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Decreased severity of the Omicron variant of concern: further evidence from Italy

Fabio Divino[1], Pierfrancesco Alaimo Di Loro[2], Alessio Farcomeni[3], Giovanna Jona-Lasinio[4], Gianfranco Lovison[5,6], Massimo Ciccozzi[7], Marco Mingione[4], Antonello Maruotti[2,8,*]

[1] *Department of Biosciences, University of Molise, Campobasso, Italy*
[2] *Department GEPLI, Libera Università Maria Ss Assunta, Rome, Italy*
[3] *Department of Economics and Finance, University of Rome "Tor Vergata", Rome, Italy*
[4] *Department of Statistical Sciences, University of Rome "La Sapienza", Rome, Italy*
[5] *Department of Economics, Management and Statistics, University of Palermo, Palermo, Italy*
[6] *Department of Epidemiology and Public Health, Swiss TPH Basel, Basel, Switzerland*
[7] *Department of Medicine, Unit of Medical Statistics and Molecular Epidemiology, University Campus Bio-Medico of Rome, Rome, Italy*
[8] *Department of Mathematics, University of Bergen, Bergen, Norway*

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Introduction

We are currently facing a COVID-19 pandemic ongoing wave because of the Omicron variant, owing to its very high transmissibility with a doubling time between 1.5 to 3 days (Pascarella et al., 2021).

According to Institute for Health Metrics and Evaluation forecasts, the massive wave of Omicron infections implies that hospital admissions will increase to twice or more the number of COVID-19 hospital admissions of past surges in some countries (IHME, 2022).

Fortunately, those forecasts were not confirmed, and early studies revealed that Omicron is less severe than other variants, with a risk of hospitalization ranging from 15% to 80% lower than the Delta variant (Wolter et al., 2022; Maslo et al., 2022; Abdullah et al., 2022; Christie, 2021), but the debate is still ongoing.

In this study, we focus on Italian cases and provide useful findings – derived from national-level COVID-19 surveillance data – as a reassuring confirmation of early indicators that the Omicron variant might lead to less severe disease and have a reduced effect on deaths and hospital resources than variants that dominated earlier pandemic waves.

Methods

We analyse disease severity by introducing a simple measure and comparing different waves during 2021, based on aggregated data on admissions to intensive care units and deaths.

Data come from the national surveillance system (https://github.com/pcm-dpc/COVID-19) and are on different scales. Thus, to summarize that information, we transform and rescale the indicators' time series by the size of the respective range (Divino et al., 2022). We obtained 2 comparable series on a standardized, comparable scale at each time point.

Formally, let $X_1, \ldots, X_k$ be a set of indicators of the same type (incidence-type or prevalence-type, for instance) observed at time $t = 1, \ldots, T$. For each indicator $X_j,\ j = 1, \ldots, k$, let $x_{j1}, \ldots, x_{jT}$ be the observed time series and define the following transformation:

$$\gamma_{jt} = \frac{x_{jt} - m_j}{M_j - m_j}, \tag{1}$$

where $m_j = min\{x_{j1}, \ldots, x_{jT}\}$ and $M_j = max\{x_{j1}, \ldots, x_{jT}\}$ respectively. Furthermore, if R_j denotes the observed range size, which is $R_j = M_j - m_j$, the transformation in (1) may be written as follows:

$$x_{jt} = m_j + \gamma_{jt} R_j, \tag{2}$$

where m_j is an offset and the standardized values γ_{jt} are the specific proportions of the range size R_j observed at each time point $t = 1, \ldots, T$. To avoid that the γ_{jt} may be null, a proper choice is to consider the modified relation $x_{jt} = \gamma_{jt} M_j$, which corresponds to $m_j = 0$ in (2), for every indicator.

* Corresponding author.
E-mail address: a.maruotti@lumsa.it (A. Maruotti).

