Decomposing sex differences in hospitalization-free years at age 60 by age and cause of admission to hospital in Denmark, 1995–2014.

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Abstract

Little is known on whether narrowing sex differences in mortality have been accompanied by shrinking sex differences in health in Denmark within the last decades. Using register data for the total population, we estimated the number of hospitalization-free years for men and women aged 60 between 1995 and 2014. We decomposed differences across time and between sexes using a method of continuous change. Between 1995 and 2014, the number of hospitalization-free years rose from 8.6 to 11.4 among men and from 9.4 to 12.6 among women. A decreasing risk of admissions from neoplasms among women aged 60-69 was the main driver of widening sex differentials between 1995 and 2014. Widening sex difference in the number of hospitalization-free years at age 60 point towards increasing sex differences in the postponement of disease towards older ages, and might indicate that women have benefited more from medical progress of the last decades.

Background

After having reached a peak in the 1970s predominantly, the remaining life expectancy of men and women aged 60 has started to narrow in all low-mortality countries, including Denmark.[1,2] While the drivers of mortality trends are well explored,[3,4] little is known on whether this narrowing in the average length of remaining years of life among men and women has been accompanied by shrinking sex differences in health.

We refer to an admission to hospital as an event, which indicates an acute manifestation of health

deterioration.[5,6]. Studies have shown that a variety of risk factors for mortality are also strongly associated with an increased risk of hospitalization, including smoking, hazardous drinking, a lack of physical activity and obesity diet.[7,8] Furthermore, the access to health care services is free and universal in Denmark, with general practitioners having a strong gate-keeping function for the use of hospital care.[9] Based on these observations, we utilized hospital admissions as indicators of population health in order to monitor changes in health on a population level.[10]

In a first step, we investigated changes in the average number of remaining years until the first admission to hospital for an individual aged 60 between 1995 and 2014 in Denmark. In a second step, we disentangled the ages and the causes that accounted for these changes, and identify the drivers of the sex differences within this period among the Danish population aged 60+.

Methods and Materials

Data

In this study we used data of the total Danish population. Using the unique personal identification number (CPR-Number) we linked records from the National Patient Register (NPR) with data of the Central Population Registry (CPR). The CPR, covers data on the vital status, sex, place and date of birth of all individuals alive and residing in Denmark since 1968.[11] The NPR, a population-based register with nationwide coverage, contains information on all treatments provided in Danish hospitals since 1977.[12] Reports to the NPR are compulsory and levels of completeness and reliability are high making it a valuable tool for epidemiological research.[13] At this stage of the project, we focused on the time period after the introduction of the ICD-10 in Denmark. We classified the causes of admission according to the main chapters of the ICD-10.

Study Population

To ensure consistency in the methodology and comparability of the estimated values through-out the entire period, we applied an identical methodology for each calendar year. We first linked the CPR and the NPR to gather information on all inpatient admissions and the population alive and residing in Denmark. We dropped all individuals from the study population, who were admitted to hospital

within a previous 7-year period to exclude follow-up admissions. In a next step, we identified the population at risk and first events. First events were defined as the first admission to hospital as an inpatient after the age of 60, for all causes of admission, and of at least 3 days of stay.

Analysis

We calculated life tables for each calendar year and separately.[14] We used the age-specific risk to have a first event at age x and year t, $q(x,t)$, to estimate $e(60)_{Hosp,t}$. Our measure $e(60)_{Hosp,t}$ quantified the expected average number of years a person of exact age 60 in year t experiences until the first admission to hospital – or in other words: the expected number of hospitalization-free years of life at age 60. We split the overall age-specific risk $q(x,t)$ into the contribution of different causes, $q_i(x,t)$. This enabled us to disentangled the causes of admission to hospital which accounted for the changes in the number of remaining years until the first admission to hospital between 1995 and 2014, and the male – female differences in 1995 and 2014 using a method of continuous change.[15]

