Time Trends of Mortality and Morbidity for US Older Adults

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INTRODUCTION

Determining the prevailing trends in the health and mortality in the growing U.S. elderly population is a major concern for public health professionals, economists, policymakers and government institutions. Identification of time trends of mortality and morbidity with sufficient precision requires a large population-based database that is costly to collect. Studies based on existing observational data, such as the Medicare Files of Service Use (MFSU), which collect administrative health data for the entire Medicare-eligible population in the U.S., could provide a reasonable alternative. The growth of the Medicare-eligible elderly population and the associated rising costs in health expenditures to the U.S. healthcare system makes the development of approaches for analyses of Medicare data and their application to the discovery of substantive bio-demographic results well-timed, especially given the relative scarcity of such comprehensive and representative analyses at a national level.

This study addressed this gap in knowledge with four specific tasks. First, we use four nationally representative datasets to evaluate the time patterns of age-specific and age-adjusted mortality. Second, we use the Medicare information from three of these datasets to evaluate time patterns of incidence and prevalence of common among the older adult diseases. Third, the identified patterns of disease incidence and prevalence were used to explain the observed mortality trends. Fourth, we project the time series for mortality, incidence, and prevalence for the near future using the Lee-Carter approach and several recent generalizations.

Data

Four datasets with the capabilities for estimation of the older adult population at the national level are used in this study: i) the Human Mortality Database, ii) the Health and Retirement Study linked to Medicare Files of Service Use (MFSU), iii) the Surveillance, Epidemiology, and End Results Registry data also linked to MFSU (SEER-Medicare), and iv) the U.S. 5%-Medicare data (5PCT). In all three Medicare-linked datasets Medicare records are available for each institutional (inpatient, outpatient, hospice, or home health agency) and non-institutional (carrier-physician-supplier and durable medical equipment providers) claim type.

The SEER-Medicare was the primary dataset analyzed in this study. The expanded SEER registry covers approximately 26% of the U.S. population. The SEER-Medicare includes data on two groups of individuals: those diagnosed with skin melanoma (n=101,123), breast (n=353,285), colon (n=222,659), lung (n=342,961) and prostate (n=448,410) cancers, and a random 5% sample of Medicare beneficiaries residing in SEER areas who had none of the above-mentioned diseases. The total SEER-Medicare sample consisted of 2,154,598 individuals. Unlike the other datasets used in this study, the population in the SEER-Medicare data is representative of the population of SEER areas only; therefore, SEER represents the U.S. general population only approximately. Even so, the age and sex distribution of the total SEER population is similar to non-SEER areas, though SEER areas have less whites, more urban residents, and less areas with low socio-economic status compared to non-SEER areas.

The HRS is a national longitudinal dataset that is fielded every other year starting in 1992. It collects data on a battery of demographic and socio-economic factors, income, employment, health insurance, physical

and cognitive functioning, and health-related behaviors. Originally, HRS surveyed persons aged 51-61 and their spouses/partners who could be of any age. In 1998, the Aging Dynamics of the Oldest-Old (AHEAD), a survey of persons aged 70+ conducted in 1993 and 1995, was combined with the HRS. Beneficiaries who were under the age of 65 and therefore not eligible for Medicare were dropped from the analysis. The final HRS sample consisted of 10,057 individuals. Use of population weights provided by the HRS allowed for the production of nationally representative population estimates.

The 5PCT is a nationally representative database of a 5% sample of the total U.S. Medicare population provided by the U.S. Centers for Medicare and Medicaid Services (CMS) as a restricted-access public use file. As with other Medicare databases we limited our analysis to beneficiaries aged 65 or older, living within the borders of the U.S. and not enrolled in a Medicare advantage plan. The final 5PCT sample consisted of 1,997,923 individuals.

Methods

Methods of empirical analyses were used to evaluate age-specific rates of mortality and disease-specific incidence and prevalence rates. These rates were then age-adjusted to a standardized population structure using the population counts from 2000 Census. These calculations were performed on a yearly basis for the SEER, 5PCT and HMD datasets and on a bi-annual basis for the HRS data. Incidence and prevalence were evaluated on a month-by-month basis to capture the possible seasonal fluctuations.
The standard Lee-Carter approach was used to fit the observed rates and to project the observed time series 5 years ahead. Several approaches (e.g., Wilmosh generalization) generalizing the standard Lee-Carter model were used to address the problem of "zero rates" that appeared for some age groups of month-specific disease incidence and/or prevalence.

Results

Year-specific age-adjusted mortality rates declined over the study period in all datasets used in the analysis. No significant differences were observed in either the level or in the shape of identified year-specific rates between the four datasets. These findings held for both the combined and gender-specific rates. The age-adjusted mortality rates for males were in a steady decline between 1991 and 2010. The female rates were stable until 2003, but started to decline since 2004.

