparison of survival curves for colon cancer: example 2

For colon cancer screening programs result in earlier detection and larger proportion of lighter stages with higher survival rate.
Precision Medicine: The Future of Cancer Care?

Precision Medicine can be implemented at each stage of patient care:

- **Prevention**: Identify at risk groups and target prevention
- **Diagnosis**: Detect disease at an earlier stage when it is easier to treat
- **Treatment**: Optimize therapies and reduce adverse reactions

**Improve health-related outcomes**
Cancer Incidence Worldwide

Estimated age-standardised incidence rate per 100,000
All cancers excl. non-melanoma skin cancer: both sexes, all ages

GLOBCAN 2008 (IARC) - 21-10-2013
Global Death Toll From Cancer

Estimated age-standardised mortality rate per 100,000
All cancers excl. non-melanoma skin cancer: both sexes, all ages

GLOBOCAN 2008 (IARC) - 21.10.2013
Cancer Burden in Asia

- In 2008: 6.1 million new cases, 4.1 million deaths (55% men)
- Prevalence of 11.6 million

- **Male:** Lung > stomach > liver > colon-rectum > oesophagus
- **Female:** Breast > cervix uteri > lung > stomach > colon-rectum

- Risk of getting cancer before age of 75 is 18% for men and 14.1% for women and risk of dying respectively 13.2 and 8.7%
Cancer Burden in Asia

- **World**: 12.6 million new cases
  7.6 million deaths
  28.8 million prevalence

- **Asia**: 6.1 million new cases 48%
  4.1 million deaths 55%
  11.6 million prevalence 40%

- **NB**: World population 7.058 billions Asia 4.2 billions 59%

- In most of the Asian countries, cancer of the colon & rectum is the most common among male cancer **survivors**, it is third for women after breast and cervix cancer.
## 5 year cancer survival, some comparisons

<table>
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<tr>
<th>Coverage of the population</th>
<th>Average 5Y Survival</th>
<th>Country</th>
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<tbody>
<tr>
<td>83%</td>
<td>65%</td>
<td>USA</td>
</tr>
<tr>
<td>91%</td>
<td>64%</td>
<td>Australian registries</td>
</tr>
<tr>
<td>100%</td>
<td>63%</td>
<td>NZ</td>
</tr>
<tr>
<td>18%</td>
<td>63%</td>
<td>French registries</td>
</tr>
<tr>
<td>100%</td>
<td>61%</td>
<td>Canada</td>
</tr>
<tr>
<td>29%</td>
<td>55%</td>
<td>Japanese registries</td>
</tr>
<tr>
<td>100%</td>
<td>53%</td>
<td>UK</td>
</tr>
<tr>
<td>100%</td>
<td>50%</td>
<td>Korea</td>
</tr>
<tr>
<td>4%</td>
<td>50%</td>
<td>Indonesia (jakarta)</td>
</tr>
<tr>
<td>100%</td>
<td>45%</td>
<td>Taiwan</td>
</tr>
<tr>
<td>5%</td>
<td>43%</td>
<td>Malaysia</td>
</tr>
<tr>
<td>1%</td>
<td>35%</td>
<td>Indian registries</td>
</tr>
<tr>
<td>3%</td>
<td>35%</td>
<td>Chinise registries</td>
</tr>
<tr>
<td>6%</td>
<td>29%</td>
<td>Thai registries</td>
</tr>
<tr>
<td>100%</td>
<td>18%</td>
<td>Mongolia</td>
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Source: CONCORD-2
5 year cancer survival, some comparisons

- Cancer epidemiology is very different from one country to another:
  - Cancers that are difficult to cure are more frequent in Asia…
  - Poor countries have very low survival rates for all cancers….
Differences in cancer mortality: some possible explanations

- **Cancer survival:**
  - Access to medical care
  - Better detection (screening programs)
  - Distribution per cancer site

- **Incidences:**
  - Behavioral (smoking, obesity, …)
  - Environmental
  - Genetic predisposition
  - Ageing
Conclusion

- Continuing progress in life expectancy, but at different pace for different countries
- Different situation for the dynamics of the disparities in life durations
- Countries that have increasing disparities in life durations progress slower
- Future progress is linked to health expenditure and access to health care – but also to behavioural and environmental factors
- The need for old age protection and pensions will stimulate the demand for private coverage, especially in the case of government’s partial disengagement.