Results

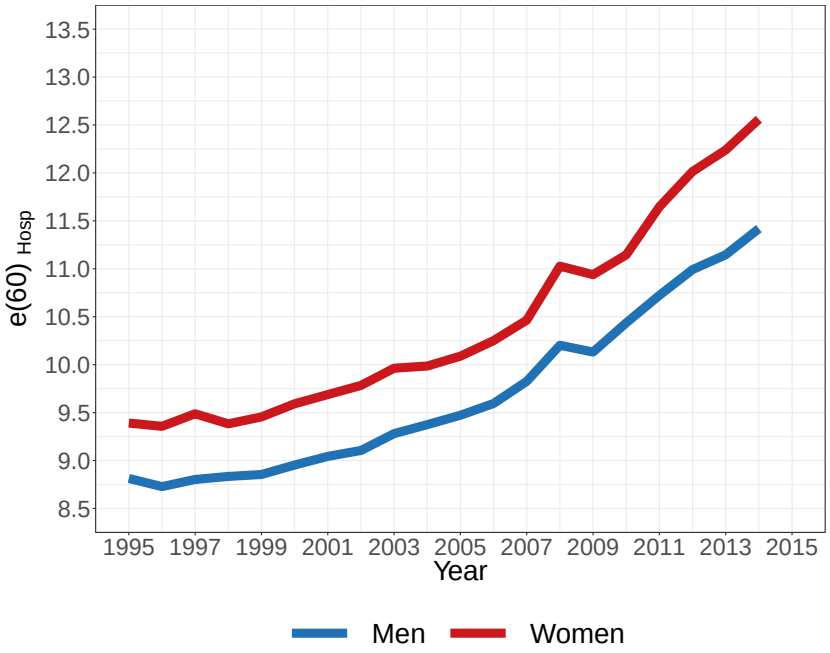

Figure 1: Trends in $e(60)_{Hosp}$ for men and women in Denmark, 1995–2014.

As shown is figure 1, we found the number of hospitalization-free years at age 60 to be consistently higher for women than for men. In 1995, the levels were 8.6 years for men and 9.4 years for women. The levels increased steadily among men and women within the observed period. While it increased by 2.6 years among men and to levels of 11.4 years, it increased by 3.2 years among women and to levels of 12.6 years in 2014. We found the gap between men and women to almost double within the observed period and to increased from 0.6 years in 1995 to 1.1 years in 2014.

