Estimating total excess mortality during a COVID-19 outbreak in Stockholm, Sweden

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Abstract

Total excess mortality peaked during a COVID19 outbreak in Stockholm, but 25% of these deaths were not recognized as Covid-19-related nor occurred in hospitals. Estimate of total excess mortality may give a more comprehensive picture of the total disease burden during a COVID19 outbreak, and may facilitate managing future outbreaks.

Keywords: Mortality; SARS-CoV-2; COVID-19; outbreak, public health

Introduction

The first COVID19-related death in Stockholm, Sweden occurred on Friday March 11st (2020) and already next week (week 12 in Figure) a drastic outbreak of Covid-19-related deaths had started (Figure)[1]. However, the regional morgue noticed that the number of deceased persons accumulating during the outbreak was much larger than the reported number of COVID-19-related deaths, which incited the current investigation of how the total excess mortality developed during the outbreak in relation to the recognized number of Covid-19-related deaths.

Methods

We retrieved mortality data for 2020 from the Swedish National Board of Health and Welfare and mortality estimates for the past 10 years from EuroStat[2]. As total mortality may vary somewhat between calendar years, partly due to differing severity of seasonal epidemics such as influenza, a solid average baseline to compare against is necessary. Although 5-year averages are readily available, we found that the baseline was not fully stable until 10-year average mortality was calculated. The mortality was calculated for the Stockholm region only using the annual adjusted population statistics for Stockholm during the last 10 years. The reported COVID-19-related mortality was retrieved from publicly available repositories and classified as COVID-19-related death by the death certificate (www.SCB.se and www.C19.se). In addition, the daily number of deaths recognized as COVID-19-related either in hospital or in special housing and confirmed by SARS-CoV-2 RNA test were also reported to us by the regional morgue.

Results

Beginning of 2020 the weekly total mortality in the Stockholm region was slightly lower than the 10-year average mortality for the region, but at the onset of the outbreak in week 12, there was a rapid increase in total mortality (Figure). Comparison with the number of reported Covid-19-related deaths in the 5-weeks peak period of the outbreak between week 12 and 17 found that 25.6% of the

excess mortality during the COVID-19 epidemic was not recognized as COVID-19-related, neither by public health data nor by the regional morgue. Since Janurary 1st (2020) the accumulated excess morality in the Stockholm region in week 18 was still +22.8% compared with the average over previous ten years. Reported COVID-19-related deaths in public health data constituted 74.4% of the accumulated excess mortality between week 12 and 17 in Stockholm (Figure). Data from the regional morgue had similar findings, with minor shifts in the reported dates of deaths (Figure). In agreement with other countries[3], only 32.6% of the reported COVID-19-related deaths between week 12 and 17 had occurred in hospitals. A much larger number of COVID-19-related deaths had occurred in other caretaking institutions, such as nursing homes for the elderly (Figure). For the remaining cases of reported COVID-19-related deaths the location of the death was not recorded on the death certificate but could be considered as "non-hospital, unknown".

Discussion

We find that during a Covid19 outbreak the total excess mortality using average 10-year mortality as baseline, may provide a more comprehensive measure of the total disease burden. The region where the outbreak occurred has multiple, population-based reporting systems and the well-established reporting infrastructure is likely to have identified a comparatively high proportion of all COVID-19-related deaths. Thus, proportion of the total excess mortality that was recognized as COVID-19-related between week 12 and 17 in our study (c. 74%) is probably a high estimate. Hypothetically, if the total global death toll would be similarly larger than the known Covid-related deaths as it was in Stockholm, we predict that without the total global death toll of the COVID-19 epidemic may reach more than 1.4 million deaths (>1,074,768/0.74).

Strengths of our study is that we obtained public data from several sources, making the analysis of data robustness and reproducibility straightforward. Limitations include the fact that we focused on an outbreak in one region only and have no real data to present on generalizability. Also, autopsies

did not include systematic SARS-CoV-2 testing of the deceased which might have contributed to a number of unrecognized COVID-19-related deaths.

In agreement with analysis from other countries [4–7], total excess mortality during the peak period seems to give a more comprehensive picture of the total burden of COVID-19-related deaths. Discrepancy between COVID-19-related mortality data and total excess mortality has also been noted by others [8,9]. Reporting systems based mostly on hospitals are likely to capture only a small fraction of the mortality burden. During the outbreak, testing capacity was reserved for patients and subjects with symptoms. This could have contributed to unmitigated spread of the outbreak, but on the other hand resulted in that testing capacity was available for testing patients with symptoms at the healthcare providers. In our study, only 24% (0.33 x 0.74) of the excess mortality between week 12 and 17 was reported as COVID-19-related based on hospital data. Some COVID-19 fatalities may have been misclassified due to attribution to other comorbidities. Further, concerns about COVID-19 have been shown to be associated with delayed or avoided medical care, including emergency care and may have caused some excess deaths, not directly induced by the deaths [10].

In summary, total excess mortality during a Covid19 outbreak may give a more comprehensive picture of the total burden of excess deaths. In addition to managing future outbreaks, this would facilitate appropriate resource allocation as well as political and public health priorities.

