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Lockdown measures and COVID-19 related deaths during the first and second COVID-19 waves in Italy: A descriptive study

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Abstract

Introduction: The aim of this study was to compare the effectiveness of lockdown measures in Italy between the first and the second wave of the COVID-19 pandemic.

Methods: In this observational study, the total number of COVID-19 related deaths drawn by Worldometer and the COVID-19 Stringency Index (SI) were used. Descriptive statistics and student t-test were applied for comparison.

Results: The number of deaths in Italy was higher during the second wave (n = 38,549) compared to the first wave (n = 34,167). During the first wave, the mean SI was significantly higher (M = 79.96, SD = 15.76) compared to the second wave (M = 67.36, SD = 14.17; t = 4.73, P < 0.001).

Discussion and Conclusion: In Italy, a two-wave pattern in the reported COVID-19 during the 2020 pandemic was reported; while lockdown measures were more restrictive during the first wave, the number of COVID-19 related deaths was higher during the second wave. This could be attributable to the relaxation of social distancing measures after the end of the first wave. Our findings may provide precious information to Italian and international stakeholders to address the next waves of COVID-19 pandemic.

KEY WORDS: COVID-19; Italy; lockdown measures; public health; SARS-CoV-2; Stringency Index.

INTRODUCTION

On 30th January 2020, the World Health Organization (WHO) declared the COVID-19 epidemic in China as a 'public health emergency of international concern'. Later, on 11 March 2020, COVID-19 epidemic was officially declared a pandemic by the WHO [1]. While China was the central location of the SARS-CoV-2 outbreak from December 2019 to February 2020, Italy was the most hit country in Europe during the first wave, so that, in March 2020, Italy was described as 'the second epicenter of the pandemic' [2]. In Italy, the first official case was detected in Codogno, on 21 February 2020. Since this period, COVID-19 has strongly hit Italy, especially certain at high-risk categories like healthcare workers (HCWs), elderly and people affected by co-morbidity, the so-called 'fragile' or vulnerable strata of populace.

As of 21 March 2021, 126,606 Italian healthcare professionals were infected with SARS-CoV-2 while in the general population, 3,356,331 infection cases and 104,642 deaths resulted in a case fatality ratio of 3.12% [3–6]. In Italy, the immediate political response to the first wave was very strong. Italy's strict and generalized lockdown -one of the world's longest and severe in Europe - has been credited with getting the major outbreak under control [7], and the way Italy handled the first wave was considered a lesson for other countries [8, 9]. In February 2020, restrictive measures were put in place in the red Zone in 11 municipalities in Lombardy and Veneto. The public health strategies put in place were targeted to flattening the curve, namely decreasing and/or delaying the peak of the COVID-19 epidemic, to guarantee the capacity of healthcare systems and buy time to vaccinate the population [10]. The Decree Law no.6 of the 23 February 2020, integrated by Decree Law no.19 of the 25 March 2020 required among urgent measures to tackle the pandemic, some non-pharmaceutical interventions (NPIs), including isolating ill per-

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TAKE-HOME MESSAGE

In Italy, a two-wave pattern in reported cases of coronavirus disease-19 during the 2020 pandemic was reported; while lockdown measures were more restrictive during the first wave, the number of COVID-19 related deaths was higher during the second wave.

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sons, contact tracing, quarantine of exposed persons, travel restrictions, school and business closures, cancellation of mass gatherings, and hand washing, measures that in literature are considered essential components of the public health response to any outbreaks. In Italy, the implementation of strict health policy measures was effective in containing the spread of COVID-19, so that the curve was gradually, but forcefully, flattened between June and August 2020 [11].

