Biomedical Statistics and Informatics
2020; 5(2): 47-51
http://www.sciencepublishinggroup.com/j/bsi
doi: 10.11648/j.bsi.20200502.12
ISSN: 2578-871X (Print); ISSN: 2578-8728 (Online)

Review Article

Use of Databases Available on the Web to Describe COVID-19 Morbidity and Mortality Trends

Uri Eliyahu*, Mona Boaz

Department of Nutrition, Faculty of Health Sciences, Ariel University, Ariel, Israel

Email address:
urieli@ariel.ac.il (U. Eliyahu), monabo@ariel.ac.il (M. Boaz)
*Corresponding author

To cite this article:
Uri Eliyahu, Mona Boaz. Use of Databases Available on the Web to Describe Covid-19 Morbidity and Mortality Trends. *Biomedical Statistics and Informatics*. Vol. 5, No. 2, 2020, pp. 47-51. doi: 10.11648/j.bsi.20200502.12

Received: April 19, 2020; **Accepted**: June 23, 2020; **Published**: August 4, 2020

Abstract: In December 2019, an infectious pandemic outbreak occurred in the city of Wuhan in the Province of Hubei, China. The pathogen was identified as a novel coronavirus - COVID-19. This virus belongs to a family of viruses that cause Severe Acute Respiratory Syndrome, known as SARS-COV. The disease is characterized by a high mortality rate among adults aged 60 years or above, particularly those with chronic comorbidities. Databases available on the web provide updated, real-time data on the incidence and mortality rates ascribed to the COVID-19 pandemic in various countries. However, to draw accurate epidemiologic conclusions, demographic data (population density, age distribution, and urbanization level), as well as clinical data (number of screening tests and number of days since the first detected disease case in the country) must be taken into consideration. Informed use of these data affords reliable epidemiologic analysis. For example, a comparison of COVID-19 case fatality rates between Germany and Iran – two countries similar in population size and urbanization level – reveals that the mortality rate in Iran is significantly higher than that of Germany, while the active morbidity burden is much higher in Germany. This may seem surprising, given that Germany's population is considerably older than that of Iran and four times as dense. It may be surmised that the quality and availability of health services in Germany are superior to those in Iran, offering a higher number of screening tests and more effective clinical treatment. Another important factor affecting morbidity spread is the timing of a lockdown policy implementation. For example, a comparison between China and the USA – two countries with similar land area and median age – reveals that in spite of the fact that in China population density is about 4.25 times higher than in the USA, morbidity rate is considerably lower than in the USA. Two factors can be considered responsible for this lower rate: lower urbanization and an earlier lockdown policy compared with the USA.

Keywords: Pandemic, Prevalence, Incidence, Case Fatality, Recovery

1. Introduction

The 2019-2020 COVID-19 pandemic has turned non-epidemiologists with access to online publicly available databases [1] to potential analysts of morbidity and mortality trends. However, conclusions drawn on the basis of these data may not always be accurate if demographic attributes (population density, level of urbanization, and age distribution) and clinical information (number of screening tests designed to detect active morbidity and number of days since the first case of disease in the country) are not taken into account [2, 3].

In December 2019, an outbreak of an infectious viral pandemic occurred in the city of Wuhan in the Province of Hubei, China. The pathogen was identified as coronavirus COVID-19 [3]. Since then, more than 81,000 infections have been confirmed in that district, including more than 3,200 deaths [1]. Starting in February 2020, the disease spread to Central Europe and to the continents of North and South America and has since been declared a worldwide pandemic [2, 3]. COVID-19 appears to be related to two other pathogenic viruses – Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) – both of which have much higher CFR (about 10% and 40%, respectively) compared with COVID-19. COVID-19, however, is characterized by a much higher rate of infection, with one patient able to infect between 2 and 2.5 people [3, 4].

2. Epidemiological Terminology

Epidemiological terms describing infectious morbidity and mortality include incidence – the number of new cases of a particular disease that are diagnosed in a given unit of time – and prevalence – the number of active cases of morbidity in the population at a given time minus the number of recoveries and deaths. Case Fatality Rate (CFR) is calculated by dividing the number of deaths by the number of confirmed cases of the disease and is presented as percentages. Case Recovery Rate is calculated by dividing the number of recovered patients by the number of diagnosed patients [5].

3. Epidemiological Data Collection

3.1. Raw Data

Data on COVID-19 was collected for eight selected countries in Asia, Europe, and North America. Table 1 includes the number of deaths, the number of recoveries, and the number of active cases (not yet dead or recovered) in each of the 8 countries [1].

