Brief Communication

Measures of Mortality in Coronavirus (COVID-19) Compared with SARS and MERS

Ehsan Allah Kalteh[1], Aiuob Sofizadeh[1], Mohammad Fararooei[2], Mousa Ghelichi Ghojogh[3*], Somayeh Aljalili[4]

Abstract

In late 2019, a novel coronavirus, now designated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified as the cause of an outbreak of acute respiratory illness in Wuhan, a city in China. Mortality rate, case fatality rate, and Years of Potential Life Lost can be measured by determining death cases. Much of our information on mortality rates of diseases can be obtained through a regular implementation of care plans that are often developed to screen infectious diseases. In the YLL component, the higher the individuals die at an earlier age, the longer their life is lost. For COVID-19, this component refers to the simple subtraction of age at death due to COVID-19 from the standardized life expectancy for the same age in the same sex. A potential application of health summary indices is to consider the non-fatal consequences of diseases to ensure that they are taken into account in health policy making. Given that COVID-19 has a non-fatal effect on a large number of patients, the estimation of disease burden using the DALYs may be an appropriate index for achieving this goal.

Keywords: Coronavirus; Mortality rate; Case fatality rate; Covid-19; SARS; MERS

1. Infectious Disease Research Center, Golestan University of Medical Sciences, Gorgan, Iran
2. Department of Epidemiology, School of Health, HIV/AIDS Research Center, Research Institute for Health, Shiraz University of Medical Sciences, Shiraz, Iran
3. Department of Epidemiology, Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran
4. Health Center of Kavar, Shiraz University of Medical Sciences, Shiraz, Iran

Corresponding Author:
Mousa Ghelichi Ghojogh, Department of Epidemiology, Student Research Commitee, Shiraz University of Medical Sciences, Shiraz, Iran; Email: mghelichi2000@yahoo.com

Please cite this article as: Kalteh EA, Sofizadeh A, Fararooei M, Ghelichi Ghojogh M, Aljalili S, Measures of Mortality in Coronavirus (COVID-19) Compared with SARS and MERS. J Cell Mol Anesth. 2020;5(2):97-101.

Introduction

In late 2019, a novel coronavirus, now designated severe acute respiratory syndrome coronavirus 2(SARS-CoV-2) was identified as the cause of an outbreak of acute respiratory illness in Wuhan, a city in China. In February 2020, the World Health Organization (WHO) named the disease COVID-19, which stands for coronavirus disease 2019. The Covid-19 compared to previous outbreaks of severe acute respiratory syndrome (SARS-CoV) and Middle East respiratory syndrome (MERS) is more contagious. Since the first reports of COVID-19, infection has spread to include more than 80,000 cases in China and increasing cases worldwide, prompting the WHO to declare a public health emergency in January 2020 and characterize it as a pandemic in March 2020 (1-5)

In accordance with the latest data published by the World Health Organization, since the first report of COVID-19 cases from Wuhan China to May 11, 2020, more than 4,006,257 confirmed cases of the disease and 278,892 death cases were reported in the world (6). However, despite the lower case fatality rate, covid-19 has so far resulted in more deaths than SARS and MERS combined (A total of 1,632 deaths; including 774 deaths due to SARS and 858 deaths due to MERS) (7). Mortality rate "MR" (8), case fatality rate "CFR" (9), and Years of Potential Life Lost "YPLL" (8) can be measured using data on cases and deaths. Much of our information on mortality rate of diseases can be obtained through a regular implementation of care plans that are often developed to screen infectious diseases (10). Mortality Rate is the ratio of number of deaths from a particular cause to the size of the entire population at risk (both sick and healthy). The index represents the risk of death due to a specific reason in a defined population. Case fatality rate on the other hand is the ratio of individuals, who have died from a particular disease, to the total number of individuals with the disease at a certain time (usually expressed in percentage), indicating the risk of death in the patients. Case Fatality Rate can determine the severity of diseases and can thus help us determine how to improve the treatment methods over time. Basic reproductive number (R_0) is a measure of the average number of infections caused by an infected person at the early stages of an epidemic in which all contacts are sensitive (11-13). The aim of this paper is comparison of measures of mortality in COVID-19.

