No Excess Total Mortality in Italy in the First Semester of 2023 at All Ages and in the Working Age Population

Gianfranco Alicandro[1,2*], Alberto G. Gerli[3], Claudia Santucci[3], Stefano Centanni[4], Giuseppe Remuzzi[5], Carlo La Vecchia[3]

[1] Department of Pathophysiology and Transplantation, Università degli Studi di Milano, Milan, Italy
[2] Cystic Fibrosis Centre, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy
[3] Department of Clinical Sciences and Community Health, Università degli Studi di Milano, Milan, Italy
[4] Respiratory Unit, Department of Health Sciences, ASST Santi Paolo e Carlo, Università degli Studi di Milano, Milan, Italy
[5] Istituto di Ricerche Farmacologiche Mario Negri IRCCS, Bergamo, Italy

Abstract

Background: *Italy experienced a sustained excess in total mortality between March 2020 and December 2022, resulting in approximately 226,000 excess deaths. This study extends the estimate of excess mortality in the country until June 2023, evaluating the persistence of excess mortality.* **Methods:** *We used mortality and population data from 2011 to 2019 to establish a baseline for expected deaths during the pandemic. Over-dispersed Poisson regression models were employed, stratified by sex, to predict expected deaths. These models included calendar year, age group, and a smoothed function for the day of the year as predictors. Excess mortality was then calculated for all ages and working ages (25-64 years).* **Results:** *From January to June 2023, we found a reduction in the number of deaths compared to the expected ones: 6,933 fewer deaths across all age groups and 1,768 fewer deaths in the working age category. This corresponds to a 2.1% and 5.2% decrease in mortality, respectively.* **Conclusions:** *The excess mortality observed in Italy from March to December 2022 was no longer observed in the first six months of 2023.*

1. Introduction

During the first half of 2023, there has been a global decrease in COVID-19-related deaths, hospitalizations, and intensive care unit admissions [1]. This reassuring trend, along with the high levels of population immunity to SARS-CoV-2, prompted the WHO Director-General, with the advice of the International Health Regulations (2005) Emergency Committee regarding the COVID-19 pandemic, to determine in May 2023 that COVID-19 has transitioned from being a global public health emergency to an established and ongoing health issue which no longer constitutes a public health emergency of international concern [2]. However, they also acknowledged the remaining uncertainties posed by

the potential evolution of SARS-CoV-2. In this regard, some concerns arise from the recent excess mortality reported in Australia and New Zealand, countries with high vaccine uptake that did not experience excess mortality during the previous phases of the pandemic [3-5].

Thus, collecting and monitoring relevant epidemiological data on the evolution of the COVID-19 pandemic is important. In this regard, excess total mortality is a critical metric. This measure captures the discrepancy between the number of observed deaths during the pandemic and those expected based on historical data. Unlike official COVID-19 death counts –which can be influenced by varying definitions, diagnostic criteria, and potential underreporting –excess total mortality offers a

comprehensive and robust understanding of the pandemic's overall impact [6].

In our previous work, we estimated a total excess of approximately 100,000 deaths in Italy from March to December 2020, around 60,000 and 66,000 additional deaths in 2021 and 2022, respectively [7, 8]. This excess mortality affected not only the elderly population but also working-age individuals, with approximately 15,000 excess deaths estimated at ages 25 to 64 from March 2020 to December 2022. No further excess was instead observed in the initial months of 2023. The present study extends these analyses to cover the most recent period.

2. METHODS

National daily mortality data and corresponding population data from January 1, 2011, to June 30, 2023, were retrieved from the Italian National Institute of Statistics archives [9]. We computed the difference between observed and expected deaths using a counterfactual scenario in which the COVID-19 pandemic had not occurred. Daily expected deaths were estimated separately for men and women using an over-dispersed Poisson regression model. The model included a linear term for the calendar year to account for temporal trends in mortality, age groups (<1, 1-4, 5-9, ..., ≥100 years) to consider the effect of age on mortality rate and a natural spline function of the day of the year to capture seasonal variations. To account for changes in the population's demographic size and age structure, the model included the natural logarithm of the population as an offset term. The number of knots in the spline function was selected based on the quasi-Akaike Information Criterion, testing up to 10 equally spaced knots. Model's coefficients were estimated using daily mortality data from January 1, 2011, to December 31, 2019.