In the second phase of pandemic, the Decree Law no. 33 released on 16 May 2020 led to a relaxation of lockdown measures in place. Thus, the resumption of touristic activities during the summer 2020, the reopening of schools and business activities in September, and a crowded and poorly managed public transport service needed for resuming these activities resulted in the resurgence of COVID-19 cases, in Italy as well as in other European countries [12]. Therefore, in October 2020 the curve showed a rapid rise [11]. But, while policymakers addressed the first wave with a severe and generalized lockdown, the second wave has been addressed with differentiated and coordinated regional interventions and without generalized lockdown to save economy. Minimum precautionary measures to counteract and contain the spread of COVID-19 were established, and increasingly restrictive measures were established based on a risk score assigned to each Region by the National Institute of Health at the Ministry of Health, taking into account the local transmissibility of the virus and the preparedness of the regional health care service. The Regions were allowed to enhance stricter and targeted measures than those established at national level based on local curve trends.

As a result of this new strategy, the 'flattening' effect on the second curve was less evident. The curve of the second wave decreased but, differently from the first wave, did not flatten out. This was likely due to less severe restrictions adopted by Italian policymakers in this phase of the pandemic. Since March 2021, Italy as well as other EU countries are enforcing new lockdown measures, as new COVID-19 infection cases are steadily increasing. Experts said the third wave in Italy and other European countries had already begun [13]. This comparison is to verify if more stringent measures resulted in lower rates of COVID-19 related deaths. In view of the forthcoming third wave, showing worrisome aspects related to the spreading of new coronavirus variants, a comparison of the first two waves may be useful for identifying best evidence-based health policy strategies to address the third ongoing COVID-19 wave both locally and internationally. Indeed, given the social and economic costs caused by lockdown measures, the effectiveness of distancing measures applied should be evaluated in terms of reduction of incidence and mortality from COVID-19. In this short paper, we compare the different strategies put in place in Italy during the first two waves, namely the generalized lockdown carried out from March to May 2020 *versus* the targeted lockdown measures carried out from September 2020 to December 2020.

METHODS

The efficacy of the public health strategies put in place in Italy during the first and second waves was evaluated in terms of COVID-19 related mortality. In this study, the incidence of new daily cases as well as the infection fatality rate, which is the total number of deaths by the total number of cases, were not used for comparison. Indeed, the total number of COVID-19 cases is unknown as many infection cases remained untested especially during the first wave. Instead, the absolute frequency (total number) of COVID-19 related deaths was used, because it is a good indicator of the control intervention strategies needed to 'flatten' the curve [14] and can be considered a good proxy of new daily COVID-19 infection cases, as well as an indirect index of the burden on hospitals being overrun and, therefore, delivering suboptimal care [15].

To identify the length of the two waves (period of the year and number of days), the COVID-19 Special report provided by the Graduate School of Health Economics and Management (ALTEMS) ALTEMS on epi-

demiology of COVID-19 in Italy was used. The ALTEMS has been monitoring the response of the Italian National Health System since the beginning of the emergency with weekly Instant Reports, to provide an integrated analysis of available data on COVID-19 [16, 17]. According to this Report, in Italy the first wave began on 24 February 2020 and ended on 11 June 2020. The second wave started on 14 September 2020 and ended on 31 December 2020. Both waves had the same number of days (*n* = 109). Fourteenth September corresponds to the re-opening of the schools and school shutdown was used as measure of quarantine in previous research [18].

Data on number of deaths was drawn by the COVID-19 Special Report by ALTEMS and was cross-checked with data drawn by the 'Worldometer country' [19] database (accessed on 21 March 2021), which is a reputable provider of COVID-19 statistics and data collected by the most reputable national and international organizations, including the United Nations, the World Health Organization, the Food and Agriculture Organization, Organisation for Economic Co-operation and Development (OECD) and others, already used in previous epidemiological surveys in COVID-19 [18]. Data from these international databases were drawn to describe the trend of new daily cases and deaths during the two waves in Italy.