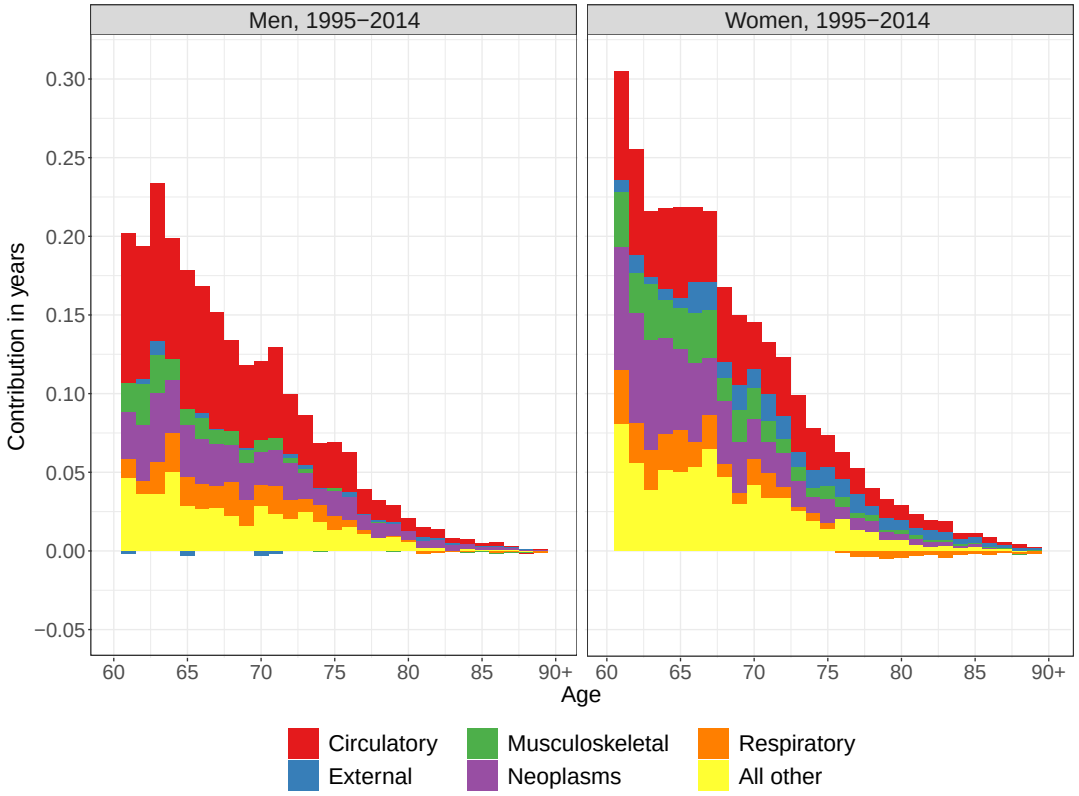

Figure 2: Contribution of ages and causes to the increase in $e(60)_{Hosp}$ between 1995 and 2014.

Figure 2 shows the contribution of causes and ages to the increase in the number of remaining hospitalization-free years at age 60 between 1995 and 2014. As shown in both panels, all ages and causes contributed to the increasing levels of $e(60)_{Hosp}$. Among men, improvements among circulatory diseases accounted for 1.1 years of the changes, followed by neoplasms with 0.5 years. Together, these two causes accounted for 62% of the increase among men. The contribution of circulatory diseases was smaller among women and on a level of 0.8 years. Reductions in first admissions due to neoplasms were higher among women than among men, contributing 0.7 years to the increase.

We found that not all causes of admission contributed to the female advantage in the remaining number of hospitalization-free years at age 60. As it is shown in figure 3, we found women to have a disadvantage regarding external causes and musculoskeletal disorders at both points in time when compared with men. Circulatory diseases accounted for the largest part of the sex differentials in 1995 and 2014. When comparing both points in time, we found that women have lost their disadvantage regarding respiratory diseases and, especially, neoplasms at ages 60–69 in 2014.

Figure 3: Contribution of ages and causes to the sex differences in $e(60)_{Hosp}$ in 1995 and 2014.

Discussion

We found the number of hospitalization-free years to increase steadily within the observed period for men and women, indicating that the onset of the first severe morbidity within the life course shifted towards older ages. However, in contrast to shrinking sex differences in remaining life expectancy at age 60, we found that the female advantage in the number of remaining years without admission has increased between 1995 and 2014. This may indicate increasing sex differences in the postponement of disease towards older ages. Our finding of widening sex differences in the mean age at first admission might point towards the fact that medical progress and the introduction of preventive measures like the "Heart Plan" in Denmark might have been more beneficial for the health of women than for men. Moreover, the extinction of the Danish women born between the two world wars, who had high rates of smoking throughout their whole life,[16] might have contributed to the increasing female advantage within the studied period.

Outlook

We plan to extent the period of observation as data on hospital admissions are available since 1977. Utilizing a 7-year washout period will enable us to go back to 1984. Furthermore, we will carry out a variety of robustness checks. These checks will aim on the duration of the wash-out period (5 years, 7 years, 10 years), the duration of stay in hospital (1 day, 3 days, 5 days), and the decomposition of differences taking consideration of sex-specific causes of admission as a separate category.