Excess mortality was reported in absolute (the difference between observed and expected deaths) and relative terms (as percent deviations from expected mortality) by combining the sex-specific estimates obtained from the regression models. Both measures were computed for all ages and the working-age population, defined as individuals aged between 25 and 64.

We conducted a Monte Carlo simulation to obtain the 95% confidence intervals (CI) surrounding excess deaths. We sampled 10,000 model parameters from a multivariate normal distribution using the parameter's estimates and their variance-covariance matrix. Subsequently, we calculated the variance of the excess death estimates for each simulation by calculating the difference between observed and expected deaths. The 95% CI was then derived using the quantiles of the standard normal distribution.

Statistical analyses were conducted using R software.

3. RESULTS

Table 1 gives the differences between observed and expected deaths in Italy from January to June 2023 for individuals of working ages (25-64 years) and for the whole population. Within the working-age group, we estimated a decrease of approximately 1,800 deaths compared to the expected numbers. This reduction was particularly prominent during the first three months of the year. Similarly, we estimated a decrease of around 8,000 deaths when considering the entire population. This reduction was most notable in March and June.

Figure 1 shows the estimates of excess (or reduced) deaths in absolute and relative terms across four different periods: from March to December the entire 2020, 2021, and 2022, and January to July 2023. Excess mortality for the working-age population stood at approximately +10% in March-December 2020 and 2021, and it decreased to +4.3% in 2022. In January-June 2023, we estimated a reduction of 5.2%. Among the whole population, the excess mortality estimates for March-December 2020 were +18.8%, which decreased to +9.3% in 2021 and +10.2% in 2022. During the first half of 2023, we estimated a reduction in total mortality of 2.1%.

Figure 2 shows the temporal trends of officially reported COVID-19 cases and our estimates of excess mortality in Italy over the pandemic period and up to June 2023. The initial phase, spanning from March to April 2020, showed a sharp increase in excess mortality, even though there were only a limited number of officially registered COVID-19 cases. The subsequent phase, which extended from

Table 1. Difference between observed and expected deaths from all causes in the first six months of 2023 in Italy among the working-age population (25-64 years) and the whole Italian population.

Age group	Month	Observed Deaths	Expected Deaths[1]	Difference	95% CI
Working-age (25-64 years)	January	6,167	6,746	-579	-623 to -534
	February	5,445	5,865	-420	-458 to -381
	March	5,451	6,009	-558	-595 to -520
	April	5,256	5,309	-53	-86 to -19
	May	5,176	5,215	-39	-73 to -4
	June	4,946	5,062	-116	-148 to -83
	Total	**32,441**	**34,209**	**-1,768**	**-1964 to -1571**
All Ages	January	66,607	66,614	-7	-370 to 356
	February	58,311	57,908	403	98 to 707
	March	56,382	59,351	-2,969	-3269 to -2668
	April	52,534	52,468	66	-209 to 341
	May	50,162	51,506	-1,344	-1627 to -1060
	June	46,863	49,942	-3,079	-3340 to -2817
	Total	**330,859**	**337,792**	**-6,933**	**-8404 to -5461**

CI: Confidence Interval.
[1]Estimated from 2011–2019 mortality and population data, separately by sex, through over–dispersed Poisson regression models including a linear term for the calendar year, age groups as a categorical variable, a smooth function of the day of the year with seven equally spaced knots, and the natural logarithm of the population as an offset term. Values were rounded up to the smallest integer.

September 2020 to April 2021, was characterized by a complex scenario with multiple waves of COVID-19 cases and important peaks in excess mortality. These peaks were notable but less pronounced than those observed in the first phase. In January 2022, during the Omicron peak, despite a substantial increase in COVID-19 cases, there was no corresponding rise in excess mortality. Later in 2022, different subvariants of Omicron became dominant, leading to new COVID-19 cases and sustained excess mortality. It is worth noting that the mortality peak observed in July 2022 was partially attributed to the extreme temperatures recorded during that month, which was related to an estimate of approximately 12,000 excess deaths. In addition, seasonal influenza peaked in Italy in November-December 2022. The latter part of 2023 displays a significant reduction in both COVID-19 cases and excess mortality.