The COVID-19 Stringency Index [20], which was successfully used in previous studies [11, 12], was accessed on 4th April 2021 to measure the degree of policy response deployed by Italian Government and Regions. This is a composite measure provided by the Oxford COVID-19 Government Response Tracker (OxCGRT), based on specific response indicators (school and workplace closures, cancel public events, restrictions on gatherings, close public transport, public information campaigns, stay at home, restrictions on internal movement, international travel controls, testing policy, and contact tracing) rescaled to a value from 0 to 100 (100 = strictest) [21].

Descriptive statistics (frequency, means) were used to describe the trend of the curves. Student t-test was used for comparing the means of the COVID-19 Stringency Index carried out during the two waves to evaluate their difference.

RESULTS

The first wave: Italy as the new epicenter of the COVID-19 crisis

From the first official case of Codogno on 21 February 2020, as of 6th May, 2020, 214,457 Italian people had a confirmed diagnosis of COVID-19 [22]. During lockdown, transmission was reportedly sustained especially by epidemic foci within families, long-term care facilities and hospitals [23]. The improvement of the epidemiological situation has allowed an easing of the restrictive measures. On 4th May, Italy entered a second phase of its coronavirus lockdown, with a progressive restarting of working activities, even schools and childcare services remained closed and gatherings forbidden. It was permitted doing individual physical activity and meeting relatives.

The situation gradually improved over the next three months. Eleventh June 2020 officially started the Phase II with the Governmental Decree, which allowed from the 15th of June most of the activities and movements. On 31 July 2020 (see Figure 1, [24]), the minimum number of confirmed cases from February 2020 onwards was reached. Despite this, the contact tracing, isolation, and testing activity were still needed. The Italian Government called Regions for monitoring local epidemic trend with the aim of tailoring the containment measures to the particular needs of regions, containing the occurrence of possible local outbreaks [1]. In September 2020, the restarting of work activities was associated with a relief of the socio-economic situation, in contrast to other European and non-European countries where the pandemic was probably less effectively controlled due to less stringent restrictions. The second wave in other European countries was therefore likely anticipated and more sustained [25].

The second wave in Italy

Since early October 2020, all the epidemiological indicators, i.e. new infected cases, number of serious or critical cases and new deaths, suddenly increased in the wake of the trends of other most hit European countries (e.g., France, Spain and UK). As of 18, October 2020, the R number across the 21 Italian regions was higher than 1, more specifically comprised between 1.24 and 1.72 [26, 27].

At this point, the 'testing, tracing and isolation' strategy carried out by health authorities, which was effective during the first lockdown and after, during the summer, as the first line of defense against the virus, was broken [28, 29], Therefore, the increasing trend of new infection cases during October 2020, prompted the Italian government, starting from early 3 November 2020, to apply a new health policy strategy to tackle the effects of the second wave. On November 3, 2020, a new Decree issued by the President of the Council of Ministers was passed, extending the minimum precautionary measures to counteract and contain the spread of COVID-19.

A comparison between the first and second wave in Italy

In the context of the first wave of COVID-19 pandemic, the containment measures of national lockdown and quarantine in Italy started on 8 March 2020 and ended on 18th May 2020. On 21 March 2020, the peak of new daily cases was reached with 6,554 new daily infection cases. On 27 March 2020, daily deaths peaked 921. However, the severe lockdown policies were effective and flattened the curve of the first wave. On 24 July 2020, indeed, only 5 daily deaths were registered.

The early beginning of the second curve could be identified on 7 August 2020, when 552 new daily infection cases were registered. On 14 September 2020, at the reopening of the schools, 1,011 new daily cases of infection were registered but with only 14 deaths.

On 7 October 2020, new 3,678 daily cases were registered, with 31 deaths. Since that, the rapid rise of the curve peaked on 13 November 2020 with 40,896 new daily cases. On 3 December 2020, daily deaths peaked 993. The less stringent measures carried out in the face of the second wave by Government and regions lowered the curve but without flattening it. On 28 December 2020, Italy reported the lowest daily COVID-19 cases (n = 8,583) since the mid-October (on 14 October, 7,331 daily cases). In the following days, the curve of new daily cases remained stable. On 25 February 2021, 19,875 new daily cases represented the starting point of a new rise of the curve, which likely corresponds to the beginning of the third wave.

