Journal of Infectious Diseases & Therapy
ISSN: 2332-0877

Research Article Open Access

Assessing the Lockdown Effect from Excess Mortalities

Alexej Weber*

Department of Physics, Heidelberg University, Grabengasse, Heidelberg, Germany

Abstract

Background and Aims: The reported case numbers of COVID-19 are often used to estimate the reproduction number or the growth rate. We use the excess mortality instead, showing the difference between most restrictive non-pharmaceutical interventions (mrNPIs) and less restrictive NPIs (lrNPIs) with respect to the growth rate and death counts.

Methods: We estimate the COVID-19 growth rate for Sweden, South Korea, Italy and Germany from the excess mortality. We use the average growth rate obtained for Sweden and South Korea, two countries with lrNPIs, to estimate additional death numbers in Germany and Italy (two representative countries with mrNPIs) in a hypothetic lrNPIs scenario.

Results: The growth rate estimated from excess mortality decreased faster for Germany and Italy than for Sweden and South Korea, suggesting that the mrNPIs have a non-negligible effect. This is not visible when the growth rate is calculated using the reported case numbers of COVID-19. This results in approximately 4 500 and 12 000 more death numbers for Germany and Italy, respectively.

Conclusion: The conclusion for the spreading of COVID-19 obtained from reported COVID-19 cases in previous studies are most likely biased. Expanding testing capacity led to an overestimation of the growth rate, masking the true decrease only visible when analyzing the excess mortality. Using our method, a more realistic estimate of the growth rate is obtained. Conclusions made for the reproduction number derived from the reported case numbers like the insignificance of most restrictive non-pharmaceutical interventions (lockdowns) might be wrong and have to be reevaluated using the growth rates obtained with our method.

Keywords: Reproduction number; Growth rate; NPI; COVID-19; Excess mortality; Lockdown

Introduction

To face the spread of COVID-19 disease, many countries introduced the so-called non-pharmaceutical interventions (NPIs). The most restrictive NPIs (mrNPIs) policies include mandatory stay-at-home and business closures. Since the mrNPIs may have potential harmful side effects [1-13] the risk-benefit ratio has to be evaluated. Usually, either the COVID-19 deaths data or the result of positive testing is used to assess the spreading of the disease and calculate the effect of NPIs [14-16]. While [15-16] evaluate mrNPIs as crucial for saving millions of lives, [14] sees no significant effect of mrNPIs over lrNPIs. However, the data used in [14-16] is of poor quality for the following reasons:

• First: The testing may have started too late to trace the beginning of the epidemic, therefore early deaths and cases attributable to COVID-19 may have been missed.

• Second: The false positive rate and the country specific counting methods have to be taken into account. Usually, the testing amount increases over the period of several weeks. While the actual COVID-19 cases may fall on average, the number of positive tests will suggest the opposite situation.

• Third: Even if the testing does not have any false positives and finds the actual SARS-COV2 virus fragments in individuals, it does not give us the information whether the virus amount found in individuals is sufficient to cause a severe disease. The very sensitive PCR-Tests might detect the same apparent spreading in different countries; however, in countries like Germany with mrNPIs, the virus amount in positively tested individuals might on average be smaller than in countries with lrNPIs. This would imply that in countries with mrNPIs, positive tested individuals are less infectious on average than in countries with lrNPIs. Looking solely at the positive test numbers, which may display a similar pattern in various countries; one then wrongly concludes that the spreading of the COVID-19 disease is equivalent.

• Fourth: Also the testing results are subject to the local decision of who is to be tested and whether the deaths with a positive test outcome are to be counted as COVID-19 deaths or not, which may vary over time. If the testing were to be restricted to the risk group, reducing the number of total tests, the positive counts may drop suddenly. Changing the convention of deaths counting also leads to sudden structural breaks in the data.

• Fifth: Also the testing is not standardized; so in the beginning, the positive tests may be repeated to exclude the false positives, while later on, when the laboratories work at their limits, the positive tests are not reevaluated, leading to a situation which appears to be much worse.

Although the reported deaths attributable to COVID-19 are more reliable data than data for positive test numbers, many of the problems mentioned above remain. Basically, it is not clear whether the person died from the disease or with the disease, leading to a biased estimate for the reproduction number or growth rate.

