



Original article

Biological and epidemiological trends in the prevalence and mortality due to outbreaks of novel coronavirus COVID-19

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ABSTRACT

The novel coronavirus (Covid-19) infection outbreak has posed a major threat to the international health system and economy. This study is aimed at investigating the biological and epidemiological trends in the prevalence and mortality due to outbreaks of novel coronavirus (COVID-19) infections. The data on the global outbreak of COVID-19, were obtained from World Health Organization (WHO), Worldometer, Centers for Disease Control and Prevention (CDC), and research institutes. The information was also recorded from research documents published in global scientific journals indexed in Pub Med and Institute of Scientific Information (ISI) Web of Science on the trends in the prevalence and mortality due to COVID-19 infection outbreaks. The results show rising trends in the transmission, prevalence and mortality rate due to coronavirus COVID-19. During the period of December 29, 2019 through March 31, 2020, it has infected 750,890 people worldwide, resulting in 36,405 deaths with a mortality rate of 4.84%. The infections were more frequent among male gender over 60 years of age. The mean growth rate index for total number of cases from January 23 to March 31, 2020 was 1.20 and growth rate index for mortality rate was 1.12. There was a positive association between the prevalence and mortality rate ($R^2 = 0.996$). The novel coronavirus COVID-19 is highly contagious and has affected a large number of people worldwide. It is still spreading with mutable prevalence and mortality outbreak trends. The global health officials have taken priority measures to prevent further outbreaks of this emerging pathogen across the globe. However, the rising number of cases and mortality risk estimates are demonstrating that enhanced public health mediations, good hygienic conditions, social distancing, and movement limitations may control the COVID-19 epidemics.

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1. Introduction

Viral infections are the most frequent infectious diseases and are common triggers for constituting major health and socio-economic harms (Meo et al., 2020). In late December 2019, an ear-

lier named novel coronavirus (2019-nCoV), currently named as coronavirus (COVID-19) emerged from Wuhan, China, resulted in a challenging outbreaks in many regions in China and expanding globally. Human infections with coronavirus COVID-19 have raised great public health apprehension globally. In the third millennium, three major threatening infectious diseases outbreaks happened. Following the outbreak of SARS-CoV in 2002 (Zhong et al., 2003) and the MERS-CoV in 2012 (Nassar et al., 2018a,b), the novel Coronavirus “COVID-19” has emerged globally and has threatened the entire world. The coronaviruses are zoonotic infections, can be transmitted from animal to animal, animal to human, and human to human (Li et al., 2020; World Health Organization, 2020a,b).

The Covid-2019 virus first appeared in the last week of December 2019. The infection cases originated from bats, snakes,

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and seafood among people living in or visiting Wuhan, China and human-to-human transmission has also been confirmed (World Health Organization, 2020a,b; Wang et al., 2020; Callaway and Cyranoski, 2020). The biological and epidemiological trends in the prevalence and mortality rate are changing daily. Initially, China bore the large burden of the diseases, but the incidence is gradually increasing in other countries mainly the Europe and United States of America. Despite recent efforts to understand the novel Coronavirus COVID-19, the science community, researchers, and general population would like more information about the current biological and epidemiological situation. This study aimed at investigating the mutable biological and epidemiological trends in the prevalence and mortality outbreaks of coronavirus COVID-19 infections.

2. Materials and methods

This study was conducted in the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia. We obtained data on biological and epidemiological trends, global number of confirmed cases, and number of deaths due to Coronavirus COVID-19 infections all around the world. The data were obtained from the World Health Organization (WHO), (Center for Disease Control and Prevention CDC, 2020), and reports from various countries and their allied ministries to the WHO. We also obtained data from search engines including (Worldometer, 2020). Moreover, we also reviewed the literature published in the (Institute of Scientific Information (ISI) Web of Knowledge, Thomson Reuters, 2020), (Pub-Med, 2020), Medline, and appropriate findings were recorded. We assessed the growth factor, a factor by which quantity multiplies itself over time; daily cases divided by cases on the previous day. A growth factor more than 1.0, indicates an increasing pattern, whereas values between 0 and 1.0 show a decline pattern (Worldometer-Coronavirus).