According to Worldometer, during the first 8 months of pandemic in Italy (from 17 February 2020 to 17 October 2020) a total of 36, 474 deaths were registered. In the next 5 months (from 17 October 2020 to 17 March 2021), deaths doubled by reaching the total count of 103,432 [24]. According to ALTEMS, the number of deaths was higher during the second wave (n = 38,549) than that occurred during the first wave (n = 34,167). As shown in Table 1, during the first wave the mean SI was higher (SI = 79.96, SD = 15.76) than that measured during the second wave (M = 67.36, SD = 14.17). This difference was statistically significant (t = 4.73, P < 0.001).

DISCUSSION

The visual comparison between the first and second waves in Italy showed how the second curve was much higher and larger than the first. This could be attributable to the differences concerning tracing and testing activity, as many cases during the first wave were untested due to lack of knowledge, resources, and available tests, and remained underdiagnosed. However, the higher number of deaths during the second wave, notwithstanding the most available resources in terms of diagnostic and therapeutic strategies, could be indirectly the proof that the first generalized lockdown measures carried out by Central Government were more effective in containing the contagion than those carried out by the Italian government in coordination with the Regions during the second wave. The important role

Table 1. Comparison of Stringency Index during the first two waves in Italy [20].

First wave (109 days, 34,167 deaths)			Second wave (109 days, 38,549 deaths)		
Period	No.days	SI	Period	No. days	SI
24 February-3 March	9	69.91	14 September-5 October	22	47.22
4 March-9 March	6	74.54	6 October-13 October	8	55.56
10 March	1	82.41	14 Octobber-22 October	9	50
11 March-19 March	9	85.19	23 October	1	68.52
20 March-9 April	21	91.67	24 October-5 November	13	66.67
10 April-11 April	2	87.96	6 November-9 November	4	76.85
12 April-3 May	22	93.52	10 November-23 December	44	79.63
4 May-15 May	12	62.96	24 December-27 December	4	84.26
16 May-17 May	2	66.67	28 December-30 December	3	80.56
18 May-1 June	15	63.89	31 December	1	84.26
2 June	1	52.78			
3 June-10 June	8	44.44			
11 June	1	50			
SI first wave (M = 76.96 SD = 15.76)			SI second wave (M = 67.36 SD = 14.17)		

played by the NIPs, has been described by Li et al, who showed in 131 countries, during the first half of 2020, a significant reduction of the effective reproduction number (R), which is the average number of infections produced by a single infected person in a population with partial immunity, by implementing lockdown measures [30, 31]. The reduction of new daily cases corresponds to the reduction of the number of deaths.

Another study on the effect of major interventions across 11 European countries from February 2020 to 4 May 2020, showed that major non-pharmaceutical interventions-and lockdowns in particular-have had a large effect on reducing transmission [18]. In Italy, Giordano et al. showed how the estimated basic reproduction number (R0) was reduced from 2.38 on day 1 (February 20) to 1.60 on day 22 (March 13), when the nation-wide lockdown was announced, and from 0.99 on day 28 (March 19) to 0.85 on day 38 (March 29), suggesting that social or 'physical' distancing measures, population-wide testing and contact tracing policies and practices were initially effective [32]. As suggested by Odusanya et al, non-pharmacological interventions are

