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Short Communication

Excess deaths from COVID-19 in Japan and 47 prefectures from January through June 2021

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ABSTRACT

Objectives: In Japan, several studies have reported no excess all-cause deaths (the difference between the observed and expected number of deaths) during the coronavirus disease 2019 (COVID-19) pandemic in 2020. This study aimed to estimate the weekly excess deaths in Japan's 47 prefectures for 2021 until June 27.

Study design: Vital statistical data on deaths were obtained from the Ministry of Health, Labour and Welfare of Japan. For this analysis, we used data from January 2012 to June 2021.

Methods: A quasi-Poisson regression was used to estimate the expected weekly number of deaths. Excess deaths were expressed as the range of differences between the observed and expected number of all-cause deaths and the 95% upper bound of the one-sided prediction interval.

Results: Since January 2021, excess deaths were observed for the first time in the week corresponding to April 12–18 and have continued through mid-June, with the highest excess percentage occurring in the week corresponding to May 31–June 6 (excess deaths: 1431–2587; excess percentage: 5.95–10.77%). Similarly, excess deaths were observed in consecutive weeks from April to June 2021 in 18 of 47 prefectures.

Conclusions: For the first time since February 2020, when the first COVID-19 death was reported in Japan, excess deaths possibly related to COVID-19 were observed in April 2021 in Japan, during the fourth wave. This may reflect the deaths of non-infected people owing to the disruption that the pandemic has caused.

Introduction

Japan has so far had a relatively low number of deaths per population from coronavirus disease 2019 (COVID-19) compared with many high-income countries.[1] In Japan, several studies during the COVID-19 pandemic have reported no excess all-cause deaths (the difference between the observed and expected number of deaths) in 2020.[2] In April 2021, the fourth wave of COVID-19 started in Japan. Although the number of new cases showed a downward trend in June, the fifth wave began around July. This study provides estimates of weekly excess deaths in Japan's 47 prefectures from the start of 2021 until June 27, 2021, and reports the first observation of excess all-cause deaths in Japan that may be related to the pandemic.

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Methods

Estimating the expected number of deaths

Vital statistical data on deaths were obtained from the Ministry of Health, Labour and Welfare of Japan. For this analysis, we used data from 2012 (including the last few days of 2011 for weekly analysis) to June 2021. These data include information on the date of death, age at death, and place of residence (prefecture) of all persons who died in Japan, regardless of nationality, and those who had a residence card. Cause of death information was not available in the data. Those who died overseas, those who stayed in Japan for a short time (without a residence card), and those whose place of residence or date of birth was unknown were excluded. The conversion from daily data to weekly data was based on the categorization defined by the National Institute of Infectious Diseases' Infectious Diseases Weekly Report.[3]

To estimate the expected number of deaths and the associated prediction intervals, we used the Farrington algorithm,[4] which is commonly used to assess annual and seasonal trends in disease burden attributable to disease outbreaks.[5] The Farrington algorithm, which is based on a quasi-Poisson regression model, places restrictions on the time points of the data used for estimation (i.e. reference period). The expected number of deaths at a calendar week t is estimated using only data from $t-w$ to $t+w$ weeks of years $h-b$ and $h-1$, where w and b are prefixed values and h is the year of t. In the present study, we used $b=5$ and $w=3$, based on previous studies.[4] In addition, to incorporate seasonality into the model, data not included in the reference period are evenly divided and included in the regression model as dummy variables. The regression model is then given by

$$\log(E(Y_t)) = \alpha + \beta t + f^T(t)\gamma_f, \tag{1}$$

where Y_t is the number of deaths at a certain week t, α, and β are regression parameters, $\gamma_{f(t)}$ is a regression parameter vector representing seasonality, and $f(t)$ is a vector of dummies that equally divides the time points outside the reference period into nine periods. The parameters, including the regression coefficients and the overdispersion parameter ϕ, were estimated using the quasi-likelihood approach.