Table 1. *Raw data (unprocessed) of the number of diagnosed cases, deaths, recoveries, and active morbid cases (not dead but not yet recovered) of COVID-19 (data updated for April 12, 2020).*

Country	Cumulative Prevalence	Cumulative Deaths	Cumulative Recoveries	Cumulative Incidence
Israel	9,387	103	1,388	10,878
Germany	63,448	2,908	60,300	126,656
USA	493,340	21,474	31,120	545,934
China	1,138	3,339	77,575	82,052
Iran	23,318	4,474	43,894	71,686
Spain	86,656	16,972	62,391	166,019
France	91,012	14,393	27,186	132,591

3.2. Initial Examination of Raw Data

Table 1 demonstrates that the USA has the largest number of diagnosed and active cases. In contrast, China has the highest recovery rate, reaching 94.5% (77,575 / 82,052). The country with the second highest number of cases is Spain, with 166,019 sick people. The number of deaths in Spain is 16,972, which amounts to a 10.2% (16,972 / 166,019) CFR. In Israel, CFR is the lowest, reaching only 0.9% (103 / 10,878).

4. Demographics and Infectious Disease – Iran and Germany

4.1. Demographic Factors and Morbidity

A major factor affecting morbidity rates related to infectious diseases is population density (number of inhabitants / state area) [6].

Another demographic factor that may explain the rate of infectious diseases spread is the level of urbanization [7].

Table 2 summarizes demographic information of the countries mentioned in Table 1, including population size, land area, population density, urbanization, and median age.

Table 2. *Demographic information about population size, land area, population density, and urbanization (data updated for April 12, 2020) [8, 9].*

Country	Population Size	Land Area (Km^2)	Population Density ($Person/Km^2$)	Urbanization (% of Population size)	Median age (years)
Israel	8,655,535	21,640	400	93%	30
Germany	83,783,942	348,560	240	76%	46
USA	331,002,651	9,147,420	36	83%	38
China	1,439,323,776	9,388,211	153	61%	38
Iran	83,992,949	1,628,550	52	76%	32
Spain	46,754,778	498,800	94	80%	45
France	65,273,511	547,557	119	82%	42

Table 2 shows that Iran and Germany have similar population sizes (almost 84 million people) and similar urbanization levels (76%). However, population density in Germany is 4.61 times higher (240 / 52) than that of Iran.

4.2. Analysis of Cumulative Incidence and Mortality

COVID-19 prevalence and CFR in Iran and Germany were compared. Figure 1 describes the number of cumulative incidence during the period of February 12 to April 12, 2020 [1].

Figure 1 shows that starting from March 24, the number of COVID-19 cases in Germany began to surpass the number of cases in Iran. It should be mentioned, however, that the absolute numbers presented in the graph are not entirely comparable, as they do not represent population density, which is strongly linked to the rate of virus spread [10-12].

Although it is expected that the rate of disease spread in Germany would be higher and faster, Figure 1 indicates that until March 24, it is Iran that had the higher rate of disease spread [1].

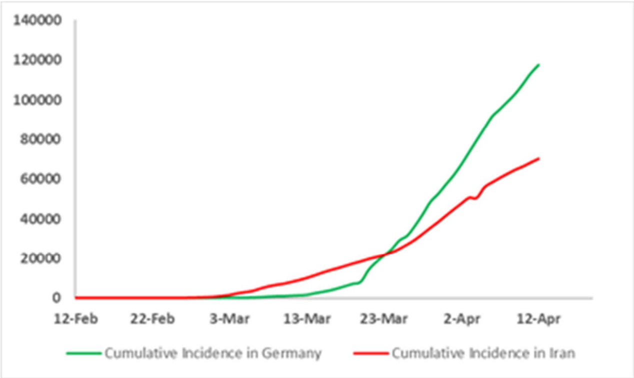

Figure 1. *Cumulative incidence of COVID-19 reported in Germany (green) and in Iran (red) between February 12 and April 12, 2020.*

Urbanization level, which has also been linked to the rate of disease spread [3, 6, 7, 10], should not be taken into consideration in the currently presented example since the level of urbanization in both countries is the same (72%) [8, 9].

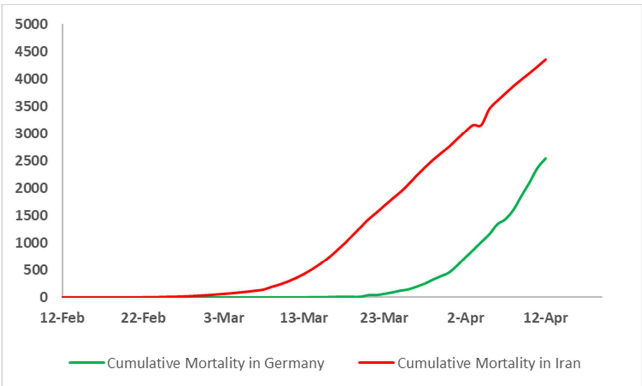

Figure 2. *Number of cumulative deaths from COVID-19 virus reported in Germany (green) and in Iran (red) between February 12 and April 12, 2020.*

Figure 2 shows that in Germany, the cumulative mortality (the area under the curve) is small compared to that of Iran. This difference is particularly striking, given that the disease was diagnosed 23 days earlier in Germany [1].