2.1. Ethical statement

In this study the information on the biological and epidemiological trends on global prevalence and mortality due to novel Coronavirus Covid-2019 infections was obtained from the World Health Organization, Worldometer-Coronavirus, the Centers for Disease Control and Prevention and reports from various countries and their allied ministries to the WHO; hence ethical approval was not required.

2.2. Statistical analysis

The data were recorded and analyzed, and the results were expressed in numbers and percentages. The regression analysis was performed; and a p -value <0.05 was considered significant.

3. Results

These results are established from the available information at the time of publication originating from the mentioned sources. The data were interpreted carefully, however, the outbreak is evolving rapidly and there is swift change in the numbers. The global number of cases and number of deaths due to novel coronavirus COVID-19 infection are presented in Table 1, and Figs. 1 and 2. Moreover, epidemiological trends were presented and correlations were established (Figs. 2–4). The novel coronavirus COVID-2019 has infected people in 198 countries and territories.

The total number of cases worldwide is 750,890 people and the disease has caused 36,405 (4.84%) deaths during the period December 29, 2019–March 31, 2020 (Table 1). The majority of these coronavirus cases, were reported from the European Region 423,946 (56.45%), American Region 163,014 (21.70%), Western Pacific Region 104,868 (13.96%), Easter Mediterranean Region 50,349 (6.70%), South-East Asia Region 4215 (0.56%) and African Region 3786 (0.50%) (Table 1). In these continents COVID-19 highly affected the various countries including United States of America, Italy, France, Spain, Germany, Switzerland, and Iran (Fig. 1). However, the highest mortality rate has been found in Italy, Spain, United Kingdom, France and Iran (Fig. 5). The outbreak of novel coronavirus Covid-2019 started on December 29, 2019. The results shows rising trends in the transmission, prevalence and mortality rate due to coronavirus Covid-2019.

In this study, we also analyzed the daily cases and death growth factors of the coronavirus Covid-2019. It was identified that during the January 22–March 31, 2020 the growth factor of the number of cases worldwide was 0.28–6.96 (Mean 1.20) and the growth factor of death rates was 0.51–2.17 (Mean 1.12). There was a positive association between the prevalence and mortality rate ($R^2 = 0.996$). The disease showed a mutable change in both the daily case growth factor and mortality rate (Fig. 3).

4. Discussion

Coronavirus infection is an emerging global health concern and has infected a significant portion of the world's population. In this study, we investigated the biological and epidemiological trends in the prevalence and mortality due to outbreaks of novel coronavirus COVID-19 infection. The COVID-19 infection is expanding to over 198 countries and territories. It has infected 750,890 people, and has caused 36,405 (4.84%) deaths during the period December 29, 2019 to March 31, 2020 (Table 1).

The coronavirus Covid-2019 infection is rapidly transmitted. The disease is still in its spreading phase with predictions of infection expand to over 250,000 people globally. We have derived the estimates of the ongoing COVID-19 epidemic and found that still the mean growth factor for number of cases and mortality rate is more than 1.0. It is highly contagious because of its biological

Table 1
Worldwide number of laboratories confirmed cases and deaths due to Coronavirus Covid-2019.

Number	Total	(%)	Number of Deaths	(%)
Total number of cases	750,890	100	36,405	4.84
Western Pacific Region	104,868	13.96	3671	3.50
European Region	423,946	56.45	26,694	6.29
South-East Asia Region	4215	0.56	166	3.93
Easter Mediterranean Region	50,349	6.70	2945	5.84
American Region	163,014	21.70	2836	1.73
African Region	3786	0.50	77	2.0
Preexisting conditions	CAD 13.2%; Diabetes 9.2%; Respiratory diseases 8%			
Age group	60–69 = 3.6%; 70–79 = 8%; >80 21.9%			

Note: World Health Organization, Data updated on March 31, 2020.

