

Public health perspective of the COVID-19 pandemic: Host characteristics and prevention of COVID-19 in the community (Review)

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Abstract. The Coronavirus Disease 2019 (COVID-19) pandemic is a recent, ongoing global concern that has affected >200 countries worldwide. Numerous cases of COVID-19 have been reported. The confirmed cases of COVID-19 have increased unexpectedly and continuously to 1,051,635 and the confirmed deaths have reached up to 56,985 on April 4, 2020. COVID-19 is a novel disease caused by SARS-CoV-2, and there are currently no vaccines or drugs available for its prevent or treatment. The whole genome of SARS-CoV-2 was first identified in January, 2020 during the spread of COVID-19. A number of researchers are determining the characteristics of this virus in order to develop vaccines, drugs and proper prevention steps with which to attenuate the spread of COVID-19. The present review aimed to discuss the characteristics and prevention strategies of COVID-19. The response from the public health perspective is important to prevent the further escalation of the COVID-19 pandemic through communities. This is based on the characteristics of COVID-19, not only of the virus itself, but also of the infected host, such as the level of illness, symptoms, vulnerable groups (age, sex and health status) and fatality rates. There are several public health interventions which may be used to combat COVID-19, namely, i) social and physical distancing, travel restrictions, self-quarantine and lockdown; ii) personal hygiene and good sanitation, such as the washing of hands, covering of the mouth and nose while coughing or sneezing and spraying disinfectants on surroundings; iii) boosting immunity by the consumption of nutritious food, getting sufficient rest and taking supplements or vitamins; iv) case detection, contact tracing and mass testing; and v) vaccine development. The understanding of COVID-19 characteristics and appropriate

prevention strategies may suppress the rapid and extensive spread of COVID-19.

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1. Introduction

The Coronavirus Disease 2019 (COVID-19) was declared a public health emergency of international concern by the World Health Organization (WHO) on January 30, 2020. Eventually, it was classified as the COVID-19 pandemic on March 11, 2020 (1). At the time of the writing of the present review, the global pandemic of COVID-19 has been present for approximately 3 months worldwide. Since the first case was identified in the city of Wuhan, Hubei Province in China, some individuals suffered from the symptoms of pneumonia, although the cause of the disease was unclear at that time. Eventually, researchers in China isolated the agent of the disease and published the whole genome of the virus. The virus identified has only an 80-90% similarity with SARS-CoV from bats, shares a 79% sequence identity with SARS-CoV in 2002 and a 50% similarity with MERS-CoV in 2012 (2). Therefore, the WHO announced that pneumonia symptoms are caused by the novel coronavirus and it was named SARS-CoV-2. The characteristics of this novel coronavirus also differ from those of previously identified coronaviruses that cause severe pneumonia, such as SARS-CoV and MERS-CoV.

Coronaviruses are known to circulate among mammals and birds; however, the virus was probably transmitted to humans by another animal. In humans, coronaviruses cause respiratory tract infections that can be mild for 4 genera of the virus (*Alpha*, *Beta*, *Gamma* and *Deltacoronavirus*) (3,4), such as in some cases of the common cold (other possible causes, for example, rhinoviruses). However, other types, such as SARS-CoV and MERS-CoV can be lethal and can

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cause major outbreaks of severe pneumonia (5). Recently, the novel coronavirus or SARS-CoV-2 has caused the COVID-19 pandemic (6). SARS-CoV, MERS-CoV and SARS-CoV-2 cause severe respiratory tract infections and are zoonotic pathogens, which begin in infected animals and are transmitted from animals to humans, and can be transmitted, moreover, from human to human. There are currently 7 types of coronaviruses, including the novel coronavirus, SARS-CoV-2. Common signs of COVID-19 infection include respiratory symptoms, fever, cough, shortness of breath and breathing difficulties. In more severe cases, the infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even death (7,8).

Extensive research is being conducted in order to obtain a deeper understanding of this novel coronavirus. Efforts are being made to identify strategies with which to prevent and break the chain of transmission. The characterisation of SARS-CoV-2 is not similar to that of SARS-CoV in 2002 and MERS-CoV in 2012. First, SARS-CoV-2 is the most contagious virus among the coronaviruses group. This has been proven by the continuously increasing number of positive cases over the course of merely 3 months until >1,000,000 individuals who were affected (up to the time of the writing of the present review). On the other hand, SARS-CoV in 2002 and MERS-CoV in 2012 caused only 8,098 and 2,494 cases, respectively (9,10). The number of COVID-19 cases will continue to increase for an undetermined amount of time this year. Moreover, the estimated early range of the reproductive rate (R_0) of COVID-19 is from 2.6 to 4.71, indicating that new cases are increasing by 2-4-fold each day (11). COVID-19 may spread between individuals before any symptoms appear, rendering its identification and control difficult.