To estimate the baseline in Equation (1), we also used the data for 2020, which was during the pandemic period (e.g. the baseline estimate for 2021). To adjust for the impact of COVID-19 on the 2020 data and obtain a robust baseline estimate, the estimate was weighted by applying Anscombe residuals, as recommended in the original articles describing the Farrington algorithm. More details can be found in other reports.[4]

Using the estimated regression parameters, the expected number of deaths was predicted for the week of interest t_0. The one-sided 95% prediction interval was then estimated by assuming that the data follow a negative binomial distribution as $Y_{t_0} \sim NB(\widehat{Y_{t_0}}, \widehat{\nu_0})$, where $\widehat{Y_{t_0}}$ is the mean of the distribution and $\widehat{\nu_0} = \frac{\widehat{Y_{t_0}}}{\hat{\varphi}-1}$ is its dispersion parameter.

Adjusting for reporting delays

The observed number of deaths may differ from the actual number of deaths due to delays in reporting deaths. The delay in reporting deaths refers to any delay in submitting death notification to municipal offices, perhaps depending on where the death occurs. Nationally, the percentage of deaths reported with a one-month delay is about 1.5% of total deaths, a two-month delay is about 0.30%, and a three-month delay is about 0.11%. Therefore, in this study, we calculated the one-to three-month reporting delay rates of deaths in March 2021 for each prefecture and used them to adjust the observed number of deaths for the most recent three-month period (i.e. April to June 2021) to account for up to three months of reporting delay.

Results

Since January 2021, excess deaths were observed for the first time in the week corresponding to April 12–18 and have continued through mid-June, with the highest excess percentage occurring in the week corresponding to May 31–June 6 (excess deaths: 1431–2587; excess percentage: 5.95–10.77%) (Fig. 1). Similarly, excess deaths were observed in consecutive weeks from April to June in 18 of 47 prefectures. The largest cumulative number of excess deaths during this period was observed in Osaka Prefecture (1527–2629), followed by Hyogo Prefecture (839–1611) and Hokkaido Prefecture (652–1491). The highest excess percentage was observed in the week corresponding to May 3–9 (315–423; 18.44–24.77%) in Osaka Prefecture, in that corresponding to April 26–May 2 (187–268; 17.35–24.86%) in Hyogo Prefecture, and in that corresponding to June 7–13 (157–232; 13.38–19.78%) in Hokkaido Prefecture. The weekly observed and expected number of deaths for 47 prefectures can be found in the Supplementary Fig. 1, and the weekly excess number of deaths since April 2021 can be found in the Supplementary Table 1.

Discussion

For the first time since February 2020, when the first COVID-19 death was reported in Japan, excess deaths possibly related to COVID-19 were observed in April 2021, during the fourth wave. Osaka is the prefecture with the highest number of observed deaths from COVID-19 since the start of 2021 through June 27, 2021 ($n=2068$), followed by Tokyo ($n=1596$), Hyogo ($n=1072$), and Hokkaido ($n=932$).[6] The number of excess deaths during this period exceeded that of the observed COVID-19 deaths, possibly reflecting the deaths of non-infected people due to the disruption that the pandemic has caused. This is a very serious indication that Japan's healthcare system, which has coped so well with the past three waves, is finally unable to withstand COVID-19. In fact, it was reported that the healthcare systems in these prefectures were strained by the surge in COVID-19 cases during the fourth wave,[7] affecting urgent and emergency care for non-infected people, as well as general medical care and hospital services. It should be noted, however, that heterogeneity in excess deaths across prefectures is not necessarily explained by the resilience of the healthcare system alone[8] but that features outside the traditional healthcare system, such as leadership, social safety nets, and trust in the system to provide information and care, are also important.[9,10]

In the midst of the fifth wave of COVID-19, which surged again in July 2021 with the spread of the Delta variant,[11] many prefectures have issued requests to medical institutions to postpone hospitalization and surgery of non-urgent general patients as much as possible and to increase the number of beds for severely ill patients with COVID-19.[12] As of September 2021, when nearly half the population has received two doses of vaccine against COVID-19, the number of daily infections remains higher than during the fourth wave, and normal medical care remains limited. Continued monitoring of excess deaths is necessary to fully understand the impact of the COVID-19 pandemic, which varies by prefectures and has had a significant indirect impact on the population health.