NOTES

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A conflict of interest statement

All authors declare no competing interests.

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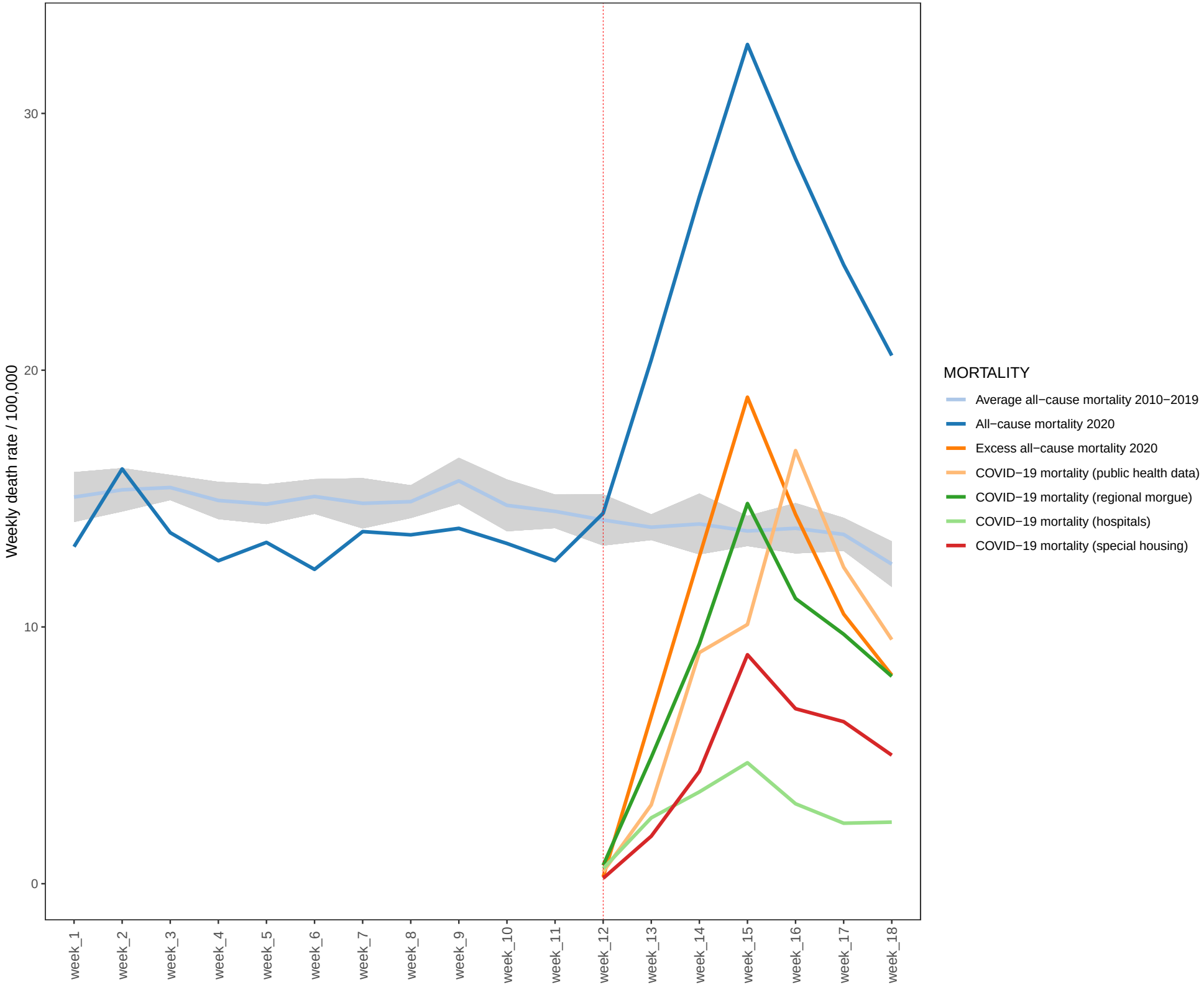
Figure Legend

Figure. Excess mortality in 2020 in Stockholm between week 1 and 18. Total all-cause mortality in 2020 compared to the average all-cause mortality in the previous 10 years (2010-2019) and to the reported COVID-19-related mortality. The 2020 total all-cause mortality exceeds the average of the previous 10 years (95% confidence interval as a gray area) and becomes excess mortality at the same time as reporting of COVID-19-related deaths start emerging in week 12 (dashed vertical red line). Note that only a proportion of the excess mortality is recognized as COVID-19-related and that only a very small proportion is derived from recognized COVID-19-related deaths in hospitals.


Weekly death rate / 100,000
30
20
10
0
week_1
week_2
week_3
week_4
week_5
week_6
week_7
week_8
week_9
week_10
week_11
week_12
week_13
week_14
week_15
week_16
week_17
week_18
MORTALITY
Average all−cause mortality 2010−2019
All−cause mortality 2020
Excess all−cause mortality 2020
COVID−19 mortality (public health data)
COVID−19 mortality (regional morgue)
COVID−19 mortality (hospitals)
COVID−19 mortality (special housing)