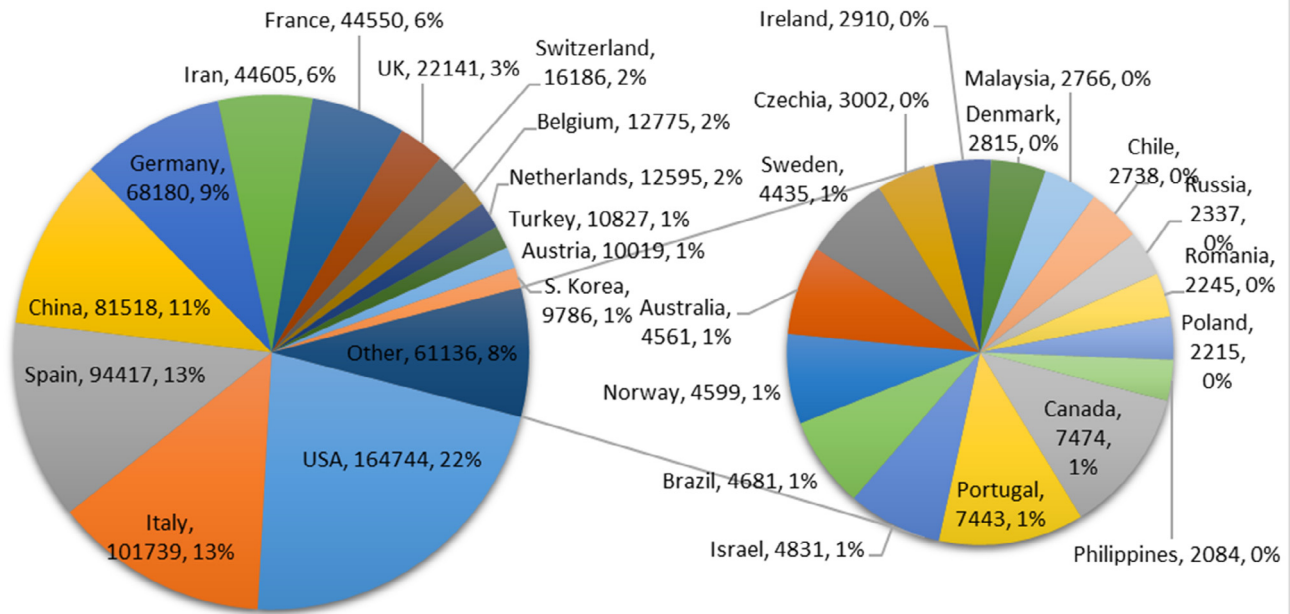


Fig. 1. Worldwide prevalence of COVID-19 infection. Note: Novel Coronavirus “COVID-19” data is presented from Dec 29, 2019 to March 31, 2020. Countries with less than 2000 cases are not presented in this graph Ref. (Worldometer, 2020).

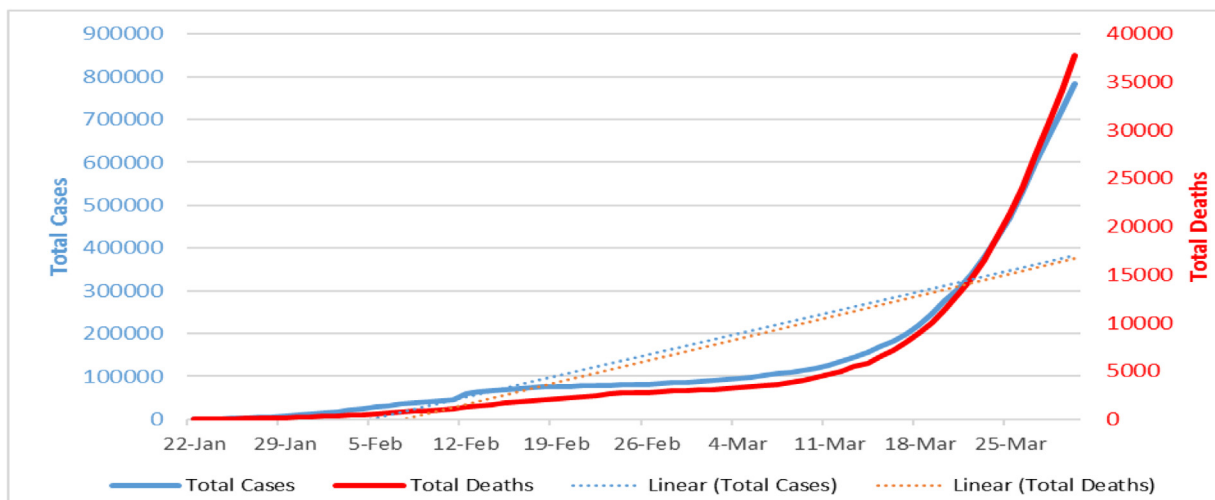


Fig. 2. Trend of global prevalence of number of cases and deaths due to COVID-19 infection. Note: Novel coronavirus “COVID-19” data is presented from Jan 22, 2020 to March 31, 2020. Ref. (Worldometer, 2020).

