Healthy Life Expectancy, Mortality, and Age Prevalence of Morbidity

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Is variation in health over the lifespan better characterized by chronological age or time-to-death?
Expected life years with disability (DLY): Sullivan Method

$$DLY = \frac{1}{\ell_0} \sum_{x=0}^{\omega} \pi_x L_x$$
But what is $\pi_X$ exactly?

- **Disability prevalence at each age**
  - Stock variable: slow to react to abrupt health innovations since it depends on past cohort experiences with sickness (Barendregt et al. 1994)
  - Can also depend on future mortality if disability is patterned by time-to-death
  - Since $\pi_X$ changes across mortality regimes, attributing between-population differences in DLY to mortality and morbidity is problematic.
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A simple illustration
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Disability broken down by age and time to death

Proportion of USA males from the 1915-1919 cohort with at least 1 of 5 IADLs
Proportion disabled by TTD and mortality level

Steep TTD Disability

Med TTD Disability

Gentle TTD Disability

Death density

Age

Proportion disabled

Time to Death

Age

Proportion disabled

Time to Death

Age

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Decomposing DLY

- Are differences in DLY from mortality or morbidity?
  - Decomposition methods isolate the effects of changes in $L_x$ and changes in $\pi_x$.
  - These are considered as mortality and morbidity effects (Nusselder and Looman 2004, Andreev et al. 2002).
  - Interpretation problem: mortality can change $\pi_x$ all by itself if disability is patterned by time-to-death.
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Estimating the upper magnitude of bias of morbidity differences from mortality decline

- Estimated average TTD profile for different disability types, based on USA HRS data, quinquennial cohorts 1905-1930
- Calculated apparent period age prevalence of morbidity for HMD countries had they experienced the US TTD morbidity
- Assumed all populations were stationary
- Decomposed differences between all population pairs in 1980, 1990, 2000 into apparent mortality and morbidity components
- Same for within-population changes over 10-year periods, 1950-2010
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TTD disability prevalence for different disability types

- ADL ≥ 1 of 5
- ADL ≥ 2 of 5
- ADL ≥ 3 of 5
- In nursing home
- Poor self-rated health
- Unable to name month
Decomposition: Change in disability component

![Graph showing change in disability component for different ADL Disability levels.]{:width=1500px}
Interpreting decomposition results

- True value of the change in disability component is zero by design
- Deviation is result of differences in mortality
- Departure from upper bound depends on patterns of $\pi_x$, how well US pattern applies, departure from stationarity.
- Different slopes partly from differences in final $\pi_x$ between disability types and the sexes
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Considerations

- Considering morbidity prevalence as a function of time to death does not imply that morbidity incidence is a time to death.
- Modeling prevalence as TTD requires no specification of process.
- In reality morbidity varies over both chronological age and time-to-death.
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- In reality, morbidity varies over both chronological age and time-to-death.
Summary

- HLE or DLY provide an important snapshot of expected life years lived in good or poor health
- Difficulty in interpreting period differences in these quantities between populations
- Chronological age pattern of disability can change solely as a function of mortality change even when the underlying morbidity function is held constant
- Could partly explain why mortality levels and disability prevalence are related (Van Oyen et al. 2013, Luy and Minagawa 2014)
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Thanks!