Trends in Cause-Specific Lifespan Variation in the U.S. and Canada

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BACKGROUND
Lifespan variation depends greatly on the distribution of deaths across the entire age range:
- More dispersed deaths resulting in higher/lower variability in age at death.

Variation in length of life measured notably by:
- Mean-based indicators: \( M, S_d, S_m \)
- Mode-based indicators: \( SD(M_x), SD(M) \)
- Percentile-based indicators: \( IQ(R), C-family \)

Recently, \( SD(M) \) became an attractive measure for monitoring changes in distribution of deaths.

Increased survival to advanced ages in past decades led to substantial modifications in the age-at-death distribution:
- Notably reflected by a reduction of variability in old age mortality, measured by \( SD(M) \).

Increasing dispersion of deaths at older ages is possibly an aggregate of various mortality schedules by cause of death:
- Lifespan variation analyzed along a cause of death dimension is desirable.

STUDY OBJECTIVES
For each sex, we estimate variability in age at death for leading causes in U.S. and Canada to:
1. Identify the causes for which deaths are more concentrated in a narrower age range.
2. Examine trends in cause-specific lifespan variation since the mid-1970s.

DATA AND METHODS

Trends in \( SD(M) \) for U.S., females aged 70 and above, 1974-2011:

- Decreased variability hints at a younger age distribution of deaths.

Poisson P-spline smoothing of cause-specific mortality:

- Smooth cause-specific density functions \( \delta(x) \) for cause \( c \), describing the age distributions of deaths are:
  - Obtained by a nonparametric P-spline technique (Davis and Ruppert, 1998).
  - Adapted to the context of cause-of-death analysis (Diaconu et al., under review).

For each sex, we estimate variability in age at death for leading causes in the U.S. and Canada to:
1. Identify the causes for which deaths are more concentrated in a narrower age range:
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RESULTS

Leading causes of death in the U.S. differ greatly in terms of variability at older ages:

- Males:
  - Variance of cause-specific lifespan distributions for five leading causes among males in the U.S. and Canada, 1974-2011:
    - Heart disease shows a faster pace of decrease than any other cause.
    - Older-age compression of deaths for the three types of cancers was slow until the mid-1980s, but accelerated afterwards.
    - The spread of deaths at older ages is high for lung cancer, and low for prostate cancer and cerebrovascular diseases.

- Females:
  - Variance of cause-specific lifespan distributions for five leading causes among females in the U.S. and Canada, 1974-2011:
    - Lung and breast cancers exhibit the largest reduction of variability in age at death.
    - Pace of decrease for heart diseases, cerebrovascular diseases, and colorectal cancer has been very slow since the mid-1970s.
    - Older-age dispersion of deaths is high for breast cancer and low for cerebrovascular diseases (and heart diseases lately).

CONCLUDING REMARKS

Few studies have focused on differences in cause-specific age-at-death distributions.

Our analysis of the variation in these distributions at older ages reveals that:
- Inequality in the age at death has narrowed markedly since 1974 for most leading causes of death in the U.S., as a result of important medical progress (treatment and prevention).
- More rapid compression of deaths for heart diseases, as well as for breast and lung cancer since the early 1990s.

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