characteristics (Meo et al., 2020). It is a zoonotic disease with person-to-person transmission through droplet or contact transmission (Wu et al., 2020). Infected people can transmit the disease before they present clinical symptoms (Rothe et al., 2020). This is the main reason that the disease could swiftly spread from Wuhan, China to various corners of the globe. More recently, the epicenter of the diseases appears to have shifted from Wuhan, China to the European world (mainly Italy), and United States of America (World Health Organization, 2020a,b). Many countries including China, Italy, Saudi Arabia, New Zealand, Poland, Ireland, Denmark, Spain, France have cancelled international flights and implemented the world’s largest and most restrictive quarantines policies to minimize the further transmission and disease burden. For the prevention of the spread of the disease, these countries are not permitting people to enter or leave the country without strict

screening of the passenger for evidence of Covid-2019 infection at airports.

Quilty et al. (2020) evaluated the usefulness of thermal passenger screening for COVID-19 infection at airports exit and entry points. The authors found that effectiveness of entry screening was dependent on the effectiveness of the exit screening at the destination. The authors identified that 46% of the infected travelers were not detected, because of the incubation period, and asymptomatic or subclinical cases (Chan et al., 2020). Quilty et al. (2020) also reported that airport screening is unlikely to detect a sufficient proportion of COVID-19 infected travelers. The screening is intended to be a barrier for preventing infected people from entering into the country; however, evidence of its effectiveness remains limited. These are reasons that health officials are still unable to control the spread of this contagious disease. The

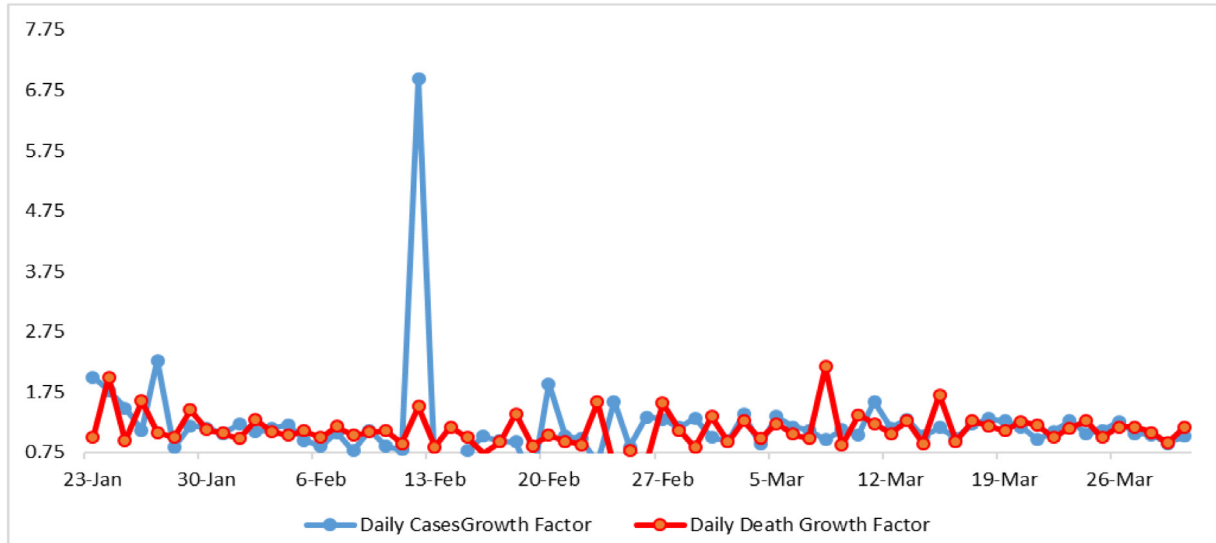


Fig. 3. Growth factor of number of cases and deaths due to COVID-19 infection. Note: Novel Coronavirus “COVID-19” data is presented from Jan 22, 2019 to March 31, 2020. Ref. (Worldometer, 2020).

