Extended abstract

How do cohorts change?
Selective mortality across cohorts born in the 1920's-1950's in the US and Finland

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Research question

A birth cohort is a collection of individuals born at a similar point in time. Sadly, a cohort begins losing members due to death from its inception—a process which continues until the cohort's last member dies. However, which members die when is not random. Instead, individuals with certain characteristics face greater mortality risks throughout their lives than do others—a phenomenon known as selective mortality. Social science research typically considers selective mortality an inconvenience, as it can bias results that condition on survival to older ages. The legacy of selective mortality, however, is in itself telling about the experiences of a cohort. Despite this, little is known about how the composition of a cohort changes across its lifetime as a result of mortality selection, or whether the force of selection has changed across cohorts.

One example of a cohort characteristic that might change with age is the distribution of educational attainment within a cohort. Since individuals with lower levels of educational attainment face greater mortality risks, a cohort's mean level of educational attainment should be expected to increase over time. The rate at which this occurs is a measure of the force of mortality selection. Differences in this force across cohorts reflect not only the prevailing mortality conditions by educational attainment during a cohort's lifetime, but also changes in the availability of formal education.

Work by Zajacova and Burgard (2013) finds that selective mortality indeed results in healthier, wealthier, and more educated cohorts at older ages. Our paper extends this work using more cohorts, a longer follow-up period, and Finnish data, enabling cross-cohort and cross-country comparisons. We ask how the force of mortality selection changes across a cohort's lifetime, how the force changes across cohorts, and how these answers vary by country context. We compare 5-year birth cohorts born between 1920-1959 in the United States and Finland. We

consider changes in several characteristics associated with differential mortality, including sex, educational attainment (own and parental), having ever smoked cigarettes, and—where appropriate—race/ethnicity.

Data and research methods

We examine selection within and across eight 5-year birth cohorts (1920's-1929,…,1955-1959) in the United States, Finland, and Sweden. We use surveys or censuses with mortality follow-up to follow members of each birth cohort until death or censoring. For the United States, we use data from the National Health Interview Survey (NHIS). The NHIS is a nationally-representative and annual cross-sectional health survey whose respondents are matched to death records through 2015. We use the NHIS to follow the birth cohorts listed above beginning in 1986, the earliest year for which cross-sectional surveys have been linked to death records.

For Finland, the data is based on census and population registration data that covers the total population permanently residing in Finland during the censuses of 1970, -75, -80, -85 and at the end of years 1987–2017. The data is obtained from the longitudinal population data file of Statistics Finland and is linked to an exhaustive database of death certificates from 1970 onwards via unique personal identification numbers.

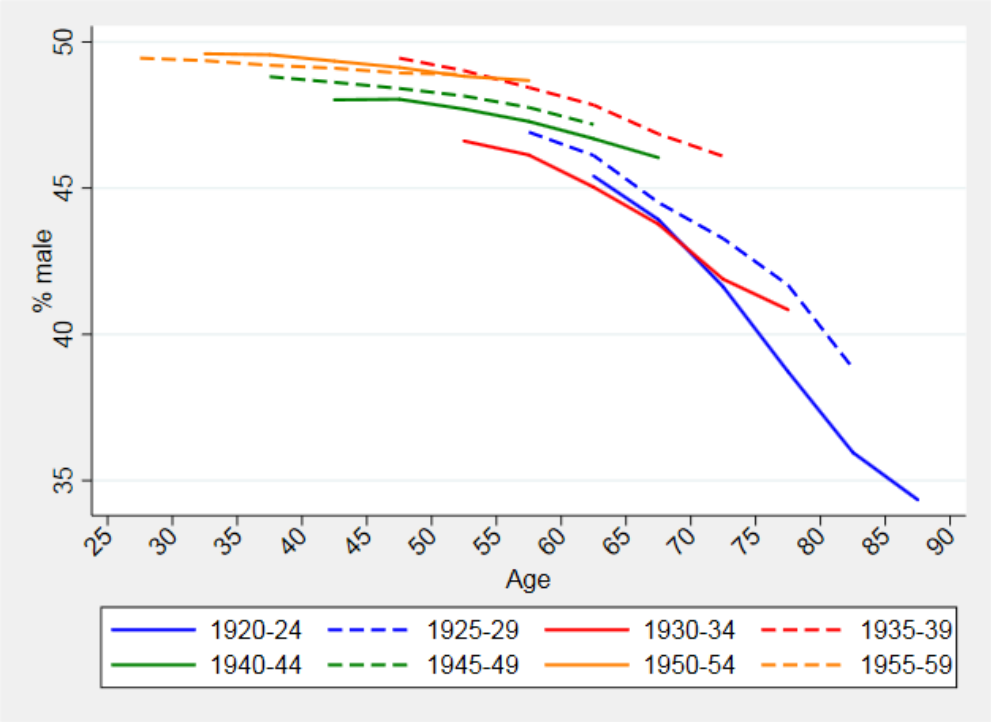
Using information on when a respondent died, we consider how several characteristics of a cohort change as a cohort ages, including sex, own and parental educational attainment, having ever smoked, and race/ethnicity in the United States. While some of these characteristics (own educational attainment, having ever smoked) are achieved rather than ascribed, they are generally fixed by mid-adulthood. We interpret the age-specific slopes of a line graphing the percentage of the cohort with at least a bachelor's degree across age as the fore of selective