4.3. Age Distribution and Recovery from COVID-19

Data published recently indicates that mortality rate related to COVID-19 is age related. Overall, the COVID-19 CFR ranges from 3.6% in the 60+ age group to 14.8% in the 80+ age group [13]. In Iran, the median age is 32 years and 6.2% of the population is older than 65, while in Germany, the median age is 46 years and 21.5% of the population is older than 65 [8, 9].

Associated with age distribution is recovery rate. In Germany, the recovery rate is 47.6% (60,300 / 126,656), whereas in Iran the rate is 61.2% (43,894 / 71,686). This is difficult to explain because the disease was identified earlier in Germany and because the population in Germany is much older and generally has more comorbidity. Older age among Germans could explain the longer duration of sickness in Germany, whereas lower CFR may indicate better availability and quality of medical services in Germany compared with Iran.

5. Morbidity and Mortality in Other Countries

5.1. Israel

Israel is characterized by the highest population density (400 people / km^2) and urbanization level (93%) among the countries included in the current review. However, Israel shows low morbidity and mortality rates. This may be explained by the fact that Israel's population is young (median age 30 years) and by early implementation of a lockdown policy, which hindered the spread of the disease [14]. Other factors that have been lately considered as contributing to lowering the spread of COVID-19 are high ambient temperature and humidity [15], which are common conditions in Israel's climate.

5.2. China and the USA

The important role of early lockdown in lowering the spread of morbidity is most noticeable when comparing China to the USA. Both countries have a similar land area (above 9 million square meters) and similar median ages (38 years). However, in China, population density is about 4.25 (153 / 36) times higher. The two factors that could explain the lower morbidity and mortality in China are the lower urbanization (61% in China versus 83% in the USA) and the early stage at which the lockdown policy was introduced in China [16, 17].

5.3. Spain and France

Spain and France have a similar urbanization level (80% versus 82%, respectively) and median age (45 and 42 years, respectively). Spain is less crowded than France (94 and 119 person / km^2, respectively), and yet the morbidity and mortality rates are much higher in Spain. This can be ascribed to cultural norms in Spain, which are characterized by closer physical contact, such as hand shaking, and lessened social isolation compared with France [18, 19].

6. Discussion

Undiagnosed disease leads to underestimation of the incidence and prevalence. High prevalence implies a heavy burden on the health care system and the potential for death. On the other hand, a high number of recoveries or deaths leads to a reduction in disease prevalence in the population [5, 20].

When comparing the morbidity burden and mortality of infectious disease outbreaks such as COVID-19 in various countries, demographic and clinical factors should be taken into consideration. A comparison between Iran and Germany demonstrates a lower number of initiated tests for morbidity detection in Iran. This may be manifested in underestimation of morbidity incidence and prevalence in Iran compared with

Germany, leading to a higher rate of infection. On the other hand, high prevalence indicates a heavy burden on the health system and potential mortality. While the rate of active cases is higher in Germany than in Iran, mortality rate is higher in Iran, which may reduce the disease burden.

The availability and quality of health services in Germany may explain the lower mortality rate in a country where population age is older [21]. This factor becomes even more noteworthy, given that population density in Germany is 4.61 times higher than that of Iran. It must be noted, though, that Iran has large arid, uninhabited areas, and the spread of COVID-19 has shown that the disease tends to be more infectious in dense, urban populations.

When trying to understand the role of population density in the spread of the disease, the term effective density must be taken into account. Effective density refers to the extent to which actual population density affects a faster and more effective infection rate. This concept is relevant to large groups of populations living in sky rises and sharing public areas such as staircases and elevators [22, 23]. In the case of Germany and Iran, the level of urbanization is similar, reaching 72% [9].

A weighted calculation of these data leads to a clear epidemiological observation. While in urban Germany the population is older and denser compared with Iran, it has access to health services that are of better quality and availability (a higher number of screening tests and a lower rate of mortality) [1, 21].

Additionally, the older population age in Germany may explain the longer morbidity period (number of active cases) and the lower rate of recovery at any given point in time.

Another important factor responsible for the spread of infectious diseases such as COVID 19 is the timing of implementing a lockdown policy. Highly crowded countries with relatively young population and relatively high humidity and temperature climate conditions such as Israel, where a lockdown policy was implemented at early stages, are characterized by a slow spread of the infectious disease and therefore a lower rate of morbidity and mortality [15-17, 24].