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Supplementary Material

Classification of Causes of Admission

Cause of hospital admission	ICD-10
Cardiovascular diseases	I00 - I99
External causes	S00 - T98 & V01-Y98
Musculosceletal disorders	M00 - M99
Neoplasms	C00 - D48
Respiratory Diseases	J00 - J99
All other diseases	- all other -

Sensitivity Analysis

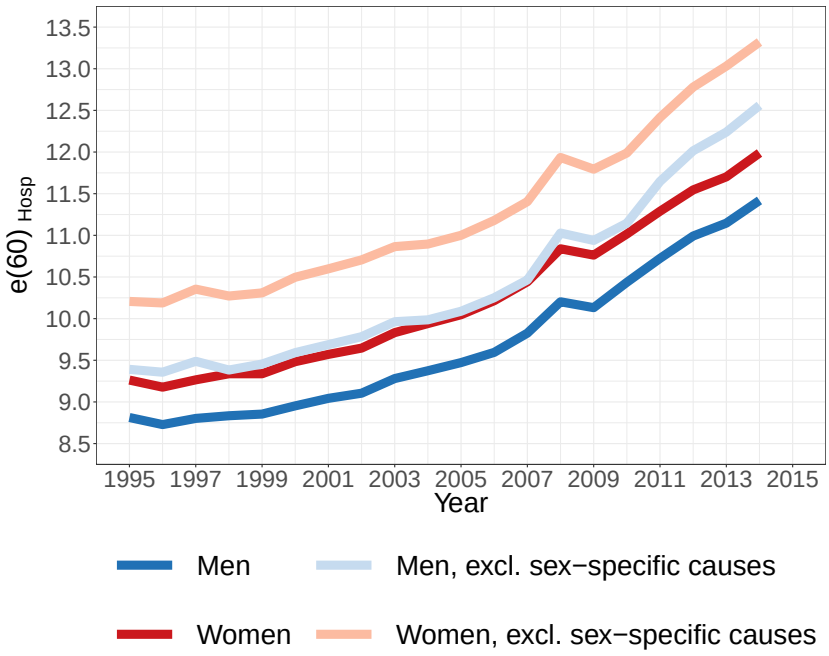

Figure S-1: Trends in $e(60)_{Hosp}$ for men and women; with and without sex-specific causes of admission.

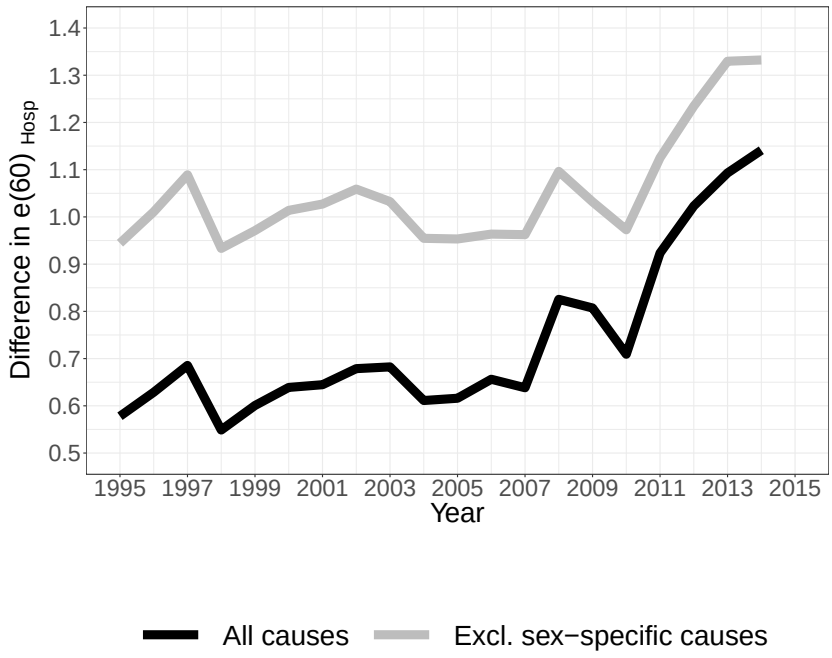

Figure S-2: Absolute sex differences in $e(60)_{Hosp}$; with and without sex-specific causes of admission.

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Ethics Approval

The study involves secondary data analysis of existing register data. The project was approved by the ethical committee assigned through the Danish National Committee on Biomedical Research and the Danish Data Protection Agency.