Changes in Case Fatality Rate in COVID-19

Knowledge of the CFR is critical to characterize the severity and understand the pandemic potential of COVID-19 in the early stage of the epidemic. Using the exponential growth rate of the incidence, the present study statistically estimated the CFR and the basic reproduction number—the average number of secondary cases generated by a single primary case in a naïve population (14). Real or false changes can be seen in the fatality rate of COVID-19, whether increasing or decreasing, in a society or different geographical areas and subgroups of any society over time. The following table presents an estimate of case fatality rates in different countries on May 11, 2020 (Table 1) (6).

Results of studies in China indicated that factors, which cause actual changes in case fatality rate of COVID-19 include the patients' age (population composition), as the older ages (population aging) increases the fatality rate; and underlying diseases including (cardiovascular diseases, renal impairment

Table 1: Reported deaths from COVID-19 on May 11, 2020.

Countries	Confirmed cases	Deaths	Estimated case fatality rate
Germany	169575	7417	4.37
China	84450	4643	5.50
United States of America	1271645	76916	6.05
Iran (Islamic Republic of)	107603	6640	6.17
Brazil	155939	10627	6.81
Canada	67996	4728	6.95
Spain	224390	26621	11.86
Netherlands	42627	5440	12.76
Italy	219070	30560	13.95
The United Kingdom	219187	31855	14.53
Belgium	53081	8656	16.31
France	137073	26338	19.21

Only countries with more than 4600 death cases are included. Data are from WHO (6)

Table 2: Comparison of epidemiological characteristics in COVID-19 ،MERS و SARS.

Morbidity Index	Disease and Epidemic Period			Results
	SARS	MERS	COVID-19	
	2003 - 2002	2016 - 2012	From 2020	
Basic Reproductive Rate (R_0)	1-2	>1	2-3	MERS< SARS< COVID-19
Number of patients	8096	2494	*4006257	MERS< SARS< COVID-19
Number of death	774	858	278892*	SARS < MERS < COVID-19
Case Fatality rate	9.6 %	34.4 %	6.9 %	COVID-19 < SARS< MERS
Number of countries involved	29	27	more than 210	MERS< SARS< COVID-19

*Reported total confirmed cases and total deaths from COVID-19 on May 11, 2020. Data are from WHO (6)

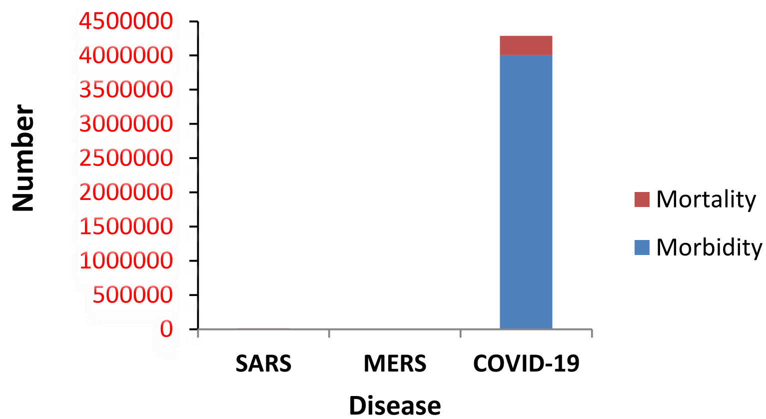

Figure 1. Comparison of Morbidity (Number of patients) and mortality (Number of death) in COVID-19 ،MERS, SARS. Reported morbidity and mortality from COVID-19 on May 11, 2020. Data are from WHO (6).