Due to the above challenges, we restrict our data to excess mortalities as this is the most solid number, being directly linkable to the spreading of the deadly disease.

We perform the analysis for Germany, Italy, South Korea and Sweden. Germany and Italy serve as representative countries which applied mrNPIs (Germany being hit much less by COVID-19 than

***Corresponding author:** Alexej Weber, Department of Physics, Heidelberg University, Grabengasse, Heidelberg, Germany, E-mail: Alexej.weber@gmx.de

Received date: February 02, 2021; **Accepted date:** February 16, 2021; **Published date:** February 23, 2021

Citation: Weber A (2021) Assessing the Lockdown Effect from Excess Mortalities. J Infect Dis Ther S1:002.

Italy) whereas South Korea and Sweden serve as representative countries which applied lrNPIs only (South Korea being hit much less by COVID-19 than Sweden).

Data

For Germany and Sweden, we used the data from the regional statistical bureaus [17-18]. For Italy and South Korea, we used data from the human mortality data base [19] which gets the data from the regional statistical bureaus. For South Korea, the weekly mortality data for 2020 was taken from the regional statistical bureau [20].

Methods

To overcome the testing problems mentioned in the introduction, we propose to calculate the growth rate directly from the excess deaths obtained from weekly or daily mortality data. While this method will not work when the excess deaths are small compared to the average noise level, it provides a reasonable result when the excess deaths are much bigger than noise and can be attributed to the spreading of the disease, causing the individual to die within a few weeks after infection. This is the case for COVID-19 in the first half of the year 2020, where we do not expect to see big side effects from NPIs yet (compared to COVID-19 itself), but where COVID-19 in fact lead to a big excess mortality. Although the method can also be applied to the second half of the year (where death numbers went down substantially), additional side effects of NPIs have to be carefully estimated, and cannot be neglected.

To calculate the excess deaths, the actual deaths have to be subtracted from the expected deaths. Usually, the expected deaths are calculated by taking the average of several past years of data, or by applying a more sophisticated statistical model to past years [21-25]. Since the weekly death data is available for a few past years only, the expected deaths are usually calculated by taking around 4-10 past years into account. This direct approach leads to an overestimation of the expected deaths, independently of the statistical method used, due to influenza and heat waves. Since the influenza waves mostly occur around the beginning of the year, they do not cancel out. The statistical model interprets the influenza wave as a regular pattern and the estimate of the expected deaths is biased. Instead, the expected deaths have to be estimated from clean years without a strong influenza wave adjusted to the current level of deaths, accounting for a crisis-free baseline.

Like influenza, the COVID-19 disease is more deadly to the elderly population and to people with serious preconditions. Deaths of these people form part of the expected deaths curve. If they are hit by the disease and die, the expected deaths will be lowered for some period after the disease wave, since the most vulnerable have "pre-died" some weeks earlier. We simulate this effect by distributing a portion of the cumulated excess deaths equally to a period of 20 weeks into the future, thus lowering the baseline of the year. In this way, we obtain more excess deaths compared to the case when the actuals deaths are subtracted from the baseline year directly. We have chosen 20 weeks, since we observe the lowering of deaths numbers after the COVID-19 wave for a period of about 10 weeks, and the first COVID-19 wave lasts for around 10 weeks itself.

We calculate the results for 3 representative proportion numbers of 0.0, 0.4 and 0.8, meaning, no one pre-dies from the future 20 weeks period, 40% pre-die and 80% pre-die, respectively.

We compare the results for 3 parameter values for Germany, Italy, Sweden and South Korea.

Since the data is also noisy, we apply a gentle smoothing using a lower order moving average model.

To calculate the baseline year, we did the following. We chose clean years, adjusted them to the starting level of 2020, took the median and applied a lower order moving average to reduce the remaining noise.

For Germany, we only have data for 2016-2020. The years 2017 and 2018 contain strong influenza waves, while 2016 is clean and 2019 has a small wave from week 1 – 10. Also, 2020 started as a clean year without any strong influenza wave. For the construction of the model year, we take 2016 and 2019. For the weeks 1-10, only 2016 data is used due to the small influenza wave in 2019.

For Sweden, we took the years 2016 and 2019.