4. Discussion

We estimated a decrease of over 2% in the total number of deaths in Italy during the first half of 2023 compared to the expected figures based on historical trends. There was also a decrease of over 5% in the working-age population.

The statistical office of the European Union reported that during the first semester of 2023, the entire European Union-27 experienced a level of mortality comparable to or slightly higher than the expected one based on a baseline period spanning from 2016 to 2019 [10]. However, when individual countries are examined, the results are mixed. Some countries, such as Austria and Netherlands, showed important excesses that in some months exceeded 10%, while others, including Bulgaria, Croatia, Lithuania, and Romania, showed decreased mortality.

In England, the Office for Health Improvement & Disparities used a statistical model based on historical trends to derive the expected number of deaths in the absence of the pandemic and found an excess mortality of approximately 18,500 deaths (+6.1%) for the whole population of England in the first six months of 2023 [11]. In the same period, the number of deaths with COVID-19 mentioned on the death certificate was only around 11,500.
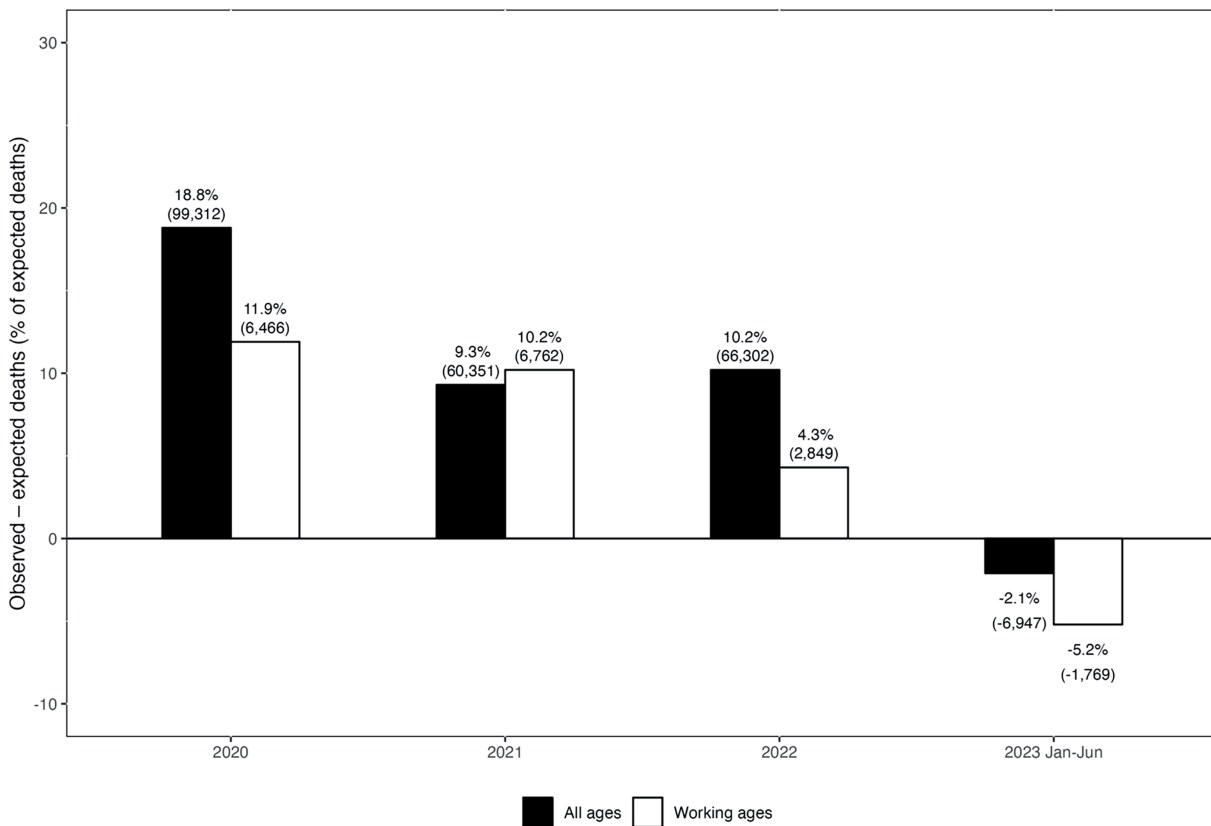
Figure 1. Differences between observed and expected deaths in Italy at all ages and working ages (25-64 years) in March-December 2020, 2021, 2022, and from January to June 2023.
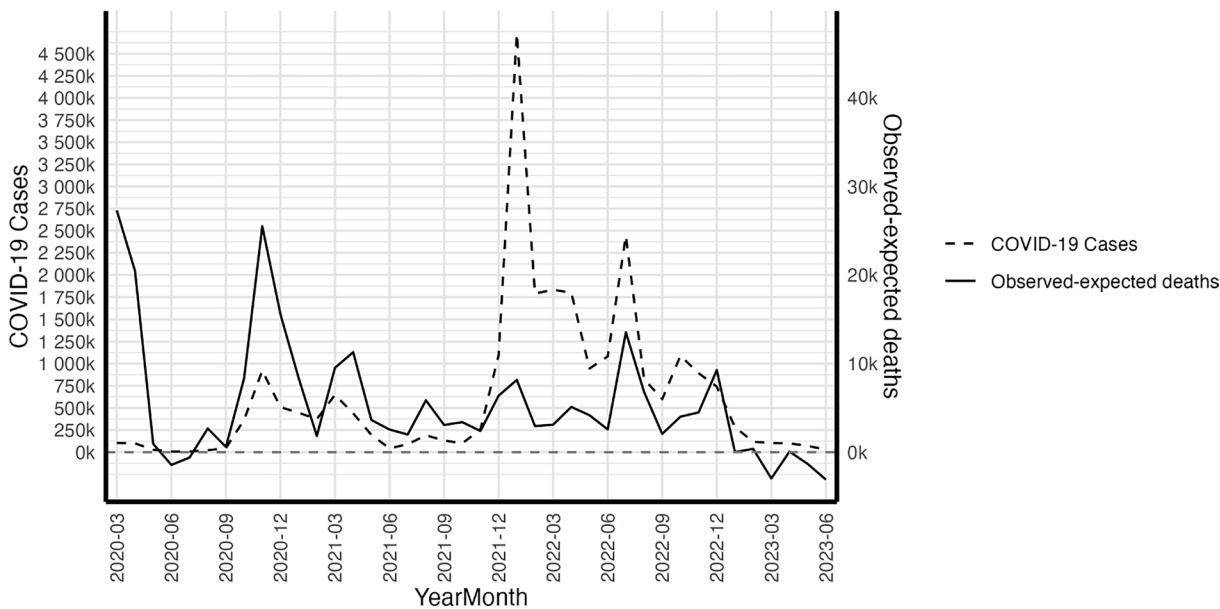
Figure 2. Monthly trend in COVID-19 cases and difference between observed and expected deaths from March 2020 to June 2023 in Italy.