(15, 16) diabetes, chronic respiratory diseases (17), hypertension, and cancer) (18-20). Having an effective drug to treat the infectious agent will reduce the case fatality rate, but there is currently no proven effective therapeutic drug for COVID-19; and other care and support methods are provided for hospital admissions (21). Factors, which may cause a false change in fatality rates in various diseases such as COVID-19 include errors in disease diagnosis, changes in disease name coding, changes in disease classification, errors in counting, errors in classification of demographic variables including age (calculation of case fatality rate in age groups), errors in the proportion of at-risk groups (Calculation of case fatality rate in groups with underlying diseases) (13, 22, 23).

Reporting communicable diseases is an essential element in control these diseases and quickly diagnosing epidemics (24). Hospitals are among the centers where patients visit and are even hospitalized. Hospitals can also be the starting point for an epidemic. Low awareness among the health care staff regarding the reporting system, high workload in hospitals, lack of a standard reporting system and incomplete documentation are the causes of incomplete reports of infectious diseases in hospitals. As a result, it is not so much easy to analyze and interpret information and use their results; so, the data could rarely be used for public health decision making (25). Possibly, it could be as one of the reasons for the differences in COVID-19 case-fatality among different countries.

Discussion

Table 2 presents the criteria for susceptibility and mortality in COVID-19, MERS and SARS (7, 18-23, 26-33). The higher the rates of transmission and fatality of a disease, the higher its mortality. According to Table 2 and Fig 1, fewer people in the world have become infected with MERS and SARS, resulting in fewer deaths despite their higher fatality rates, but due to lower transmission rates, but due to the higher rate of transmission in COVID-19, many people have become infected around the world, and despite lower fatality rates, it causes a large number of patients and more deaths. However, new travel facilities in 2020, especially for air travels, in comparison with the beginning of MERS (in 2002) and SARS (in 2012) epidemics, has accelerated the transmission of COVID-19 (2020), leading to its spread in a great number of countries around the world within two months. On the contrary, the preventive measures of governments and people during MERS, SARS and COVID-19 epidemics, including quarantine, home quarantine, social distance, and health care have all contributed to a decrease in the spread of diseases (34, 35).

Quality of Life and COVID-19: Figure 1 shows that COVID-19 has a non-fatal effect on patients compared to MERS and SARS. In other words, COVID-19 is a more non-fatal disease and despite the fact that its effect on people, who are recovered from the disease, is not a means of determining its mortality, its effect may be important in terms of human health considerations. The concept of quality of life includes dimensions of the overall quality of life that clearly affect the health (physical or mental). At the individual level, this concept includes feelings of physical and mental health and related issues, including the health risks and status, functional status (person), social support, and socio-economic status (36). Despite the fact that prioritizing resources in health care programs is often based on mortality rates, since COVID-19 is not deadly compared to similar diseases, it seems that patients' quality of life should be taken into account in developing a care plan.

Disability-Adjusted Life Years and COVID-19: Disability-Adjusted Life Years (DALYs) refer to the sum of years of life lost due to premature mortality (YLL) and Years of life lost due to Disability (YLD) in society (8).

$$\text{DALYs} = \text{YLL} + \text{YLD}$$

In the YLL component, the higher the individuals die at an earlier age, the longer their life is lost (13). For COVID-19, this component refers to the simple subtraction of age at death due to COVID-19 from the standardized life expectancy for the same age in the same sex. The total life loss in a society is thus the simple addition of YLLs of died people in that society. For the second component of the Disability-Adjusted Life Years (DALY), namely Years of life lost due to Disability (YLD), we should study non-fatal effects of COVID-19, including disabilities; and its study seems to require a longer period than the beginning of the COVID-19 epidemic. A potential application of health summary indices is to consider the non-fatal consequences of diseases to ensure that they are taken into account in health policy making (37). Given that COVID-19 has a non-fatal effect on a large number of patients, the estimation of disease burden using the DALYs may be an appropriate index for achieving this goal.