Time trends of common aging-related diseases were studied, including: acute coronary heart disease (ACHD, the components such as myocardial infarction and angina pectoris were also studied), heart failure, stroke, common cancers (i.e., lung, colorectal, prostate, and female breast), diabetes mellitus, chronic obstructive pulmonary disease (COPD), Alzheimer's disease, chronic renal disease, and hip fracture. Increases of incidence rates were dramatic for renal disease [the average annual percent change (APC) is 8.56%, 95% CI = 7.62, 9.50%], and Alzheimer's disease (APC = 3.96%, 95% CI = 2.67, 5.26%), and less prominent for diabetes and lung cancer. Decreases of incidence rates were remarkable for angina pectoris (APC = −6.17%, 95% CI = −6.96, −5.38%); COPD (APC = −5.14%, 95% CI = −6.78,−3.47%), and less dramatic for colon and prostate cancers, stroke, and hip fracture.

The prevalence of the majority of the studied diseases increased over time. At least in part, that could be due to increase in the frequency of early-stage diagnoses. To test this hypothesis, we calculated the death hazard ratios (HR) for individuals with and without the studied diseases using the Cox model. For majority of cardiovascular diseases and malignancies, chronic renal disease, diabetes, and hip fracture the prevalence increased over time while their respective HRs decreased. Opposed to these trends, the prevalence of myocardial infarction, pneumonia, and peptic ulcer decreased while HRs increased. The most alarming trends were detected for pancreatic cancer, Alzheimer's disease, and weight deficiency: both prevalence (APC was 1.5-2.5%) and HRs (APC=1.6-2.1%) of these diseases dramatically increased over time.

The joint analysis of disease incidence/prevalence and mortality patterns showed that only a small fraction of variance in mortality patterns can be explained by respective trends in disease incidence and prevalence. The quantitative evaluation of the association between these patterns is based on a formulation of the Lee-Carter model as a state space model with predictors. This analysis is still in progress and will be presented at the PAA annual meeting.

All patterns investigated in these studies were fitted by the standard Lee-Carter model. Several examples of both age-adjusted mortality and incidence rates and predictions using the Lee-Carter model are presented in Figures 1-3.

Discussion and Conclusion

In this study, we presented a spectrum of analyses aimed at clarifying many important aspects underlying the time trends in mortality and morbidity of the older U.S. adults. These analyses were applied to three widely used Medicare-based datasets and a dataset representing the general U.S. population in order to provide new quantitative information about the dynamics of disease prevalence and the impacts of multimorbidity on mortality among the older U.S. adults.

The estimates of the effects obtained using Medicare data are relevant to the specialists from such health-related fields as physicians and public health professionals as well as to economists and government policy makers. These results have clear interpretations and practical applications, e.g., they create a basis for long-term forecasting of mortality and health characteristics of the U.S. older adults which allows for better management of both planning of medical care and medical expenditures.

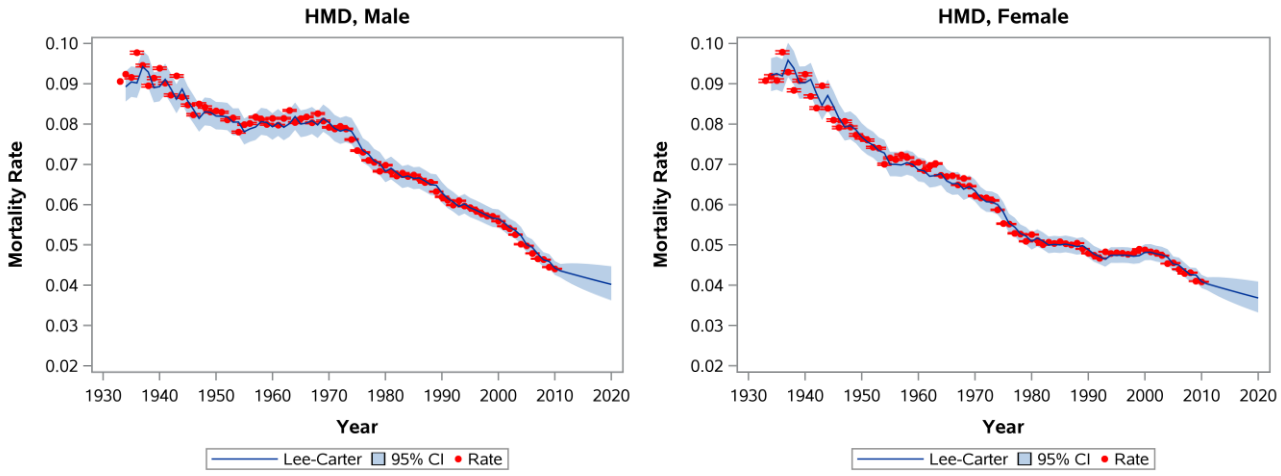

Figure 1: Mortality rates calculated using HMD data for 1930-2010 and the 10-year projection using Lee Carter model.

