A Cohort Perspective on Trends in Hospitalization Rates and Case-fatality-rates in Switzerland

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Abstract:

Understanding hospitalization patterns in Switzerland is essential for assessing healthcare quality, costs, and the effectiveness of disease treatment. While previous studies indicate that hospitalizations for conditions such as hypertension and heart failure increased between 1998 and 2018, the extent to which different birth cohorts experience varying hospitalization risks and outcomes has not been systematically examined. Understanding these generational patterns is crucial for healthcare planning and evaluating whether medical advances benefit all generations equally.

This study adopts a cohort perspective to analyze hospitalization rates and case-fatality rates across birth cohorts from 1930 to 1975, using Swiss Hospital Discharge Data (Medical Statistics from Hospitals) spanning 1998-2022 for patients aged 45-94. Unlike traditional period-based approaches, using generational lens examines whether successive cohorts face different risks of hospitalization and death for specific causes including cardiovascular, respiratory, cancer, and other major conditions, that by itself have generational components in incidence and mortality. We will analyze separately hospitalization rates (which reflect disease burden and healthcare access) and case-fatality rates (which indicate care effectiveness and illness severity).

The analysis investigates cause-specific hospitalization rates and case-fatality rates across cohorts, disaggregated by sex, age and other sociodemographic determinants. Special attention is given to the aftermath of the COVID-19 pandemic's potential differential impact across generations. Results will inform whether cohort-specific vulnerabilities exist, guide targeted interventions, and support projections of future healthcare demand as younger cohorts age into periods of elevated health risk.

Extended Abstract:

Introduction

Switzerland consistently ranks among the countries with the highest life expectancy worldwide, with current estimates exceeding 84 years (1). While improvements in nutrition, medicine, public health interventions, and socioeconomic conditions have all contributed to mortality decline (2–4), the specific role of hospitalization as a health intervention is unclear to address improvements in health.

Change in disease patterns across the population, and the drivers behind them is a major public health issue. Knowledge of the disease trends and changing burden of disease is essential for estimating the impact of primary prevention, defining public health priorities, and predicting future health care needs (5). Furthermore, understanding hospitalization patterns and outcomes also becomes essential when it comes to understand population health, not only from a mortality perspective, but also when it comes to estimate the remaining quality of life as a result of health interventions.

Traditional epidemiological studies have predominantly employed cross-sectional or period-based approaches to analyze hospitalization and mortality trends. These methods compare rates across different calendar years, essentially asking "how have hospitalization rates changed over time?" While informative, such approaches conflate several distinct mechanisms: aging of the population, improvements in medical technology and treatment protocols over calendar time, and differences between birth cohorts that reflect their unique life course experiences.

A cohort perspective offers a fundamentally different analytical lens. In demographic and epidemiological research, a cohort is defined as a group of individuals who share a common temporal experience (typically birth in the same period) and thus experience similar historical events, societal conditions, and healthcare environments at comparable life stages (6,7). This shared exposure creates cohort-specific patterns of health risks and outcomes. A cohort-based perspective therefore follows generations born in specific years as they age through the healthcare system, recognizing that individuals born in 1930, for instance, experienced a markedly different epidemiological and medical landscape throughout their lives compared to those born in 1950 or 1970, even when both groups are observed at the same age.

When examining specific diseases, such as cancer (8–10), cardiovascular conditions (11,12) and respiratory conditions (13,14) among others, generational patterns can help understand better if successive generations are more or less likely to receive and survive a hospitalization for a given cause.

This is crucial for understanding whether medical advances benefit all generations equally or whether there are cohort-specific vulnerabilities or advantages. For example, if older cohorts who lived most of their lives without access to preventive cardiovascular care show higher case-fatality rates when hospitalized for heart disease compared to younger cohorts with lifelong access to statins and blood pressure management, this would suggest that early-life and midlife medical care create cohort-specific advantages that persist into old age.

Moreover, the COVID-19 pandemic represented a major disruptive event for healthcare systems and hospitalization patterns, potentially altering both the volume and nature of hospital admissions across age groups (15). Understanding cohort patterns before, during and after the pandemic provides knowledge for evaluating how this unprecedented period effect may have differentially impacted successive generations.

In Switzerland, previous studies hint that the burden of hospitalizations that are potentially avoidable due to hypertensive causes has increased between 1998 and 2018 (16), and the same has occurred with heart failure (17), representing non-negligible financial costs for the healthcare system. However, there is no mention about the generational aspects of hospitalization neither mention of other sociodemographic determinants besides age and sex, and citizenship.