Conclusion

A potential application of health summary indices is to consider the non-fatal consequences of diseases to ensure that they are taken into account in health policy making. Given that COVID-19 has a non-fatal effect on a large number of patients, the estimation of disease burden using the DALYs may be an appropriate index for achieving this goal.

Acknowledgment

We would like to thank all our research team for their participation in research and support of the project.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

References

1. Ghelichi-Ghojogh M, Allah Kalteh E, Fararooei M. Coronavirus disease 2019; epidemiology and recommendations. J Prev Epidemiol. 2020;5(1):e01.
2. Mubarak M, Nasiri H. COVID-19 nephropathy; an emerging condition caused by novel coronavirus infection. J Nephropathol. 2020;9(3):e21.
3. Tolouian R, Zununi Vahed S, Ghiyasvand S, Tolouian A, Ardalan MR. COVID-19 interactions with angiotensin-converting enzyme 2 (ACE2) and the kinin system; looking at a potential treatment. J Renal Inj Prev. 2020; 9(2): e19.
4. Valizadeh R, Baradaran A, Mirzazadeh A, Bhaskar LVKS. Coronavirus-nephropathy; renal involvement in COVID-19. J Renal Inj Prev. 2020; 9(2):e18.

5. Hamidian Jahromi A, Mazloom S, Ballard DH. What the European and American health care systems can learn from China COVID-19 epidemic; action planning using purpose designed medical telecommunication, courier services, homebased quarantine, and COVID-19 walk-in centers. Immunopathol Persa. 2020;6(2):e17.

6. World, Health, Organisation. Coronavirus disease (COVID-2019) situation report 112 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.

7. Mahase E. Coronavirus covid-19 has killed more people than SARS and MERS combined, despite lower case fatality rate. BMJ. 2020;368:m641.

8. Aryaie M, Roshandel G, Semnani S, Asadi-Lari M, Aarabi M, Vakili MA, et al. Predictors of Colorectal Cancer Survival in Golestan, Iran: A Population-based Study. Epidemiology and health. 2013;35:e2013004.

9. Porcheddu R, Serra C, Kelvin D, Kelvin N, Rubino S. Similarity in Case Fatality Rates (CFR) of COVID-19/SARS-COV-2 in Italy and China. J Infect Dev Ctries. 2020;14(2):125-8.

10. Thacker SB, Choi K, Brachman PS. The surveillance of infectious diseases. JAMA. 1983;249(9):1181-5.

11. Canoy D. A dictionary of epidemiology — The evolution towards the 6th edition. BBA Clin. 2015;4:42-3.

12. Lahariya CD. An evolving common language in epidemiology. Indian J Community Med. 2015;40(4):286.

13. Porta M. A dictionary of epidemiology, 5th edition. A call for submissions through an innovative wiki. J Epidemiol Community Health. 2006;60(8):653.

14. Jung SM, Akhmetzhanov AR, Hayashi K, Linton NM, Yang Y, Yuan B, et al. Real-Time Estimation of the Risk of Death from Novel Coronavirus (COVID-19) Infection: Inference Using Exported Cases. J Clin Med. 2020;9(2).

15. Aleebrahim-Dehkordi E, Reyhanian A, Saberianpour S, Hasanpour-Dehkordi A. Acute kidney injury in COVID-19; a review on current knowledge. J Nephropathol. 2020;9(4):e31-e.

16. Valizadeh R, Dadashzadeh N, Zakeri R, James Kellner S, Rahimi MM. Drug therapy in hospitalized patients with very severe symptoms following COVID-19. J Nephropharmacol. 2020;9(2):e21-e.