more effective when they are instituted early in the pandemic and for sustained periods. However, they are more effective when implemented in the context of the cultural and socioeconomic conditions of the populace [33]. They can be effective in curbing the new daily cases and, by flattening-the-curve, the likelihood of hospitals being overrun and, therefore delivering suboptimal care is reduced, and this, in turn, is associated with a reduction in COVID-19 mortality and case fatality ratio [34]. In China, scholars found that without non-pharmaceutical interventions, the number of cases would have been 67-fold higher [30]. However, non-pharmaceutical intervention may have social and economic consequences as well. Thus, the lifting of the COVID-19 lockdown in Italy was justified on the need of an evidence-based approach to population health management based on a holistic view, by combining risk factors and bio-economic outcomes, including actors' behaviors. This second strategy showed, however, some limitations, because defining methods of lockdown-lifting and follow-up (middle-term rules) that best meet the needs for resumption of economic activity, societal
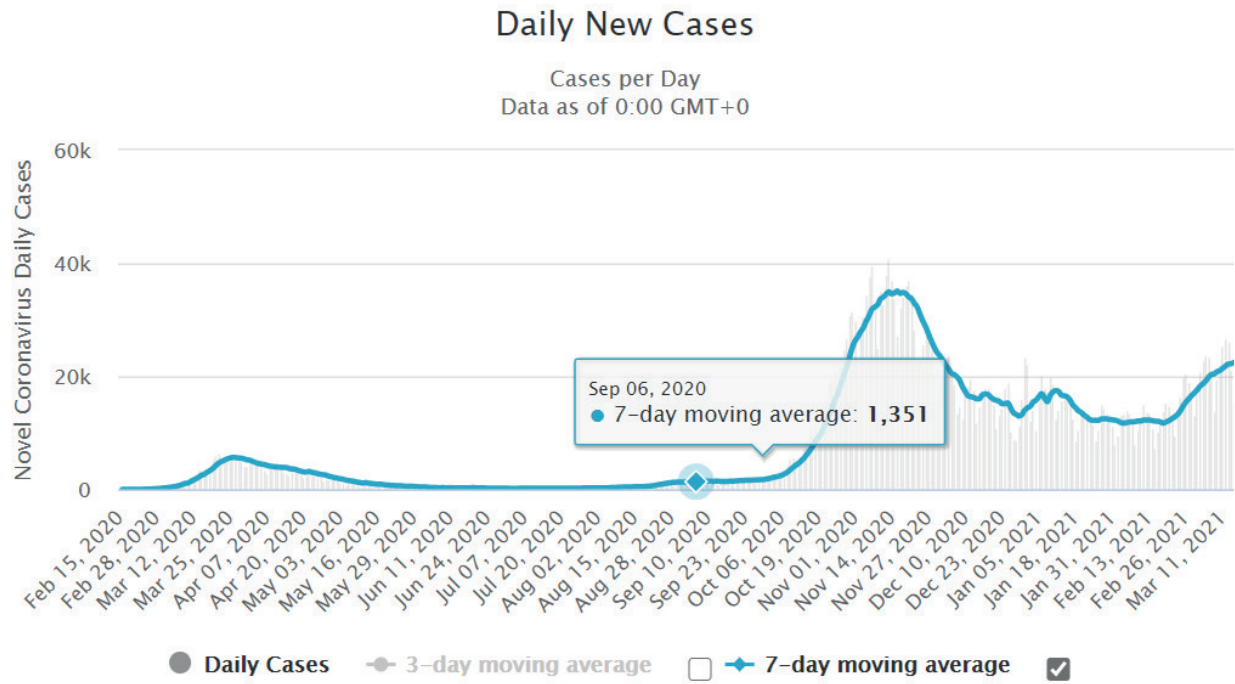
Figure 1. Trend of daily new COVID-19 cases in Italy (from February 15, 2020 to March 11, 2021) [19].
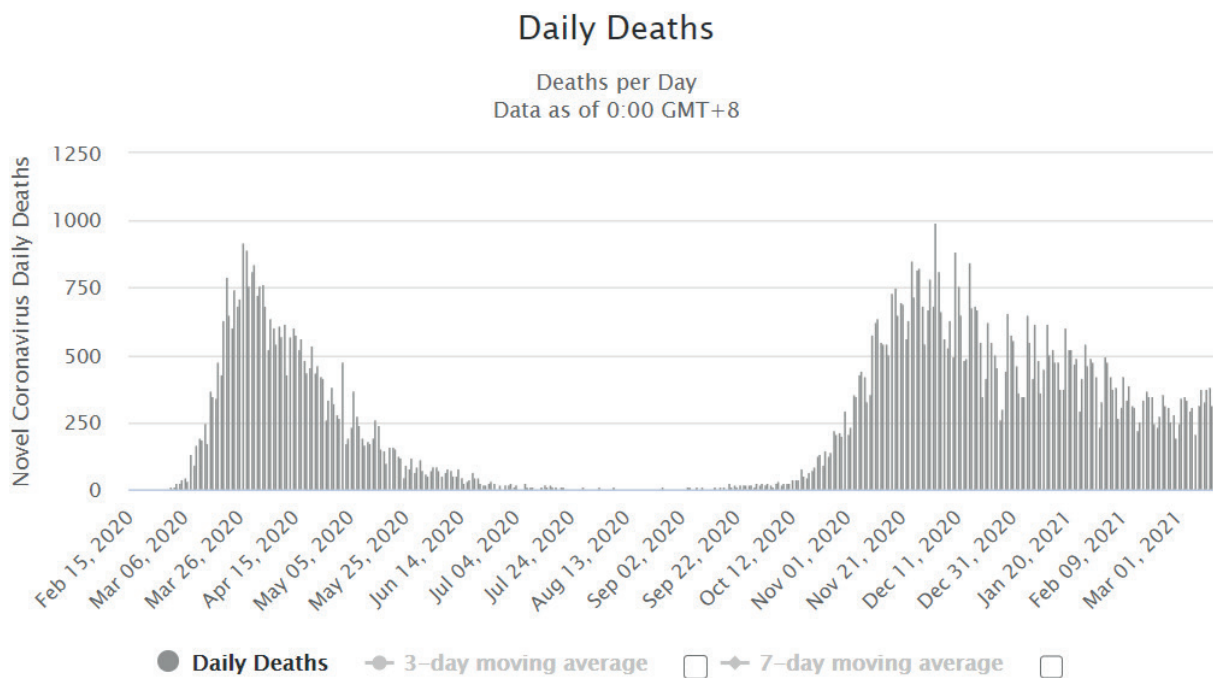