As it is common in the course of infections, there is a delay between the time of viral infection of an individual and the time point at which the individual develops symptoms (the disease onset). This is known as the incubation period. The incubation period for COVID-19 is typically 5 to 6 days, but may range from 2 to 14 days (12,13). The transmission of COVID-19 to multiple hosts may be relatively easy during the incubation period (pre-symptomatic period) compared with SARS-CoV and MERS-CoV. Moreover, the number of asymptomatic or mildly symptomatic individuals following infection is relatively high for COVID-19, but fairly low for SARS-CoV and MERS-CoV. Thus, it is difficult to carry out the isolation and contact tracing of individuals infected with COVID-19. Second, the transmission of SARS-CoV-2 slightly differs from that of SARS-CoV and MERS-CoV. The latter two viruses are mainly transmitted through direct contact with individuals who have symptoms, such as by travelling to or residing in an area where SARS-CoV and MERS-CoV have recently spread, coming in close contact with infected patients and visiting or attending healthcare facilities where SARS-CoV and MERS-CoV have spread (14). For COVID-19, however, there are two major methods through which the virus is considered to disseminate, namely, from individual to individual through respiratory droplets when an infected individual coughs, sneezes or talks, as well as from contact with contaminated surfaces, where the virus can survive for hours up to even days at a time. From contaminated surfaces, the transmission of the virus can take place when an individual touches a surface or object that has the virus on it and subsequently

touches their eyes, nose or mouth (15). Furthermore, the WHO states that in the context of COVID-19, airborne transmission may be possible in specific circumstances and settings, in which procedures or support treatments that generate aerosols are performed (16). Third, most reported SARS-CoV and MERS-CoV cases exhibited severe respiratory illnesses requiring hospitalisation; however, approximately 20% of the patients had mild or no symptoms. Fever, chills, myalgia and cough were common. However, COVID-19 infection has led to 80% of asymptomatic cases or those with mild to moderate symptoms and, 20% severe and critical cases (17). Fourth, the case fatality rate (CFR) of COVID-19 is likely not higher compared with that of SARS-CoV and MERS-CoV. The CFR of COVID-19 is globally indicated to be approximately 2-3%. This is lower than the CFR of SARS-CoV and MERS-CoV, measured at approximately 9.6 and 34%, respectively (18). Nevertheless, the COVID-19 pandemic still continues to spread. The CFR may also increase, depending on the total number of positive cases and deaths. COVID-19 has recently become a major threat; therefore, urgent action to combat the virus according to characterisation of the virus itself is required, and it is also important to have knowledge of the characterisation of the infected host. In the present review, information on the spread and pattern of COVID-19 cases related to the characterisation of the infected host, namely the level of illness, symptoms, vulnerable groups (age, sex and health status) and fatality rate is presented. Furthermore, urgent actions, as a step of public health interventions, which are expected to prevent the spread of COVID-19 in communities are also discussed.

2. Data collection methods

The present review analysed data on COVID-19 published on the Statista, WHO and Worldometer databases on April 4, 2020 sourced from countries worldwide (19-21). In the present review, the data analysed are presented in the form of a figure, a graph or diagram. In addition, some articles (22-28) were included in the present review to compare certain indicators of COVID-19 cases published globally by websites, such as Statista, WHO and Worldometer (19-21). Data retrieved from each article were collected, and certain indicators are listed in Table I and marked in bold font as the first, second and third most common in the individuals infected. The present review also discusses the efforts made for COVID-19 prevention that were recommended by the WHO and implemented by several countries.

The data of COVID-19 cases obtained from Statista (19), WHO (20) and Worldometer (21) included the total number of cases (active infection, recoveries and deaths), grouped by age, sex, the level of illness and comorbidities from some countries that have been affected. In the present review, the number of COVID-19 cases in Indonesia is also shown; however, the characterisation of cases based on factors such as age, sex and comorbidities was not yet available of the data published on April 4, 2020, both on international and national websites (19-21,29). Furthermore, data from published articles were collected (22-28) in order to compare with the total data published on websites, such as Statista, WHO and Worldometer (19-21) from countries affected by COVID-19. Eventually, these data may enhance our understanding of the

Table I. Seven articles included in the present review for the comparison of data published in web by Statista, WHO and Worldometer.

