Bridging Morbidity and Mortality: Analysis of Mortality by Disability and Interrelated Causes of death using Czech administrative data

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Morbidity over a lifetime increases frailty, meaning that individuals with chronic diseases face different mortality risks compared to the general population. Mortality disparities across morbidities, as well as the number of years lived in good health or without disease, are often assessed using survey data. Since individuals with poorer health are less likely to respond to surveys, disease-free life expectancy may be overestimated. In this study, we use data from the Czech Health Registry for the period 2014-2024, along with mortality data based on multiple causes of death from Czechia, enabling us to work with non-self-reported data and better coverage. We employ the Sullivan method to calculate disease-free life expectancy. According to administrative data, Czechs, on average, live 65% of their lives without chronic diseases. The average duration of life before the onset of major chronic diseases ranges from 70 years for chronic obstructive pulmonary disease (COPD) to 78 years for dementia. Comparing these figures to the life expectancy of individuals who ultimately die from leading chronic conditions, we find that people live nearly 10 years with COPD or dementia, and around 6-7 years with cardiovascular disease. The second part of our research examines the role of contributing causes of death in the mortality process. We find that many of these contributing causes are directly related to the underlying cause of death and play a significant role in differentiating lifespan.

Diversity in Causes of Death: A New Approach Using Multiple Causes of Death Life Tables,

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The distribution of causes of death has become more diverse in low-mortality countries, with potential public health implications. Most studies of cause diversity focus on underlying causes of death, disregarding other causes present on death certificates, and thus potentially underestimating cause diversity. In this study, we present a multiple causes of death (MCoD) life table to examine two key dimensions of cause diversity: richness and evenness. Richness refers to the number of causes contributing to death, while evenness relates to the relative abundance of these causes within a population. Evenness can be quantified with common diversity indices, such as Shannon entropy and the Simpson index. We test two different approaches to quantify evenness with MCoD data: one where we consider all causes as part of the mortality process, regardless of their position on the death certificates, and another where we assume that each underlying cause of death is

accompanied by its own set of contributing causes, each with specific diversity. Both approaches yield similar levels and trends. Our results show that, in the U.S. between 2006 and 2021, causes of death have become more diverse over time due to both an increase in the number of contributing causes and a more complex distribution of causes of death. Analyzing MCoD data reveals greater cause diversity than focusing solely on the underlying cause. All indices used in this analysis are decomposable, enabling us to understand the factors driving the increase in diversity. Our findings reveal that increases in both richness and evenness are partly due to a shift towards underlying causes of death with more complex and numerous contributing causes. This increase in diversity indices can largely be explained by a decline in mortality from diseases of the circulatory system, redistributing their share of deaths towards various other causes.

Smoothing trends and seasonality in short-term mortality forecasting

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Excess mortality, i.e., the difference between expected mortality and observed mortality, is used to quantify the death toll of mortality shocks, such as epidemics and pandemics of infectious diseases. Predictions of expected mortality are sensitive to model assumptions. We analyse which specification of a Poisson regression for seasonal mortality in the short term, i.e., 1 to 3 years, yields more accurate predictions. We compare the Poisson Serfling model with 1) parametric effect for the trend and seasonality, 2) non-parametric effect for the trend and parametric effect for the seasonality, and 3) non-parametric effect for the trend and seasonality, also known as modulation model. Forecasting is achieved by combining modulation models with P-splines smoothing for missing data. We applied the models to monthly deaths by sex and age groups from national statistical offices in three European countries (Denmark, Spain, Sweden) from 2000 to 2019. An application to the COVID-19 pandemic years illustrates how excess death can be used to evaluate the vulnerability of populations and aid public health planning. The results show that the model with smooth trend and seasonal component (MM) better fit the historical time series of death rates, followed by the model with smooth trend and fixed seasonal component (ST). However, the model with smooth trend and fixed seasonal component (ST) produces more accurate predictions of the expected deaths, indicating that a model with smooth seasonal component may overfit the data. Therefore, accounting for demographic changes by considering smooth trends over longer reference time periods and across age groups is important for reliable estimates of expected deaths. Our short-term mortality predictions come with prediction intervals, and the widths of the confidence intervals indicate the level of uncertainly associated with the forecast.