Figure 2. Trend of daily new COVID-19 deaths in Italy (from March 06, 2020 to March 01, 2021) [19].

well-being, and containment of the outbreak can be challenging [35]. Nevertheless, some authors underline the potential benefits of differentiated (but coordinated) regional interventions [36].

In Italy, however, the relaxation of public health policies, for instance police checks during the 2021 Easter period were halved compared to the previous (2020) Easter period [37], especially those related to school reopening, no stay at home and domestic travel restrictions, and reduced contact tracing, were

the most likely causes for the resurgence of COVID-19 towards the end of September [30]. One of the main reasons for the spike in September and October seems to have been the reopening of schools and business [11], probably due to a crowded public transport needed to serve the reopening of schools and working activities. A certain role could be played by the reopening of extracurricular activities as well [38, 39]. As shown in a study published on February 2021 in the Lancet, reopening schools, lifting bans on public events, lifting bans on public gatherings of more than ten people, lifting requirements to stay at home, and lifting internal movement limits were associated with increases in R of 11–25% on day 28 after the relaxation [40].

According to Italian health experts, the relaxation of the health policy measures led to a resurgence of the second wave, wasting the sacrifices made during the first wave [41]. However, the relaxation of restrictions was also needed to solve tension and conflicts among Italian Regions and between Regions and Central Government, as restriction measures adopted during the first generalized lockdown were severe and with negative psychological and economic outcomes on vulnerable Regions and strata of the population [39, 42]. The dilemma of choosing between a second generalized lockdown, detrimental for economic recession of the country [43], and a highly probable breakdown of the healthcare system, which in recent years has been undermined by economic cuts imposed by European Union, resulted ultimately in a lifting of policy measures leading to a second wave worse than the first [28].