For South Korea, we took 2017 and 2019. For Italy, we took 2016, 2017 and 2019. For the first 9 weeks, we took 2016 only, due to visible influenza waves in 2017 and 2019 in the beginning of the corresponding year.

To calculate the growth rate we take the first difference of the logarithm [26-27] of the excess deaths (which we assume to be due to COVID-19) with a lag of 2 weeks, assuming that it takes 1 week after the infection to develop a disease and 1 week for the individual to die from the disease. We also smooth the excess mortality and the growth rate number using a lower order moving average.

Results

The result for the growth rate for the proportions of 0%, 40% and 80% is shown in Figure 1. While the growth rates obtained from the positive test cases for Germany, Sweden and Korea all share the same monotonically decreasing pattern [14] approaching 0 from above, the growth rates obtained from the excess mortality in this work have a more complicated shape.

The negative excess mortality for all four countries analyzed right after the COVID-19 wave can be well explained with the pre-dying effect, using a parameter value between 0.4 and 0.8.

The growth rates from the positive test cases [14] suggest that the spreading never stops and after the initial exponential phase continues in a linear fashion at a constant but very high rate, although the death numbers fall dramatically.

On the contrast, the growth rates obtained from the excess mortalities suggest that the spreading was exponential in the beginning and then dropped and decreased exponentially.

We report the average growth rates after the curve passed the 0 value for the period of 4 weeks, thus having 4 weeks in total (first number – 0% pre-dying, second and third number, 40% and 80% pre-dying respectively): Germany: -0.50 (-0.30, -0.18), Sweden: -0.058 (-0.027, -0.028), South Korea: -0.11 (-0.088, -0.068), Italy: -0.13 (-0.10, -0.077).

When averaging lrNPI-(Germany and Italy) and mrNPI-countries (Sweden and South Korea), we get: lrNPI: -0.084 (-0.057, -0.048) mrNPI: -0.32 (-0.20, -0.13).

Meaning that countries with mrNPI (Germany and Italy after the lockdowns) had more than twice as low spreading rates compared to the lrNPIs countries (Sweden and South Korea), resulting in a much faster exponential decay of the spreading.

We also observe that Italy (implementing early lockdowns from week 9) reached the 0 growth rate much faster than Sweden and South Korea on average.

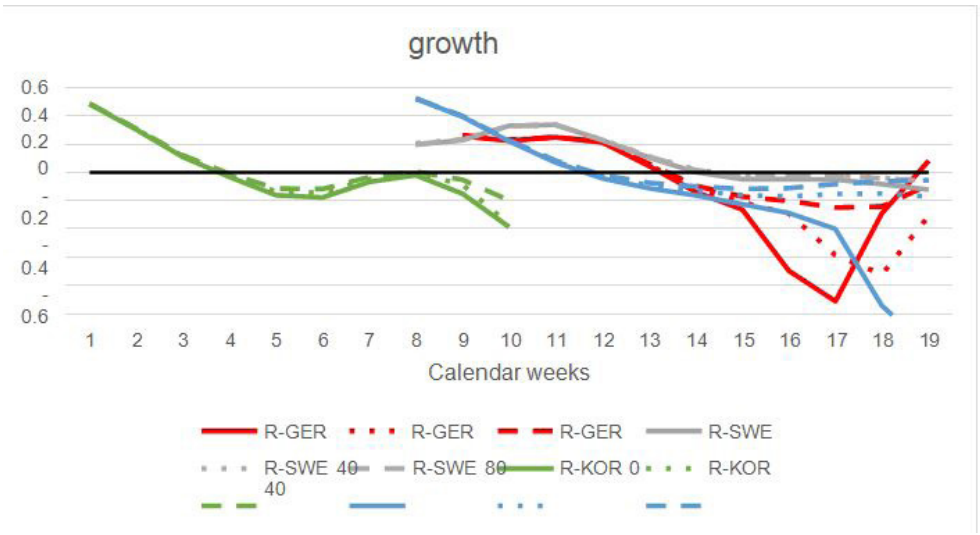

Figure 1: The figure shows the growth rates for Germany, Sweden, South Korea and Italy for different parameter values of pre-dying 0%, 40% and 80%. The countries with mrNPIs (Germany and Italy) have lower growth rates on average, once the growth rate is below 0 (corresponding to mrNPIs becoming implemented).