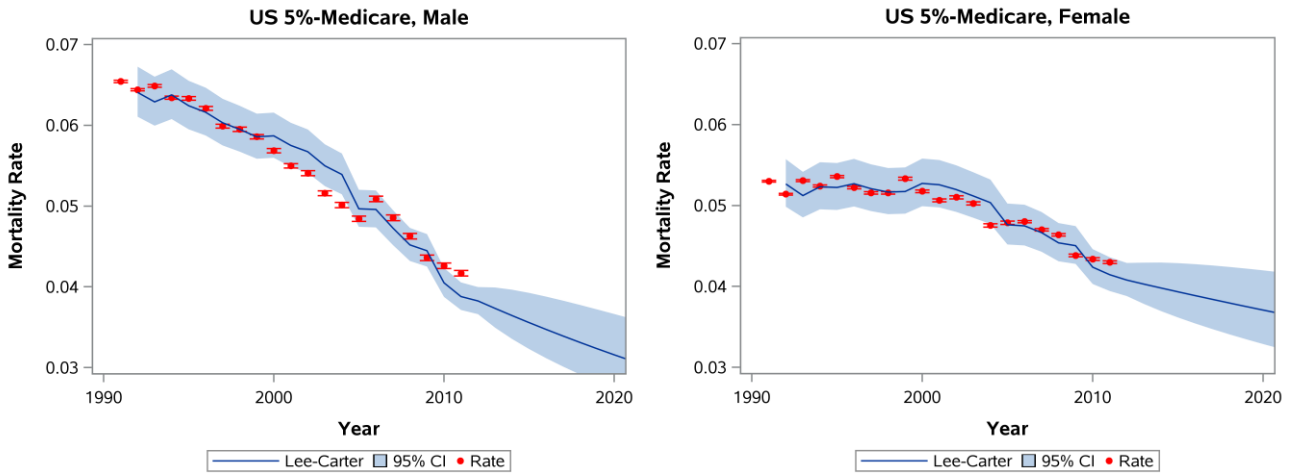

Figure 2: Mortality rate calculated using US 5%-Medicare data for 1991-2011 and the 10-year projection using Lee Carter model.

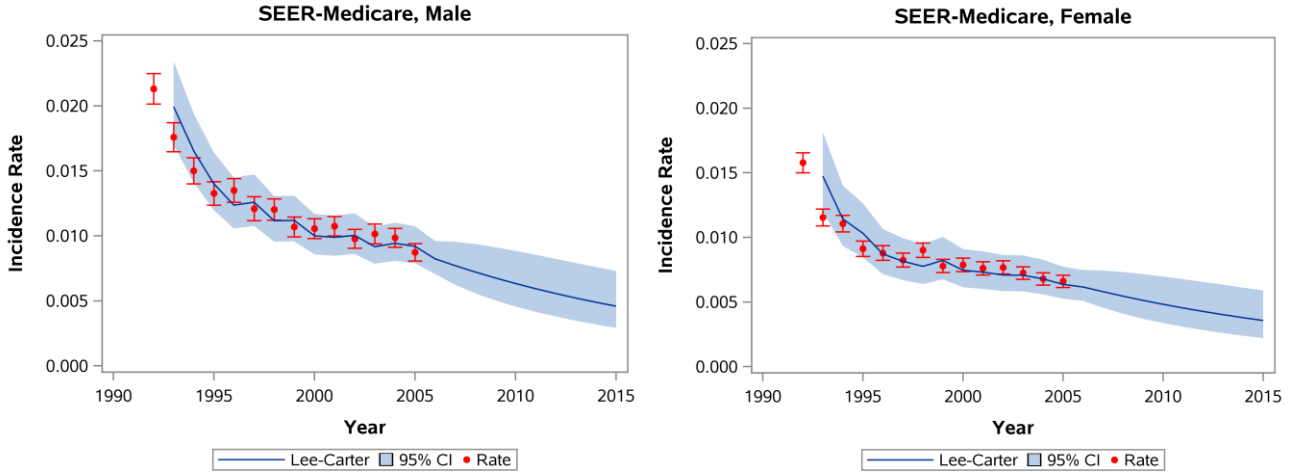

Figure 3: Incidence rate of ACHD calculated using SEER-Medicare for 1992-2005 and the 10-year projection using Lee Carter model.