Study no.	Article title/(Ref.)	No. of cases	Data on age	Data on sex (%)	Data on symptoms (%)	Data on laboratory tests	Data on comorbidities (%)
1.	Characteristics and outcomes of 21 critically ill patients with COVID-19 in Washington State (22)	21	Mean age, 70 years (range, 43-92 years)	Male (52) Female (48)	Cough 11 (47.6) Shortness of breath 17 (76.2) Fever 11 (52.4) Temperature, mean (range), 37.6°C (35.3-39.2)	White blood cell count, / μ l 9,365 (2,890-16,900) Absolute lymphocyte count, /μl 889 (200-2,390) Hemoglobin, g/dl 11.4 (8.0-13.7) Platelet count, $\times 10^3$/μl 215 (52-395)	Total with ≥ 1 comorbidity 18 (85.7): Asthma 2 (9.1) Chronic obstructive pulmonary disease 7 (33.3) Congestive heart failure 9 (42.9) Diabetes 7 (33.3) Rheumatologic disease 1 (4.8) Obstructive sleep apnea 6 (28.6) Chronic kidney disease 10 (47.6) End-stage kidney disease 2 (9.5) History of solid organ transplant 2 (9.5) Cirrhosis 1 (4.8) Immunosuppression 3 (14.3)
2.	Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China (23)	138	Median age, 56 years (interquartile range, 42-68; range, 22-92 years)	Male 75 (54.3) Female 63 (45.7)	Fever 136 (98.6) Fatigue 96 (69.6) Dry cough 82 (59.4) Anorexia 55 (39.9) Myalgia 48 (34.8) Dyspnea 43 (31.2) Expectoration 37 (26.8) Pharyngalgia 24 (17.4) Diarrhea 14 (10.1) Nausea 14 (10.1) Dizziness 13 (9.4) Headache 9 (6.5) Vomiting 5 (3.6) Abdominal pain 3 (2.2)	White blood cell count, $\times 10^9$ /l 3.5-9.5 Platelet count, $\times 10^9$/l 125-350 Lymphocyte count, $\times 10^9$/l 1.1-3.2	Comorbidities 64 (46.4): Hypertension 43 (31.2) Cardiovascular disease 20 (14.5) Diabetes 14 (10.1) Malignancy 10 (7.3) Cerebrovascular disease 7 (5.1) COPD 4 (2.9) Chronic kidney disease 4 (2.9) Chronic liver disease 4 (2.9) HIV infection 2 (1.4)

Table I. Continued.

Study no.	Article title/(Ref.)	No. of cases	Data on age	Data on sex (%)	Data on symptoms (%)	Data on laboratory tests	Data on comorbidities (%)
3.	Epidemiologic and clinical characteristics of novel coronavirus infections involving 13 patients outside Wuhan, China (24)	13	Mean age, 34 years (range, 34-48 years)	Male 10 (77) Female 3 (23)	Maximum temperature, °C 38.4 (0.883), Mean (SD) Cough 6 (46.2) Productive cough 2 (15.4) Rhinorrhea 1 (7.7) Myalgia 3 (23.1) Diarrhea 1 (7.7) Upper airway congestion 8 (61.5) Headache 3 (23.1)	Hemoglobin, g/l 147 (12.1) Hematocrit, % 43.2 (3.36) Platelets, x10⁹/l 199 (72.5) WBCs, x10 ⁹ /l 5.83 (2.32)	No data
4.	Epidemiologic features and clinical course of patients infected with SARS-CoV-2 in Singapore (25)	18	Median age, 47 years (range, 31-73 years)	Male 9 (50) Female 9 (50)	Fever 13 (72) Cough 15 (83) Shortness of breath 2 (11) Rhinorrhea 1 (6) Sore throat 11 (61) Diarrhea 3 (17)	WBCs, x10 ⁹ /l 4.6 (1.7-6.3) Hemoglobin, g/dl 13.5 (11.7-17.2) Platelets, x10⁹/l 159 (116-217) Neutrophils, x10 ⁹ /l 2.7 (0.7-4.5) Lymphocytes, x10⁹/l 1.2 (0.8-1.7)	No data
5.	Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China (26)	201	Median age, 51 years (range, 43-60 years) ≥65 40 (19.9) <65 161 (80.1)	Male 128 (63.7) female 73 (36.3)	Fever 188 (93.5) Cough 163 (81.1) Productive cough 83 (41.3) Dyspnea 80 (39.8) Fatigue or myalgia 65 (32.3)	White blood cells, x10 ⁹ /ml 5.94 (3.80-9.08) Neutrophils, x10 ⁹ /ml 4.47 (2.32-7.70) Lymphocytes, x10⁹/ml 0.91 (0.60-1.29) Platelets, x10⁹/ml 180.00 (137.00-241.50)	Comorbidities Hypertension 39 (19.4) Diabetes 22 (10.9) Cardiovascular disease 8 (4.0) Liver disease 7 (3.5) Nervous system disease 7 (3.5) Chronic lung disease 5 (2.5) Chronic kidney disease 2 (1.0) Endocrine system diseases 2 (1.0) Tumor 1 (0.5)

