Title: The impact of the COVID-19 pandemic on cancer mortality and socioeconomic disparities in Belgium during 2020

Background:

Cancer remains a major global health concern, accounting for almost 10 million deaths in 2020, making it the second leading cause of death worldwide. Even with advancements in cancer screening, diagnosis, and treatment that have fostered improved survival outcomes, the economic burden of cancer in Europe is staggering, surpassing €100 billion annually, as outlined by Europe's Beating Cancer Plan. However, a crucial component of cancer dynamics, the discrepancies in cancer outcomes by socioeconomic position, has often been overlooked when focusing on national or regional averages. Notably, individuals with a lower socioeconomic position, be it measured by education, income, or other indicators, disproportionately face a higher risk of dying of prevalent cancer types compared to their wealthier peers.

Moreover, the early months of the COVID-19 pandemic introduced unprecedented disruptions to healthcare systems globally. Not only were protocols for infectious disease management affected, but also the provision of care for non-COVID-19 diseases, including cancer. This disruption was palpably felt in Belgium, as with numerous other countries. Compounding this challenge, a recent systematic review revealed the significant increase in mortality risk associated with treatment delays in cancer care.

It's vital to contextualize these challenges in the context of existing health inequalities. Those with a lower socioeconomic status, even before the pandemic's onset, were already disadvantaged, experiencing limited access to care, heightened rates of non-communicable diseases, and early mortality. The pertinence of these socioeconomic disparities has been accentuated in various international reports and studies, emphasizing the need for its rigorous measurement and long-term monitoring. Indeed, the magnitude of these disparities and their ramifications have implications not just for healthcare provisioning but also for policy-making and resource allocation.

Given these complexities, this study aims to evaluate the potential repercussions on cancer mortality due to healthcare access restrictions during the pandemic's initial phase. Specifically, we will (1) examine the shifts in cancer mortality rates in the immediate aftermath of the COVID-19 outbreak compared to the pre-pandemic period, and (2) discern potential alterations in the socioeconomic gradient of cancer mortality between 2020 and 2019, inquiring whether the pandemic exacerbated or alleviated pre-existing socioeconomic disparities.

2. Material and methods

2.1 Design and study population

The data used in this study were derived from Statistics Belgium and involved linking records from various administrative data sources. These sources included the Belgian National Register, which provided annual population data containing information on sociodemographic characteristics and vital status for all individuals officially residing in Belgium on January 1st of each year. Additionally, the administrative census of 2011 provided education and housing data, while the tax register supplied yearly income data. The comprehensive and anonymous dataset comprised over 13.5 million individuals from Belgium, with a wide range of socioeconomic and sociodemographic variables available. The analyses conducted in this study were focused on individuals with cancer aged 45 years and above.

2.2 Variables

Cancer selection

The first part of our analyses included all malignant cancer sites, with an International Classification of Diseases, Tenth Revision code (ICD-10) going from C00-C96, for both men and women. The second part of our analyses focused on the five specific cancers which where: breast (for women only), colorectal and anal, lung, pancreas, and prostate (for men). Those were selected due to their high impact in terms of cancer mortality in 2019 in Belgium and SE/SD impact for both men and women.

Mortality indicators

To unravel inequalities in cancer mortality during 2020 in Belgium, we first analyzed the mortality deficit by SD and SE indicators. Mortality deficit was determined as the difference (both absolute and relative) in age-standardized mortality rates during 2020 (i.e. from the 1st of March 2020 until the 31st of December 2020) compared to the pre-COVID-19 mortality rates during a reference period (i.e. from the 1st of March 2019 until the 31st of December 2019), supposedly representing a typical pattern of mortality under normal circumstances. To evaluate whether the COVID-19 pandemic exacerbated pre-COVID-19 cancer mortality inequalities, we

then compared relative SD and SE inequalities among total mortality observed in 2020 with existing inequalities observed during the reference period. We could have additionally controlled for COVID-19 infection to account for its specific influence on cancer mortality rates during 2020 in comparison to the pre-COVID-19 times but that was outside the scope of this study.

SD and SE variables

To obtain a comprehensive understanding of disparities in cancer mortality, we focused on various SE and SD indicators. Using diverse SE indicators is crucial since they cover various aspects of socioeconomic (dis)advantage and are developed at different stages of the life course. We incorporated educational level and income in deciles as two SE indicators in our study. Education impacts individuals' access to information and critical thinking skills, influenced by early-life opportunities. The socioeconomic position is largely determined by parental circumstances, affects employment, income, and social connections in adulthood. Additionally, education enhances health literacy, behaviors, and symptom recognition, leading to better communication with healthcare providers and prompter medical care seeking.

2.3 Statistical analysis

To measure the impact on deaths during the initial COVID-19 wave, we compared the age-standardized death rates from 01/03/2020-31/12/2020 to the same period in 2019, using 2020's Belgian population for reference. We calculated both the total difference and percentage change in these death rates. This was done by looking at factors like education, income, and household setup. Then, to see if COVID-19 affected existing inequalities in deaths, we compared the age-adjusted death rate ratios for both periods. We analyzed these differences for various socio-economic and demographic factors using statistical models. All of our research was done using Stata 14.2 and split by age groups (45-59, 60-74, 75+).

3. Results

3.1 SE inequalities in mortality deficits during 2020, after the COVID-19 pandemic outbreak in Belgium

Our findings showed that when both having an overall and site-specific look at cancer mortality during the COVID-19 pandemic, significant declines were generally found among men in the oldest age groups

(75+ years) interestingly, we discovered that the largest decline in mortality was found among middle-incomed women in the youngest age group (45-59 years). We also noticed that patients with colorectal cancer had the largest decline in mortality in 2020 compared to 2019.

3.2 Change in relative SE inequalities in mortality during, 2020, after the COVID-19 pandemic outbreak in Belgium

When looking at all cancers, we observed that the classic mortality gradient was generally followed during the COVID-19 pandemic for the 45-59 and 60-74 age groups, by which mortality risks were higher for people with lower SES compared to those with higher SES. We observed that for the 45-59 age category, educational (for men) and income (for women) gradients tended to get bigger after the COVID-19 outbreak, making social disparities stronger but for the 60-74 the existent social gradient during the reference period persisted after the outbreak. However, when considering. the 75+ years category, we noticed that both men and women in the lowest income group (zero decile), had a significantly reduced risk of death during the pandemic, higher during the pandemic for women but slightly lower for men. A general observation was that for all age groups and both genders, there was a significantly increased risk of death for patients living in collective households compared to those living with their partners.

When considering the five cancer types individually for all age groups and both genders, a general observation was that living in a collective household was a strong indicator of increased risk of cancer mortality. We noticed that among the youngest age group (45-59 years) for breast, colorectal, lung and pancreatic cancer, the educational and income gradients would generally disappear or be smaller after the outbreak of the pandemic, "removing" social disparities, the same observations were made for the 75+ years group for colorectal, pancreatic, and lung cancer. In the 60-74 age category, the educational and income gradients were generally exacerbated after the COVID-19 outbreak (except for lung cancer)