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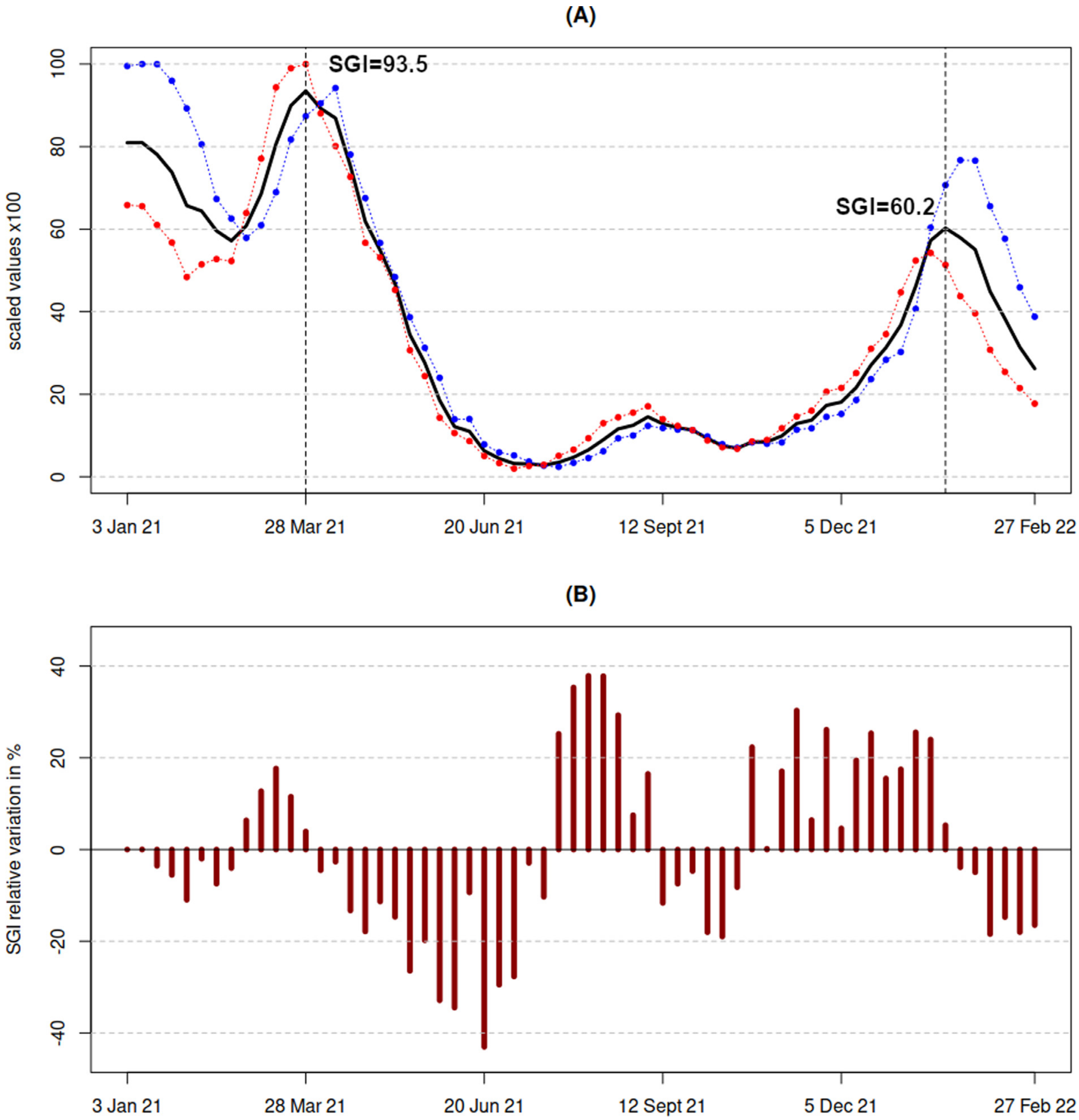

Figure 1. In Panel A, the Italian weekly series of transformed intensive care unit (ICU) admissions (red points) and deaths (blue points) with the severity generalized index (SGI) (black line); in Panel B, the relative variation (in %) of the SGI.
ICU = intensive care unit; SGI = severity generalized index.