Especially, we clearly see, that in Germany, the growth rate is already around 0 in the week of the lockdown (calendar week 13) and then continues to drop strongly. While in Sweden and South Korea, the drop from 0 soon stops at a higher value. This means that the excess mortality curve is wider due to a much weaker exponential decay. Also, the growth rate for negative values for Italy is lower than that of Sweden and South Korea averaged.

To find out what it actually means for the death numbers in Germany and Italy, we replace the negative growth rates for Germany and Italy with the corresponding average numbers obtained for Sweden and South Korea, thus simulating the lrNPI scenario, and recalculates the death numbers.

We report the numbers for the 0% pre-dying scenario. For higher pre-dying values, the effect is qualitatively similar. This results in approximately in 4 500 (Germany) and 12 000 (Italy) additional deaths for the decaying period compared to original deaths with mrNPIs (ca. 2 200 for Germany and ca. 24 000 for Italy), since the decay is less for lrNPIs. The prolongation of the excess mortality due to lrNPIs is shown in Figure 2 for the 0% of pre-dying (for 40% and 80% we obtain a similar prolongation effect).

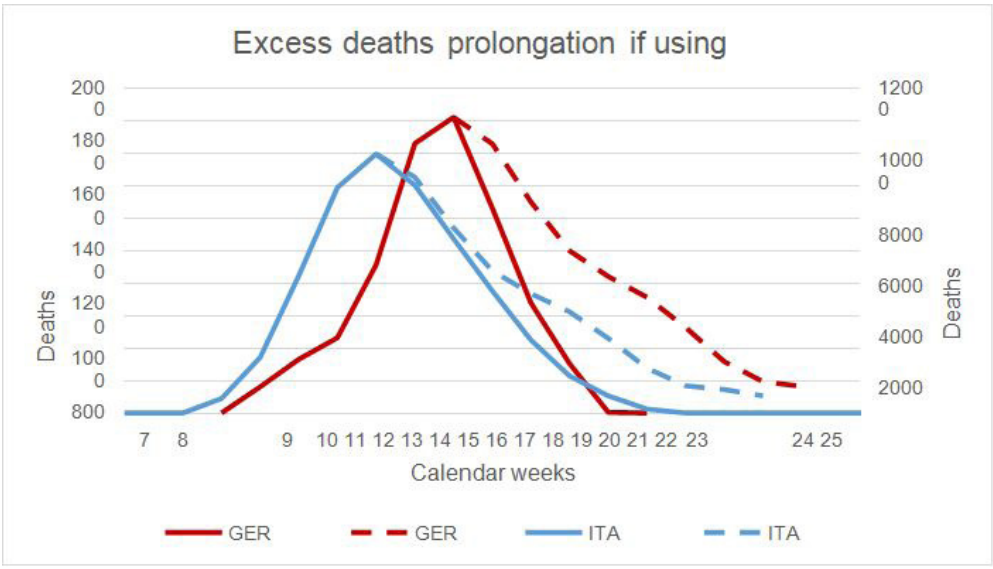

Figure 2: The figure shows the original excess mortality for Germany and Italy (solid lines, left and right y-Axis, respectively) and the hypothetic excess mortality for the case that lrNPIs had been used in the corresponding country for 0% pre-dying value (dashed lines). This scenario would have resulted in ca. 4500 more deaths for Germany and ca. 12000 more deaths for Italy.

Conclusion

We demonstrated that the mrNPI effect is clearly visible when calculating the growth rate from the excess mortality. mrNPIs were capable of stopping the spread of SARS-COV2 in the population stronger than lrNPIs by decreasing the spread exponentially. With lrNPIs the exponential decrease was not very pronounced compared to countries having mrNPIs. The reason, the effect was not visible in previous studies such as [14] may have two main sources. First- misleading data-extended testing shows increasing numbers of people to be infected, while the average prevalence may have dropped. Second, – the positive test counts may not reflect the actual virus load found. While the actual deaths may drop due less virus load per person, (not sufficient to cause a serious infection), the very sensitive tests still report a high number of positive carriers. Both sources mask the effect of the mrNPIs over lrNPIs.