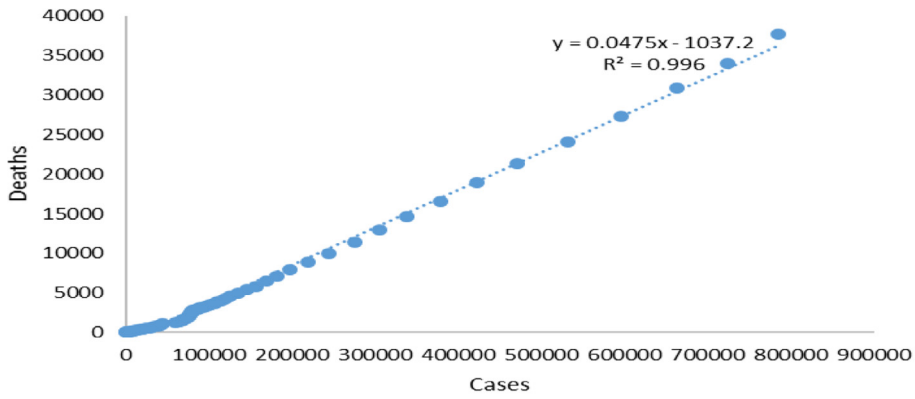


Fig. 4. Correlation coefficient between number of cases and number of deaths due to COVID-19 infection.

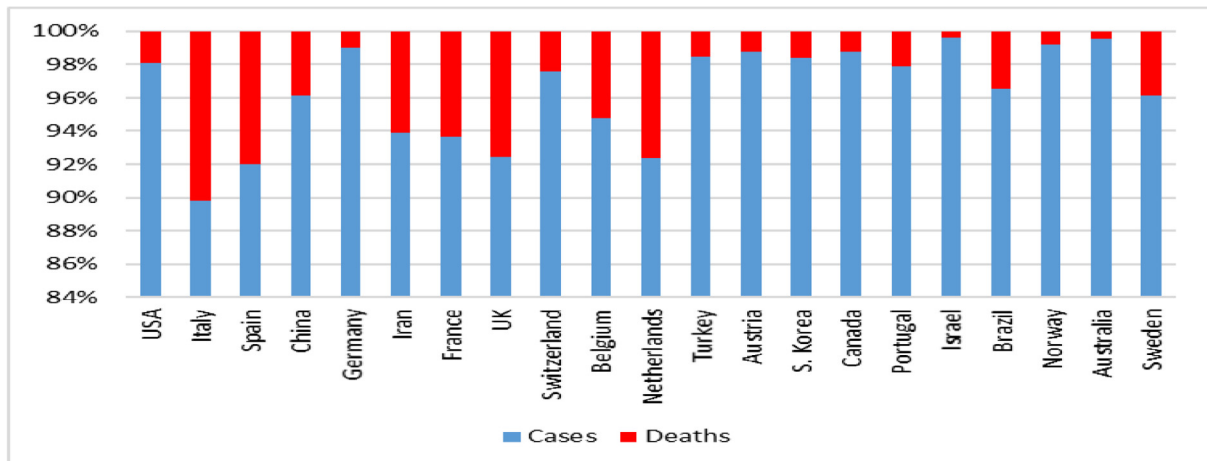


Fig. 5. Number of cases and deaths presented with 100% stacked graph. Note: Novel Coronavirus “COVID-19” data is presented from Jan 22, 2020 to March 31, 2020. Ref. (Worldometer, 2020).

transmission of the disease is closely linked to the asymptomatic and infected people and those visiting the countries with COVID-19 pandemic.

The coronavirus COVID-2019 has spread to over 198 geographical regions of the globe. The gender-based analysis demonstrated that the identified cases consisted mostly of men with a median age range of 50–65 years. (Li et al., 2020) reported that the novel coronavirus Covid-2019 infection was found in China, and later spread to almost every nation of the world. The virus infection has mainly occurred among the elderly with the median age of 59 years. December 29, 2019–March 31, 2020. The number of cases was positively linked to the death rate of COVID-19 infection (Fig. 4). The disease is still spreading with mutable prevalence and mortality outbreak trends.