Notably, the excess mortality in England also persisted among the working-age population and was higher than in the older age groups (+12.9% vs. 5.8%) [12]. These excesses were mainly driven by increased mortality from cardiovascular diseases observed in England since the first phase of the pandemic and sustained all over the first semester of 2023.

During the COVID-19 pandemic, mortality from other chronic conditions, including cardiovascular diseases and diabetes, remarkably increased in several countries, including the UK [12]. This increase in excess mortality due to cardiovascular diseases was more pronounced in the younger population than the older one in the UK and several other high-income countries.

The Center for Disease Control and Prevention used a similar model-based approach and reported excess mortality rates of 14%, 9.2%, and 5.2% in the first three weeks of January 2023 for the entire US population, with no significant excesses reported thereafter [13].

Identifying the possible reasons for these differences is challenging, given that countries like Austria, the Netherlands, England, and Italy have all achieved a high level of vaccine uptake and have relaxed non-pharmaceutical interventions implemented during earlier phases of the pandemic. Therefore, structural characteristics of these countries, such as the preparedness and resilience of their health and social care systems in responding to pandemic-induced disruptions, may have played a role.

Variations in the methodology employed to estimate excess mortality, particularly using different baseline periods, should be considered when interpreting our estimates and those provided by other institutions or research groups [14]. Another significant source of differences across countries lies in the provisional data released during the pandemic, along with delayed registration of deaths, both of which can impact cross-country comparisons.