Furthermore, societies characterized by diminished ‘man to man’ contact make them less susceptible to the development and spread of infectious diseases [18, 19].

7. Conclusions

Data on the COVID-19 epidemic can be gleaned online, providing a considerable amount of information, including the number of people infected, number of deaths from the disease, number of recoveries, and the number of active cases. These data permit calculation of the CFR and of the Case Recovery Rate. However, fundamental analysis of the data should include stratification of the population according to age, population density, urbanity, comorbidity, and early lockdown policy, as well as cultural differences between nations.

References

[1] Worldometer, http://www.worldometers.info/coronavirus/.

[2] Helmy YA, Fawzy M, et al. (2020). The COVID-19 Pandemic: A Comprehensive Review of Taxonomy, Genetics, Epidemiology, Diagnosis, Treatment, and Control. Journal of Clinical Medicine.; 1225. https://www.mdpi.com/2077-0383/9/4/1.

[3] Oksanen A, Kaakinen M, et al. (2020). Regulation and Trust: 3-Month Follow-up Study on COVID-19 Mortality in 25 European Countries. JMIR Public Health Surveill. 2020; 6 (2): e19218. Apr 24. doi: 10.2196/19218.

[4] Petrosillo N, Viceconte G, et al. (2020). COVID-19, SARS and MERS: are they closely related?. Clin Microbiol Infect.; 26 (6): 729-734. doi: 10.1016/j.cmi.2020.03.026.

[5] U.S. Department of Health and Human Services Centers for Disease Control and Prevention (CDC), https://www.cdc.gov/csels/dsepd/ss1978/SS1978.pdf.

[6] Liu L. (2020). Emerging study on the transmission of the Novel Coronavirus (COVID-19) from urban perspective: Evidence from China. Cities. 103: 102759. doi: 10.1016/j.cities.2020.102759.

[7] Corburn J, Vlahov D, et al. (2020). Slum Health: Arresting COVID-19 and Improving Well-Being in Urban Informal Settlements [published online ahead of print, 2020 Apr 24]. J Urban Health. 1-10. doi: 10.1007/s11524-020-00438-6.

[8] Worldometer, https://www.worldometers.info/world-population/population-by-country/.

[9] Index Mundi, https://www.indexmundi.com/facts/visualizations/age-distribution/#country=de.

[10] Rocklöv J, Sjödin (2020). H. High population densities catalyze the spread of COVID-19. J Travel Med. 27 (3): taaa038. doi: 10.1093/jtm/taaa038.

[11] Ahmadi M, Sharifi A, et al. (2020). Investigation of effective climatology parameters on COVID-19 outbreak in Iran. Sci Total Environ. 729: 138705. doi: 10.1016/j.scitotenv.2020.138705.

[12] Ramirez Aldana R, Gomez Varjan JC, et al. (2020) _Spatial_analysis_of_COVID-19_spread_in_Iran_Insights_into_geographical_and_structural_transmission_determinants_at_a_province_level, Research Gate https://www.researchgate.net/publication/340864924.

[13] Worldometer, https://www.worldometers.info/coronavirus/coronavirus-age-sex-demographics/.

[14] Smith AW, Freedman DO. (2020). Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak, *Journal of Travel Medicine*, Volume 27, Issue 2, March 2020, taaa020, https://doi.org/10.1093/jtm/taaa020.

[15] Wu Y, Jing W, Liu J, et al. (2020) Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries. Sci Total Environ. 729: 139051. doi: 10.1016/j.scitotenv.2020.139051.

[16] https://www.trip.com/travel-restrictions-covid-19/.

[17] https://www.worldnomads.com/travel-safety/worldwide/worldwide-travel-alerts.

[18] Muurlink OT, Taylor-Robinson AW. (2020). COVID-19: Cultural Predictors of Gender Differences in Global Prevalence Patterns. Front. Public Health, 30 April 2020. https://doi.org/10.3389/fpubh.2020.00174.

[19] https://mai-ko.com/maiko-blog/culture-in-japan/japanese-culture-research/global-coronavirus-research-connection-between-the-spread-of-covid-19-and-japanese-culture/.

[20] Ceylan Z. (2020) Estimation of COVID-19 prevalence in Italy, Spain, and France. Science of The Total Environment. Volume 729. https://doi.org/10.1016/j.scitotenv.2020.138817.

[21] https://www.bmj.com/content/369/bmj.m1395.short

[22] Neiderud CJ. (2015). How urbanization affects the epidemiology of emerging infectious diseases. Infect Ecol Epidemiol. 2015; 5: 27060. Published 2015 Jun 24. doi: 10.3402/iee.v5.27060.

[23] Centers for Disease Control and Prevention (CDC), https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e4.htm.

[24] https://honestreporting.com/how-israel-dealing-coronavirus/.