Since the scaled values are proportions, in the spirit of the Human Development Index (HDI; United Nations, 2020), we propose a *severity generalized index* (SGI) expressed in terms of geometric mean (x100) to summarize the level of severity of the epidemic waves, that is:

$$SGI_t = 100 \times \sqrt{\gamma_{icu,t} \times \gamma_{death,t}}, \tag{3}$$

where $\gamma_{icu,t}$ and $\gamma_{death,t}$ are the intensive care unit (ICU) admissions and deaths scaled values, respectively. This can be further used to monitor and summarize information about ICU admissions and deaths over time. When k severity indicators are available, the SGI in (3) is as follows:

$$SGI_t = 100 \times \sqrt[k]{\prod_{j=1}^{k} \gamma_{jt}}.$$

Results

Figure 1 is meant to illustrate the behaviour of the SGI as compared with ICU admissions and deaths from January 2021 to February 2022. Panel A reports the weekly trend of the transformed indicators and the SGI. The weekly relative variations (in percentage) of the latter are reported in Panel B.

Three waves are visible: the first one, from the week after February 14, 2021, mainly referring to the Alpha-Delta variants; the second, from the week after July 4, 2021; and the last caused by Omicron, from the week after October 17, 2021, and still active, although decreasing quickly.

Aside from the summer wave, which shows minimal severity because of seasonal effects, the peak of the SGI for the Alpha-Delta wave is 93.5, whereas the peak for the Omicron wave is 60.2. The relative ratio is 1.55, that is, the Alpha-Delta variants severity is about 55% higher than the Omicron variant. It is quite possible that immune protection can explain the reduction in the severity risk for Omicron versus Alpha-Delta against more severe outcomes of infection, which are expected to be much higher than those against milder disease. The results are "filling in a blank" about protection against severe diseases.

Discussion

The use of the SGI allows us to compare severity at 2 different time points, such as the peaks of different waves, but could also be used for monitoring purposes. Its use as a descriptive tool allows us to jointly compare the graphical patterns of several indicators. It reflects the evolution of severity over time and may be used as an alert to the increasing pressure on the health system.

Of course, the observed maximum values (or the range sizes) depend on the time points considered. It is strongly data-driven, which is not a drawback in general and can be used if only aggregated data are available.

The observed reduction in severity is believed to be driven by the combination of the fundamental properties of the Omicron variant and the high levels of population immunity achieved through vaccinations and previous infections. The effects of increasing immunity (by vaccination or previous infection) on the spread and severity of the Alpha and Delta variants during the first half of 2021 have been discussed in Marziano et al. (2021). The authors estimated a reduction in deaths of about 27% (95% confidence interval [CI]: 15%-47%), although the fully susceptible population was still abundant (about 36% on June 30, 2021) and high levels of heterogeneity by age were present.

The level of protection against COVID-19 of the Italian population steeply increased during the second half of 2021, with a significant increase since October 2021 (i.e. when booster doses were introduced). On December 31, 2021, about 74% of the Italian population was fully vaccinated (plus 6% with a single dose), of which about 43% also received the booster dose. This sums up to about 32% of the population being protected by the 3 doses (Our World in Data, 2022). The most recent studies (see e.g. Andrews et al., 2022a; 2022b) found substantial evidence that protection against severe disease and death is maintained at high levels for several months after the booster vaccination, including the Omicron variant. In contrast, the protection wanes more quickly against milder (asymptomatic or symptomatic) infections. These considerations are also apparent in the behaviour of the aggregate data and the SGI. Indeed, the all-time-high number of weekly positives reached during the Omicron wave was accompanied by a relatively limited increase in severity.

Conflict of interest

We declare that we have no conflict of interest.

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Ethical statement

This study is compliant with ethical standards.

Informed consent

Considering the design of the study, no informed consent was necessary.

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