References

1. APNews Report (2020) Virus-Linked Hunger Tied to 10,000 Child Deaths Each Month.
2. Issue Brief (2020) Reports of increases in opioid related overdose and other concerns during the COVID pandemic.
3. Guha-Sapir D, de Almeida MM, Keita M, Greenough G, Bendavid E (2020) COVID-19 policies: Remember measles. Sills J ed Science 369:261–261.
4. O'Leary ST, Trefren L, Roth H, Moss A, Severson R, et al. (2020) Number of Childhood and Adolescent Vaccinations Administered Before and After the COVID-19 Outbreak in Colorado. JAMA Pediatrics.
5. Report 18-The potential public health impact of COVID-19 on malaria in Africa.
6. Report 19-The Potential Impact of the COVID-19 Epidemic on HIV, TB and Malaria in Lowand Middle-Income Countries.
7. Kaufman HW, Chen Z, Niles J, Fesko Y (2020) Changes in the Number of US Patients with Newly Identified Cancer Before and During the Coronavirus Disease 2019 (COVID-19) Pandemic. JAMA Netw Open 3: 2017267-2017267.
8. Fragala MS, Kaufman HW, Meigs JB, Niles JK, McPhaul MJ (2020) Consequences of the COVID-19 Pandemic: Reduced Hemoglobin A1c Diabetes Monitoring. Population Health Management.
9. Wenham C, Smith J, Davies SE, Feng H, Grépin KA, et al. (2020) Women are most affected by pandemics—lessons from past outbreaks. Nature 583:194-198.
10. Loades ME, Chatburn E, Higson-Sweeney N, Reynolds S, Shafran R, et al. (2020) Rapid systematic review: the impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. J Am Acad Child Adolesc Psychiatry 59:1218-1239.
11. Sher L (2020) The impact of the COVID-19 pandemic on suicide rates. QJM. 113:707-712.
12. Cahan E (2020) Charities that fund research face deep revenue declines. Science 368:1412-1412.
13. Roelfs DJ, Shor E, Davidson KW, Schwartz JE (2011) Losing life and livelihood: A systematic review and meta-analysis of unemployment and all-cause mortality. Social Science & Medicine 72:840-854.
14. Bendavid E, Oh C, Bhattacharya J, Ioannidis JPA (2021) Assessing mandatory stay-at-home and business closure effects on the spread of COVID-19. European Journal of Clinical Investigation.
15. Hsiang S, Allen D, Annan-Phan S, Bell K, Bolliger I, et al. (2020) The effect of large-scale anti-contagion policies on the COVID-19 pandemic. Nature 584:262-267.
16. Flaxman S, Mishra S, Gandy A, Unwin HJ, Mellan TA, et al. (2020) Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. Nature 584:257-261.
17. Statistisches Bundesamt (2020) COVID-19. Geramny.
18. Statistics (2020) We provide society with useful statistics to trust.Sweden.
19. Shkolnikovhe V, Barbieri M, Wilmoth J (2020) Human Mortality Database.
20. Statistics (2021) Economic and Social Trends. Korea.
21. Krieger N, Chen JT, Waterman PD (2020) Excess mortality in men and women in Massachusetts during the COVID- 19 pandemic. The Lancet 395: 1829.
22. Alicandro G, Remuzzi G, La Vecchia C (2020) Italy's first wave of the COVID-19 pandemic has ended. The Lancet 396: 27-28.
23. Modig K, Ahlbom A, Ebeling M (2020) Excess mortality from covid-19. Weekly excess death rates by age and sex for sweden and its most affected region. European Journal of Public Health 31:17-22.
24. Zur Nieden F, Sommer B, Lüken S (2020) Sonderauswertung der Sterbefallzahlen 2020. WISTA – Wirtschaft and Statistik 72: 38-50.
25. European monitoring of excess mortality for public health action (EuroMOMO). Work package 7 report. A European algorithm for a common monitoring of mortality across Europe.
26. Kermack WO, McKendrick AG, Walker GT (1927) A contribution to the mathematical theory of epidemics. Proceedings of the Royal Society of London Series A, Containing Papers of a Mathematical and Physical Character 115(772):700-721.
27. Atkeson A, Kopecky K, Zha T (2020) Four Stylized Facts about COVID-19. National Bureau of Economic Research.