5. Conclusions

The epidemiological trends show that novel coronavirus COVID-19 is highly contagious and has affected 750,890 people, with a mortality rate of 4.84%. The number of cases has been proportional to the number of deaths. There was a great fluctuation in the biological and epidemiological trends both in the growth factor of number of cases and the mortality rates. Global health officials have taken high priority measures to prevent further outbreaks of this emerging pathogen across the globe, but still the coronavirus COVID-19 is swiftly spreading with mutable biological trends. The rising number of cases and mortality risk estimates are demonstrating a dire need for enhanced public health mediations, good hygienic conditions, social distancing, and movement limitations to control the COVID-19 epidemics.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- Callaway, E., Cyranoski, D., 2020. China coronavirus: six questions scientists are asking. *Nature* 577, 605–607.
- Centers for Disease Control and Prevention. Available at: <https://www.cdc.gov/> (cited date March 16, 2020).
- Chan, J.F.W., Yuan, S., Kok, K.H., To, K.K.W., Chu, H., Yang, J., 2020. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*. S0140–6736 (20) 30154–9.
- COVID-19 Coronavirus. Available at: <https://www.worldometers.info/coronavirus/> (Cited date Feb 29, 2020).
- ISI Web of Knowledge. Thomson Reuters, Available at: <http://webofknowledge.com/JCR/JCR?PointOfEntry=Home&SID=4FeKpkbnHkLlmE10Ge> (Cited date March 30, 2020).
- Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., 2020. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N. Engl. J. Med.* <https://doi.org/10.1056/NEJMoa2001316>.
- Meo, S.A., Alhowaikani, A., Al-khaliwi, T., Meo, I.M., Halepoto, D.M., Iqbal, M., Usmani, A.M., Hajjar, W., Ahmed, N., 2020. Novel coronavirus 2019-nCoV: prevalence, biological and clinical characteristics comparison with SARS-CoV and MERS-CoV. *Eur. Rev. Med. Pharmacol. Sci.* 24 (4), 2012–2019.
- Nassar, M.S., Bakhrebah, M.A., Meo, S.A., Alsuabeyl, M.S., Zaher, W.A., 2018a. Middle east respiratory syndrome coronavirus (MERS-CoV) infection: epidemiology, pathogenesis and clinical characteristics. *Eur. Rev. Med. Pharmacol. Sci.* 22, 4956–4961.
- Nassar, M.S., Bakhrebah, M.A., Meo, S.A., Alsuabeyl, M.S., Zaher, W.A., 2018b. Global seasonal occurrence of middle east respiratory syndrome coronavirus (MERS-CoV) infection. *Eur. Rev. Med. Pharmacol. Sci.* 22, 3913–3918.
- Pub Med. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/?term=Coronavirus> (cited date March 30, 2020).
- Quilty, B.J., Clifford, S., Cmmid nCoV Working Group, Flasche, S., Eggo, R.M., 2020. Effectiveness of airport screening at detecting travellers infected with novel coronavirus (2019-nCoV). *Euro. Surveill.* 25 (5). <https://doi.org/10.2807/1560-7917.ES.2020.25.5.2000080>.
- Rothe, C., Schunk, M., Sothmann, P., Bretzel, G., Froeschl, G., Wallrauch, C., 2020. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. *N. Engl. J. Med.* <https://doi.org/10.1056/NEJMc2001468>.
- Wang, W., Tang, J., Wei, F., 2020. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan. *J. Med. Virol.* <https://doi.org/10.1002/jmv.25689>.
- World Health Organization. Available at: <https://www.who.int/emergencies/mers-cov/en/> (cited date March 31, 2020).
- World Health Organization: Coronavirus. Available at: <https://www.who.int/health-topics/coronavirus> (cited date March 31, 2020).
- Wu, Y.C., Chen, C.S., Chan, Y.J., 2020. Overview of the 2019 novel coronavirus (2019-nCoV): the pathogen of severe specific contagious pneumonia (SSCP). *J. Chin. Med. Assoc.* <https://doi.org/10.1097/JCMA.0000000000000270>.
- Zhong, N.S., Zheng, B.J., Li, Y.M., Poon, Xie, Z.H., Chan, K.H., Li, P.H., Tan, S.Y., Chang, Q., Xie, J.P., Liu, X.Q., Xu, J., Li, D.X., Yuen, K.Y., Peiris, Guan Y., 2003. Epidemiology and cause of severe acute respiratory syndrome (SARS) in Guangdong, People's Republic of China in February 2003. *Lancet* 362, 1353–1358.