mortality. We compare the slope across age to examine Question 1 and compare the slopes across cohorts to answer Question 2.

Preliminary results

As a cohort ages, it becomes more female. Figure 1 plots the percentage of U.S. cohorts that is male, across age. Despite a sex ratio at birth of 105 males to 100 females, females in the plotted cohorts outnumber males by the time they reach age 30. By age 60, there are 90-95 men for every 100 women in the observed cohorts. Sex-selective mortality due to World War II likely contributes to the especially-low percentage of surviving males for cohorts born in the 1920's. By the time those born in the first half of the decade reach age 80, there are 70 men for every 100 women. As compared to those born just 5 years later, the 1930-34 cohort also has a notably low proportion of adult males. Although too young to have fought in the war, this cohort was exposed to the Great Depression *in utero* and as young children, the mortality consequences of which may have been greater for males than females (Eriksson, Kajantie, Osmond, Thornburg, & Barker, 2010).

Figure 1. Percentage of birth cohort that is male, across age: United States.



Source: NHIS, 1986-2015. Weighted results.

Figure 2 plots the sex-specific percentages of cohort members in the United States that have at least a bachelor's degree, across age. The figure includes data for the age and cohort combinations available in the 30-year period, with separate lines for each 5-year birth cohort. The expansion of educational attainment is evident in the figure, for both men and women. With the exception of the 1950's cohort, a greater percentage of more recent cohorts have received a college degree than preceding cohorts had at the same age. Sixty-year olds born in 1945-1949, for example, are more than twice as likely to have a college degree than 60 year-olds born just 25 years earlier, in 1920-24 (15% vs 35%).

Among males, the percentage with a college degree clearly increases with age. While 23% of men born between 1930-1934 had a college degree at age 50, 30% of that same cohort was college-educated by the time the men reached age 75. As a result of many years of mortality selection, some older cohorts are, on average, more educated than more recent cohorts, despite

the recent increased availability of college education. In 2015, 80-year old males were 5 percentage points more likely to have a college degree than 50-year olds (28% vs 23%). Among women, the force of selective mortality by educational attainment is much more muted, suggesting that educational attainment is less closely tied to mortality for women.

Figure 2. Percentage of cohort with at least a BA degree, across age and by sex: United States.

Source: NHIS, 1986-2015. Weighted results.

Next steps and implications

We next plan to estimate similar graphs for cohorts' racial composition, as well as the proportion of each cohort that has ever smoked (and then repeat similar steps using the Finnish data). We plan to report age-specific slopes for each cohort characteristic in one comprehensive table.

Results will have both practical and empirical implications. In addition to providing estimates of how select analytic samples of older adults might be, the findings will challenge the notion of cohorts as static and monolithic entities.

References

Eriksson, J. G., Kajantie, E., Osmond, C., Thornburg, K., & Barker, D. J. P. (2010). Boys Live Dangerously in the Womb. *American Journal of Human Biology*, *22*(3), 330-335. doi:10.1002/ajhb.20995

Zajacova, A., & Burgard, S. A. (2013). Healthier, Wealthier, and Wiser: A Demonstration of Compositional Changes in Aging Cohorts Due to Selective Mortality. *Population Research and Policy Review, 32*(3), 311-324. doi:10.1007/s11113-013-9273-x