6. Conclusions

Our estimates indicate that during the first half of 2023, there was no excess mortality in Italy, both among the entire population and the working-age population. The modest decrease in mortality during this period can be partly attributed to harvesting and the early arrival of seasonal influenza in the winter of 2022-2023, resulting in a larger impact on mortality in November-December 2022 than in the early months of 2023. While data on total mortality are reassuring for the first half of 2023, the recent increase in COVID-19 cases demands attention. It is crucial for countries to continue providing timely mortality data to effectively monitor the ongoing impact of COVID-19.

REFERENCES

1. Edouard Mathieu, Hannah Ritchie, Lucas Rodés-Guirao, et al. (2020) - "Coronavirus Pandemic (COVID-19)". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/coronavirus' [Online Resource] [Last Accessed October 9, 2023].
2. WHO. Statement on the fifteenth meeting of the IHR (2005) Emergency Committee on the COVID-19 pandemic. WHO Dir Gen Speeches 2023:1–6. https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic [Online Resource] [Last Accessed October 9, 2023].
3. Australian Bureau of Statistics. Measuring Australia's excess mortality during the COVID-19 pandemic until the first quarter 2023 2023. https://www.abs.gov.au/articles/measuring-australias-excess-mortality-during-covid-19-pandemic-until-first-quarter-2023#cite-window1 [Last Accessed October 9, 2023].
4. Adair T, Houle B, Canudas-Romo V. Effect of the COVID-19 pandemic on life expectancy in Australia, 2020-22. *Int J Epidemiol.* 2023. Doi: https://doi.org/10.1093/IJE/DYAD121
5. Kung S, Hills T, Kearns N, Beasley R. New Zealand's COVID-19 elimination strategy and mortality patterns. *Lancet.* 2023. Doi: https://doi.org/10.1016/s0140-6736(23)01368-5

6. Islam N. "Excess Deaths" Is the Best Metric for Tracking the Pandemic. *BMJ*. 2022;376:o285. Doi: https://doi.org/10.1136/bmj.o285

7. Alicandro G, Gerli AG, Centanni S, Remuzzi G, La Vecchia C. Excess Total Mortality in Italy: An Update to February 2023 with Focus on Working Ages. *Med Lav*. 2023;114:e2023028. Doi: https://doi.org/10.23749/MDL.V114I3.14740.

8. Alicandro G, Gerli AG, Remuzzi G, Centanni S, La Vecchia CL. Updated estimates of excess total mortality in Italy during the circulation of the BA.2 and BA.4-5 Omicron variants: April-July 2022. *Med Lav*. 2022;113: e2022046. Doi: https://doi.org/10.23749/MDL.V113I5.13825

9. Istituto Nazionale di Statistica. Decessi e cause di morte: cosa produce l'Istat 2021: from https://www.istat.it/.https://www.istat.it/it/archivio/240401[Online Resource] [Last Accessed October 9, 2023].

10. Eurostat.2023:1.https://ec.europa.eu/eurostat/databrowser/view/tps00202/default/map?lang=en [Last Accessed October 9, 2023).

11. Excess mortality in England and English regions - GOV. UK n.d. https://www.gov.uk/government/statistics/excess-mortality-in-england-and-english-regions [Last Accessed October 9, 2023].

12. Alicandro G, La Vecchia C, Islam N, Pizzato M. A comprehensive analysis of all-cause and cause-specific excess deaths in 30 countries during 2020 [published online ahead of print, 2023 Sep 8]. *Eur J Epidemiol*. 2023;10/1007/s10654-023-01044-x. Doi: 10.1007/s10654-023-01044-x

13. Hartnett KP, Kite-Powell A, DeVies J, et al. Excess Deaths Associated with COVID-19. MMWR Morb Mortal *Wkly Rep*. 2020; https://ww:826–34. https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm%0Ahttps://doi.org/10.1111/bjh.16785 [Last Accessed October 9, 2023].

14. Levitt M, Zonta F, Ioannidis JPA. Excess death estimates from multiverse analysis in 2009-2021. *Eur J Epidemiol*. 2023:1-11. Doi: https://doi.org/10.1007/S10654-023-00998-2