Previous studies for other countries such as Finland and Germany have found an increase in hospitalizations for cardiovascular-type and respiratory conditions since the last decades (18,19). Other studies, such as one in Canada (20), have followed a secular trends, with lower hospitalization rates across age groups, but did not delve deeper among the risk factors behind hospitalization care and use.

The distinction between hospitalization rates and case-fatality rates is also relevant. Prognosis of certain hospitalization rates based on survival outcomes could tell us about the contribution of hospital treatment in longevity and healthy longevity increases. Hospitalization rates reflect both disease incidence and changes in clinical practice regarding when and whom to hospitalize. Declining thresholds for hospital admission could increase hospitalization rates even if population health improves, as milder cases receive inpatient care. Conversely, case-fatality rates among hospitalized patients provide insight into the severity of illness and the effectiveness of acute medical care. Previous findings on the United states indicate that the number of hospitalizations until 2010 increased, especially for those involving some sort of heart failure (21), but the death rates on all-causes, declined from 2.5% to 2.0%, with death rate declines of 35% for respiratory conditions and 27% for stroke (21,22). However, prognosis on other causes of death and disease is not analyzed nor understood. In a previous study in Australia, case-fatality rates for coronary heart disease did not improve for individuals aged 35-54 between 1996 and 2007, but did not hint any generational differences.

The purpose of study is mainly exploratory, in investigating generational patterns in hospitalization rate and fatality rates across the main causes for hospitalization in Switzerland, using Hospital Discharge Data from 1998 to 2022, and considering other possible determinants. Swiss healthcare system combines public healthcare with private healthcare and provides near-universal coverage through mandatory private health insurance for all residents, minimizing socioeconomic barriers to hospital care that might otherwise confound cohort comparisons. While individuals from lower socioeconomic backgrounds may be more hesitant to seek follow-up consultations due to cost concerns based on the franchise insurance system (23). The franchise is the annual amount that an insured person must pay for medical services before their insurance covers the costs. However, this tendency does not extend to hospitalizations, where there is less room for hesitancy.

The country's detailed hospital statistics and mortality records enable precise measurement of both hospitalization events and outcomes. Furthermore, Switzerland's diverse population and multilingual regions allow for examination of whether cohort patterns vary across cultural and geographic contexts within a single national healthcare system. However, despite these

advantages, comprehensive generational analyses of hospitalization and case-fatality trends in Switzerland remains rather limited.

Data, methods and partial results

Data will be used from the Medical Statistics from Hospitals (Medizinischen Statistik der Krankenhäuser), containing the reason, the type of cause behind the hospitalization and other sociodemographic information about the patients (gender, educational attainment, canton of residence, language, length of stay, reason for leaving, included but not limited to death, if the patient was or not in intensive care among others).

In order to across the whole observation period, we plan to limit our analysis to birth cohorts from 1930 through 1975, following them through the period 1998-2022, ranging from ages 45 to 94. Since the final age group is truncated in age 95+, so we decided not to include them in the analysis since we could not establish to which cohort range they belong.

Figure 1 presents the non-linear cohort effects (compared to the average trend) in hospitalization rates using a Poisson model constraining the cohort dimension with the Epi package in R (24). We can observe that among then, for most causes cohorts born between 1940 and 1955 presented a higher hospitalization risk for most of the analyzed conditions. For females, Figure 2 does the same, highlighting that even from earlier cohorts we observed an increasing trend in hospitalization, but with a decline after 1950 for most causes. Initial estimations are provided using a 20% random sample of the total records (3,201,545 records, but we will use the full records for the final analysis).

By observing the decomposing trends with a generational perspective cohort effects (using visual, such as graphical rates of improvement and statistical methods, such as non-linear statistical cohort approximations as the one we are showing now), we can identify which birth cohorts experienced particularly favorable or unfavorable outcomes. We pay special attention to cause-specific patterns, recognizing that generational trends across hospitalization patterns (and case-fatality rates) may change across specific generations. Furthermore, the analysis will consider both pre covid and post COVID-19 pandemic trends, since is possible that affected average trends in hospitalization rates (and outcomes).