The same limitations exist in this analysis as in other excess deaths studies,[13] including the reliance on provisional data

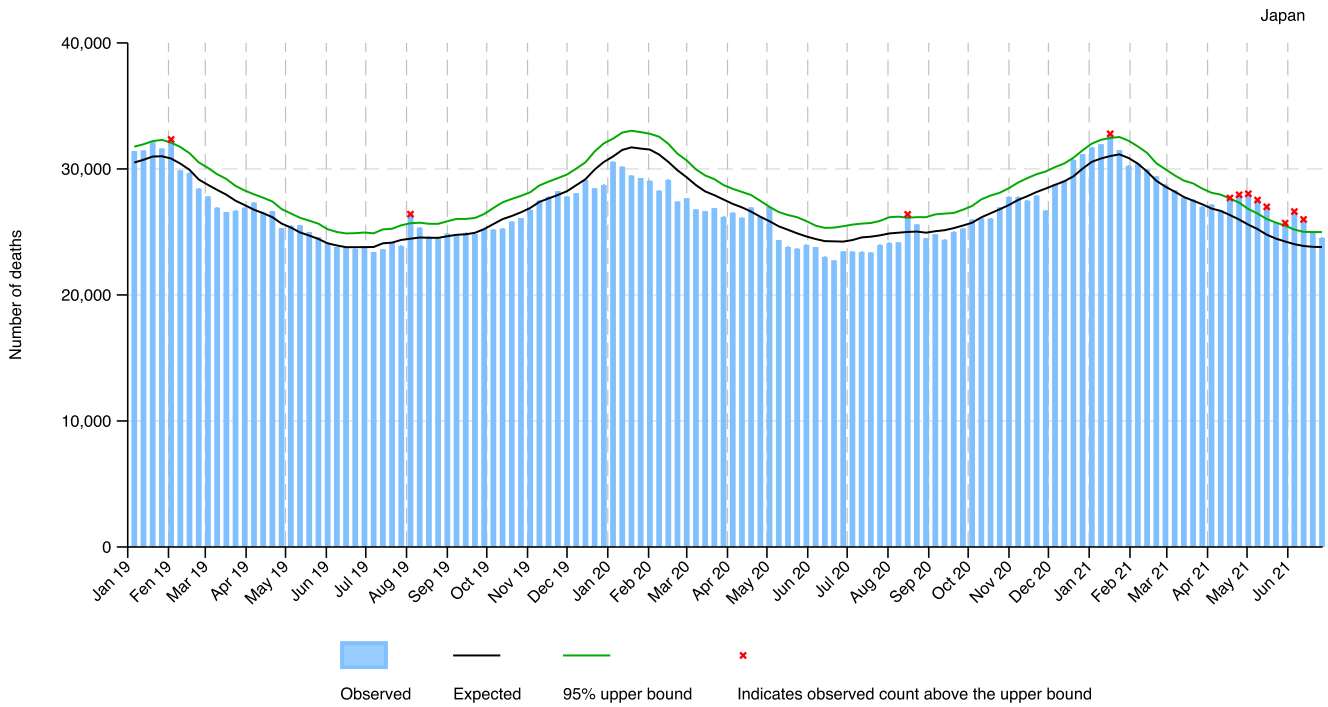

Fig. 1. Weekly observed and 95% upper bound of the expected weekly number of deaths in Japan from January 2019 through June 2021.

(although an attempt was made to adjust for reporting delays) and the assumptions applied in the model. It should be noted that the excess deaths presented in the study might be related to other factors unrelated to COVID-19.

Author statements

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Ethical approval

Ethical approval was granted by the Ethics Committee of the National Institute of Infectious Diseases, under authorization number 1174.

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Competing interests

None declared.

Author contributions

All authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: All authors.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Dr Nomura, Dr Eguchi.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Dr Nomura, Dr Eguchi, Dr Tanoue, Dr Yoneoka, Dr Kawashima.

Administrative, technical, or material support: Dr Nomura, Dr Suzuki, Dr Hashizume.

Supervision: Dr Hashizume.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2021.11.023.

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