Evidence-based medicine in times of COVID-19 pandemic poses many challenges, because the scientific evidence is weak [44] and the same pool of evidence can lead to diametrically opposed views [45]. A cost-effectiveness evaluation could be key to interpret evidence-based findings. However, ethics should be central in this evaluation. In Italy, the right to collective health, rooted into the Italian Constitution, is prevalent on every else right, like the right to free movement and economic initiative. Choosing between saving human life and saving business ventures, therefore, should not pose moral dilemma, as human life and money cannot be equated [43]. As shown by Teixeira da Silva et al, policies against COVID-19 should be pro-active rather than reactive and previsions can be complicated by socio-economic, structural, and organizational challenges of the country [11].

The situation might be compared with previous influenza pandemics. Despite some differences among Spanish influenza flu and COVID-19 pandemic, as this latter had higher mortality in elderly, the first wave of Spanish flu pandemic (March 1918 in the United States) practically did not affect the total mortality rate. The main peak of mortality in 1918 occurred in October 1918 both in the USA and Italy, with a gradual decrease in mortality over several months [46]. Our findings show that in 2020 the COVID-19 pandemic showed a two-wave pattern in Italy as well as in other European countries. A higher number of COVID-19 related deaths in Italy suggests that the second wave was likely most severe than the first wave. Conversely, previous studies conducted in patients admitted to emergency room in Lombardy region during the first and the second wave showed that the severity and the mortality of COVID-19 infection were lower during the 2nd wave of pandemic, despite the higher number of subjects who were hospitalized compared to the first wave [47, 48]. The more advanced age and the co-morbidities of Italian patients, as well as the limited number of intensive care unit beds in the Northern Regions of Italy were considered as potential explanation of the high morbidity and mortality during the first wave [49, 50]. This finding was confirmed in a Japanase study showing that the proportion of cases involving severe disease at admission was smaller in the second wave [51]. However, in Italy the first wave was likely more severe and deadly only in Lombardy region [52]. This shows the main limitation of this study, which did not consider some important epidemiological differences between Northern Italy, which was especially hit during the

first wave, and the Southern Italy that was hit only during the second wave. Our study is only a descriptive, observational study, therefore, we cannot conclude any association between restrictive measures and severity of COVID-19 infection. However, one hypothesis that deserves further investigation is that, despite the improvement of COVID-19 knowledge by the public and a better response by the healthcare system during the second wave, in Italy a decentralized national healthcare service has generated different regional responses, in terms of hospital capacity and strategy in response of the COVID-19 emergency [52, 53]. A possible explanation of the observed two two-wave pattern is that maintaining for long time lockdown and other severe restrictive measures is very complicated for socio-economic reasons. Furthermore, we cannot conclude that the most severe lockdown measures carried out during the first wave were the reason of lower COVID-19 mortality in Italy. Indeed, many infection cases were unnoticed during the first wave [5] and the number of PCR tests performed was greater in the second wave than in the first wave [51]. Therefore, mortality analyses in COVID-19 outbreak could be biased by several confounding factors [64]. Finally, many countries have seen a two-wave pattern in reported cases of COVID-19 patients during the 2020 pandemic. These studies showed that the effects of the virus do vary between the two periods, but many characteristics including differences in age range and severity of the disease should be considered in comparison analyses [55].

In conclusion, lockdown measures are effective in curbing COVID-19 related new infections and deaths as well as overburden on healthcare system, but these measures are difficult to be maintained for long time for economic reasons. This has an important implication because COVID-19 may exacerbate social inequities. Indeed, countries where economic inequity is prevalent may be disadvantaged in the fight against the COVID-19 pandemic, because the lockdown measures are unsustainable for longer time.

For this reason, new drugs like monoclonal antibody therapy and, above all, effective vaccines will be likely decisive to reduce the global public health damage unleashed by SARS-CoV-2 virus [56].

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