Understanding these temporal patterns is essential for healthcare planning, as the cohorts entering advanced ages in coming decades will determine future demand for hospital services and end-of-life care. Moreover, identifying cohorts with elevated both hospitalization rates and case-fatality rates can guide targeted interventions and reveal vulnerabilities that may be addressed through cohort-specific clinical approaches or public health strategies.

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Figure 1: Non-linear detrended cohort effects on hospitalization rates between 1998 and 2022 in Switzerland, males.

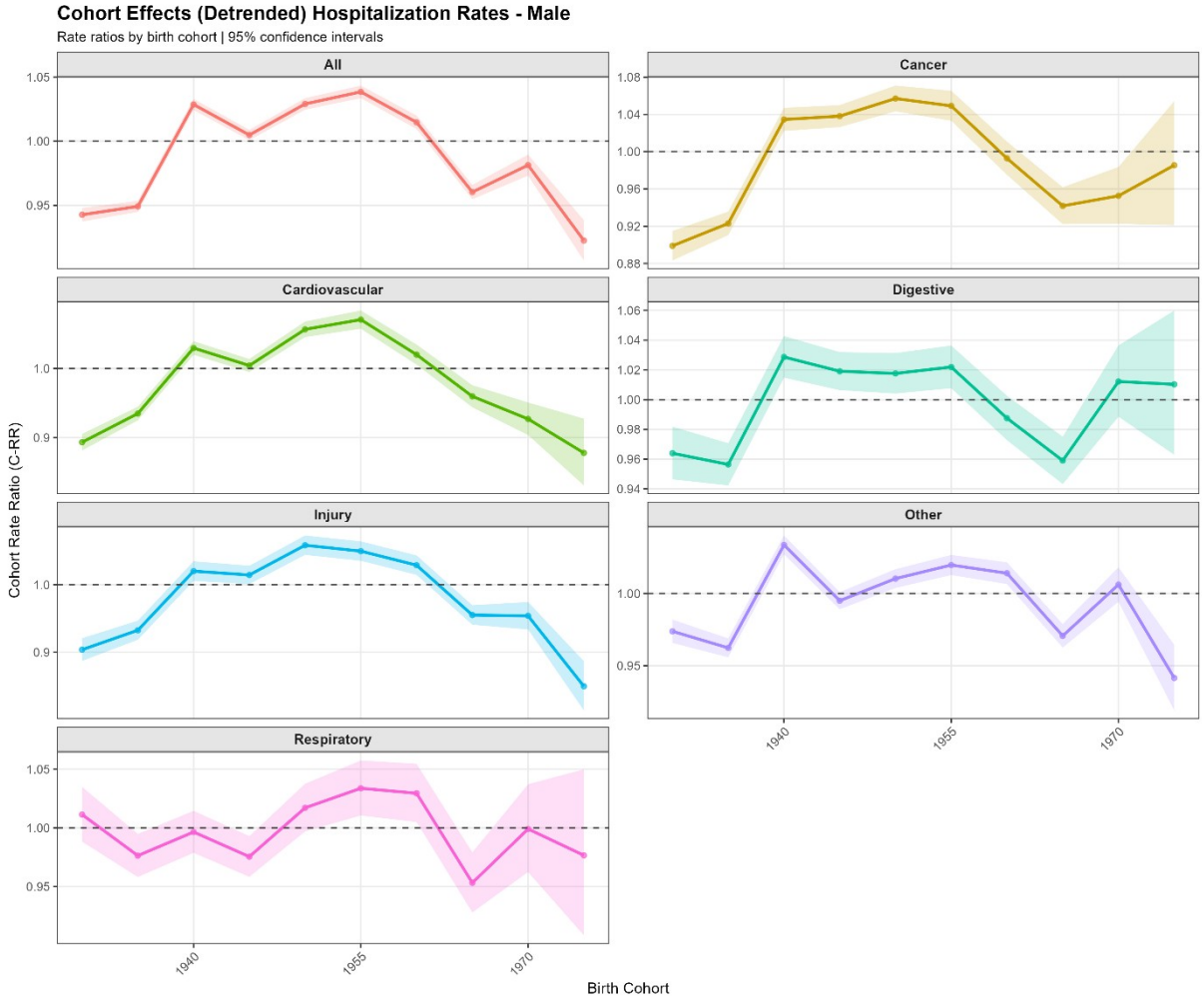

Figure 2: Non-linear detrended cohort effects on hospitalization rates between 1998 and 2022 in Switzerland, females.