- The demographic future is going to be very different to what we have seen in the past, and it will have profound implications on society. The balancing act between insurance and the state’s social provision for the elderly is going to become an extremely important dynamic going forward in addressing the insurance needs of the older age population.
Thank you for your attention!
## Trends in Life Expectancy in the United States: Widening socioeconomic differences II

<table>
<thead>
<tr>
<th>References</th>
<th>Findings</th>
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</thead>
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<tr>
<td><strong>County Level</strong></td>
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</tr>
</tbody>
</table>
| Singh and Siahpush (2006) *Widening socioeconomic inequalities in U.S. life expectancy, 1980-2000*. International Journal of Epidemiology, 35, 969-979 | • In the lowest decile counties, life expectancy increased by only 1.7 years, while for the highest decile it increased by 3.4 years  
• The gap between the two rose from 2.8 to 4.5 years from 1980 to 2000 |
| **Education** | |
| Olshansky et al. (2012) *Differences in life expectancy due to race and educational differences are widening, and many may not catch up*. Health Affairs, 31(8), 1803-1813 | • Life expectancy at birth among white man with fewer than 12 years of education decline by more than 4 years, while that for comparably educated white women fell by more than 5 years  
• Life expectancy at birth between males with less than 12 years of education and those with more than 16 rose from 13.4 years in 1990 to 14.2 years in 2008, while for females the comparable increase was from 7.7 to 10.3 years |
• Clear evidence for increasing dispersion of survival probabilities between those in the bottom and top of the educational distribution |
• No evidence that the gradient among males has not changed |
| Meara et al. (2008) *The gap gets bigger: Changes in mortality and life expectancy, by education, 1981-2000*. Health Affairs, 27(2), 350-360 | • Although socioeconomic status differences in mortality were rising, mortality differences across sexes and races were falling  
• Difference in life expectancy at age 25 between high- and low-education black males (for 12 or fewer years of education versus at least 13 years of education) was 8.4 years, and between high and low education white males the difference was 7.8 years. For black and white females, the corresponding difference was 5.4 years. Each of these differences had increased substantially since 1990, by 1.3 to 1.9 years |
# Trends in Life Expectancy in the United States: Widening socioeconomic differences III

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<td><strong>Income</strong></td>
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• The gap in life expectancy between high-earning males and low-earning males is projected to expand from 4 years to 13.6 years |
| Waldron (2007) *Trends in mortality differentials and life expectancy for male Social Security-covered workers, by socioeconomic status*. Social Security Bulletin, 67(3), 1-28 | • Life expectancy difference at age 60 for males between the top and bottom half of the earnings distribution is 1.2 years for the 1912 cohort, rising to 5.8 years for the 1941 cohort.  
• The bottom half of the earnings distribution was estimated to gain 1.9 years of life expectancy between the 1912 and 1941 birth cohorts, while the top half was estimated to gain 6.5 years of life |
| **International comparisons** |          |
| Manchester and Topoleski (2008) *Growing Disparities in Life Expectancy*. Congressional Budget Office Economic and Budget Issue Brief, April 17. Available: [http://www.cbo.gov/publication/41681](http://www.cbo.gov/publication/41681) | • The difference in life expectancy across socioeconomic groups is significantly larger now than in 1980 or 1990. A similar trend is observed in Great Britain but not in Canada |
• The difference in male life expectancy at birth between the most and least advantaged classes rose from 4.9 years in 1982–86 to 6.2 years in 1997–2001  
• For female life expectancy, no significant difference between any of the estimates of range in life expectancy across the classes between 1982–86 and 2002–06, and no sign of any narrowing of the range in 2002–06 |