Table I. Continued.

Study no.	Article title/(Ref.)	No. of cases	Data on age	Data on sex (%)	Data on symptoms (%)	Data on laboratory tests	Data on comorbidities (%)
6.	Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China (27)	41	Median age, 49 years (range, 41-58 years)	Male 30 (73) Female 11 (27)	Fever 40 (98) Cough 31 (76) Myalgia (muscle pain) or fatigue 18 (44) Sputum production 11/39 (28) Headache 3/38 (8) Haemoptysis 2/39 (5) Diarrhea 1/38 (3)	White blood cell count, $\times 10^9$ per liter 6.2 (4.1-10.5) Neutrophil count, $\times 10^9$ per liter 5.0 (3.3-8.9) Lymphocyte count, $\times 10^9$ per liter 0.8 (0.6-1.1) Haemoglobin, g/l 126.0 (118.0-140.0) Platelet count, $\times 10^9$ per liter 164.5 (131.5-263.0)	Any comorbidity 13 (32): Diabetes 8 (20) Hypertension 6 (15) Cardiovascular disease 6 (15) Chronic obstructive pulmonary disease 1 (2) Malignancy 1 (2) Chronic liver disease 1 (2)
7.	Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study (28)	99	Mean age (SD) 55.5 years (13.1) (range, 21-82 years)	Male 67 (68) Female 32 (32)	Fever 82 (83) Cough 81 (82) Shortness of breath 31 (31) Muscle ache 11 (11) Confusion 9 (9) Headache 8 (8) Sore throat 5 (5) Runny nose 4 (4) Chest pain 2 (2) Diarrhea 2 (2) Nausea and vomiting 1 (1)	Leucocytes ($\times 10^9$ per liter; normal range 3.5-9.5) 7.5 (3.6) Increased 24, Decreased 9 Neutrophils ($\times 10^9$ per liter; normal range 1.8-6.3) 5.0 (3.3-8.1) Increased 38 Lymphocytes ($\times 10^9$ per liter; normal range 1.1-3.2) 0.9 (0.5) Decreased 35 Platelets ($\times 10^9$ per liter; normal range 125.0-350.0) 213.5 (79.1) Increased 4, Decreased 12 Haemoglobin (g/l; normal range 130.0-175.0) 129.8 (14.8) Decreased 50	Any 33 (33): ARDS 17 (17) Acute renal injury 3 (3) Acute respiratory injury 8 (8) Septic shock 4 (4) Ventilator-associated pneumonia 1 (1)

The first, second and third most common indicators, as well as abnormal data laboratory tests in the individuals infected are marked in bold font.

pattern of individuals infected by COVID-19, such as the level of illness, symptoms, vulnerable groups (age, sex and health status) and the fatality rate. The presentation of these data may be used to consider the efforts to determine which responses will be the most effective in the COVID-19 crisis.

3. Summary of data obtained

In the present review, data were collected on the following: i) Updated data until April 4, 2020 of the total number of COVID-19 cases for the 10 most affected countries, namely the USA, Italy, Spain, Germany, China, France, Iran, UK, Switzerland and Turkey, as well as the number of COVID-19 cases in Indonesia; ii) descriptions of the symptoms and levels of illness from COVID-19 cases; iii) demographic information on the age and sex of COVID-19 cases; and iv) death rate by age and comorbidities. The present review aimed to determine the characteristics of hosts infected with COVID-19 based on categories such as age, sex, symptoms, comorbidities and levels of illness. Moreover, these characteristics may encourage general awareness in an effort to prevent and avoid the spread of COVID-19 and the rising mortality rate.