17. Dadashzadeh N, Farshid S, Valizadeh R, Nanbakhsh M, Rahimi MM. Acute respiratory distress syndrome in COVId-19 disease. Immunopathol Persa. 2020; 6(2):e16. 1

18. Clark A, Jit M, Warren-Gash C, Guthrie B, Wang HHX, Mercer SW, et al. Global, regional, and national estimates of the population at increased risk of severe COVID-19 due to underlying health conditions in 2020: a modelling study. Lancet Glob Health. 2020.

19. Wan K, Chen J, Lu C, Dong L, Wu Z, Zhang L. When will the battle against novel coronavirus end in Wuhan: A SEIR modeling analysis. J Glob Health. 2020;10(1):011002.

20. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. JAMA. 2020.

21. Ji Y, Ma Z, Peppelenbosch MP, Pan Q. Potential association between COVID-19 mortality and health-care resource availability. Lancet Glob Health. 2020;8(4):e480.

22. Heymann DL, Shindo N. COVID-19: what is next for public health? Lancet. 2020;395(10224):542-5.

23. Lazzerini M, Putoto G. COVID-19 in Italy: momentous decisions and many uncertainties. Lancet Glob Health. 2020;8(5):e641-e2.

24. Keramarou M, Evans MR. Completeness of infectious disease notification in the United Kingdom: A systematic review. J Infect. 2012;64(6):555-64.

25. Brewster L, Tarrant C, Dixon-Woods M. Qualitative study of views and experiences of performance management for healthcare-associated infections. The Journal of hospital infection. 2016;94(1):41-7.

26. Ge H, Wang X, Yuan X, Xiao G, Wang C, Deng T, et al. The epidemiology and clinical information about COVID-19. Eur J Clin Microbiol Infect Dis. 2020;39(6):1011-9.

27. Gao H, Yao H, Yang S, Li L. From SARS to MERS: evidence and speculation. Front Med. 2016;10(4):377-82.

28. Lai A, Bergna A, Acciarri C, Galli M, Zehender G. Early phylogenetic estimate of the effective reproduction number of SARS-CoV-2. J Med Virol. 2020;92(6):675-9.

29. Liu Y, Gayle AA, Wilder-Smith A, Rocklöv J. The reproductive number of COVID-19 is higher compared to SARS coronavirus. J Travel Med. 2020;27(2).

30. Majumder MS, Rivers C, Lofgren E, Fisman D. Estimation of MERS-Coronavirus Reproductive Number and Case Fatality Rate for the Spring 2014 Saudi Arabia Outbreak: Insights from Publicly Available Data. PLoS Curr. 2014;6.

31. Smith BA. A novel IDEA: The impact of serial interval on a modified-Incidence Decay and Exponential Adjustment (m-IDEA) model for projections of daily COVID-19 cases. Infect Dis Model. 2020;5:346-56.

32. Peeri NC, Shrestha N, Rahman MS, Zaki R, Tan Z, Bibi S, et al. The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned? Int J Epidemiol. 2020.

33. Zhang S, Diao M, Yu W, Pei L, Lin Z, Chen D. Estimation of the reproductive number of novel coronavirus (COVID-19) and the probable outbreak size on the Diamond Princess cruise ship: A data-driven analysis. Int J Infect Dis. 2020;93:201-4.

34. Chinazzi M, Davis JT, Ajelli M, Gioannini C, Litvinova M, Merler S, et al. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. Science. 2020;368(6489):395-400.

35. Nussbaumer-Streit B, Mayr V, Dobrescu AI, Chapman A, Persad E, Klerings I, et al. Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review. Cochrane Database Syst Rev. 2020;4(4):Cd013574.

36. Yin S, Njai R, Barker L, Siegel PZ, Liao Y. Summarizing health-related quality of life (HRQOL): development and testing of a one-factor model. Popul Health Metr. 2016;14:22.

37. Naghavi M, Abolhassani F, Pourmalek F, Lakeh M, Jafari N, Vaseghi S, et al. The burden of disease and injury in Iran 2003. Popul Health Metr. 2009;7:9.