4. Pattern of COVID-19 cases

The spread of COVID-19 is currently increasing worldwide outside the Chinese mainland. By contrast, the number of COVID-19 cases in China has significantly decreased. Some countries have exhibited a notable increase in COVID-19 cases as of April 4, 2020, the confirmed cases and deaths in countries, such as the USA, Italy, Spain and Germany have exceeded the number of cases in China. Currently, China is ranked 5th among the countries with COVID-19 cases worldwide. The total number of COVID-19 cases, active infections, recoveries and deaths globally reported worldwide up to April 4, 2020 by Statista were 1,016,395, 750,024, 213,133 and 53,238, respectively (19). These data were collected over a period of 3 months (Fig. 1A). The highest number of active infections was in the USA, while the highest number of deaths was in Italy. Moreover, in Indonesia, the number of COVID-19 cases, recoveries and deaths, was approximately 2,092, 150 and 191, respectively (Fig. 1B). Even though the number of cases in Indonesia remains low, an awareness of the widespread cases is required.

WHO has reported that the most common symptoms of COVID-19 include fever, dry cough and fatigue. Some patients may also have a runny nose, sore throat, headache, shortness of breath and diarrhoea (Fig. 2) (30). These symptoms have been found at a higher percentage in certain studies (Table I) (22-28). When a pathogen of SARS-CoV-2 invades, the difference between individuals and their health determines the race between how rapidly the pathogen can spread within the body and how rapidly the immune response can react without causing extensive organ damage. COVID-19 may present with mild, moderate or severe illness. Among the severe clinical manifestations, symptoms include severe pneumonia, acute respiratory distress syndrome (ARDS), sepsis and septic shock. In the total number of cases, there is a sudden worsening of clinical conditions with rapid respiratory failure after about a week. The criteria of severe respiratory

insufficiency and diagnostic criteria of sepsis and septic shock can refer to reference (31). Approximately 14% of infected individuals experience severe disease and 5% become critically ill (Fig. 3) (32).

COVID-19 is the most infectious virus among the coronavirus group, although it is not more lethal compared to the other 2 strains of coronaviruses, SARS-CoV and MERS-CoV. Therefore, the spread of COVID-19 is rapidly increasing, and the number of deaths is also increasing. Furthermore, the present review observed the characteristics of COVID-19 cases based on demographic information, that is, the sex and age group of the individuals infected with COVID-19. Although sex-disaggregated data for COVID-19 have not exhibited a marked difference in the numbers of cases between males and females to date, male patients seem to be slightly greater in number than female patients in countries, such as China, Germany, Iran, Italy and Sweden. By contrast, COVID-19 cases among female patients are slightly higher than those in male patients in Denmark, France, Portugal, Ireland, Korea, Spain, Switzerland and The Netherlands (Fig. 4). As per the data shown in Fig. 4, the proportion of deaths among confirmed cases is higher in males than in females (female data in Fig. 4 can be calculated by subtracting the male data from 100%). This may be caused by the fact that the rates of tobacco smoking are substantially higher among male than female patients (33). Preliminary reports of individuals with severe COVID-19 disease symptoms have found associations with existing comorbidities, including hypertension, cardiovascular disease and certain chronic lung diseases, and these conditions tend to burden the male population to a greater extent globally (34).

COVID-19 can infect all age groups with the same risk, particularly the ages 20-80 years (Fig. 5A, C and D); however, the age group has an impact on deaths caused by the virus, particularly in elderly individuals >60 years of age. The greater the age, the higher the risk the individual has. The age groups between 60-69, 70-79, 80 years and older have higher risks of mortality in China, Italy, Spain and Korea. The highest number of fatalities has been recorded in ages >80 years in these countries (Fig. 5B). A similar trend has also been observed in the USA and France (Fig. 5C and D). This is due to the fact that, in older individuals, the body's immunity is weak compared with that of younger individuals. Older individuals are vulnerable to infection, not only by COVID-19, but also by other infectious diseases. The human immune system has two sets of defences against viruses and other pathogens. The first line of defence comprises cells termed leukocytes that attack invading microbes within minutes to hours. The second line is composed of precisely targeted antibodies and T-cells that surge to the battlefield as late as several days following infection. With advancing age, the body has fewer T-cells and produces fewer virus-fighting chemicals. The cytokine barrage varies somewhat by sex. A previous study demonstrated that older males have more cytokine-producing cells than older females, who have a greater number of and more effective B- and T-cells, suggesting that elderly males generally fare worse than elderly females as a result of a cytokine storm (35). Furthermore, previous studies have indicated that the majority of children with COVID-19 have mild or moderate clinical-type symptoms. In a study published in *Pediatrics*, researchers conducted the first retrospective

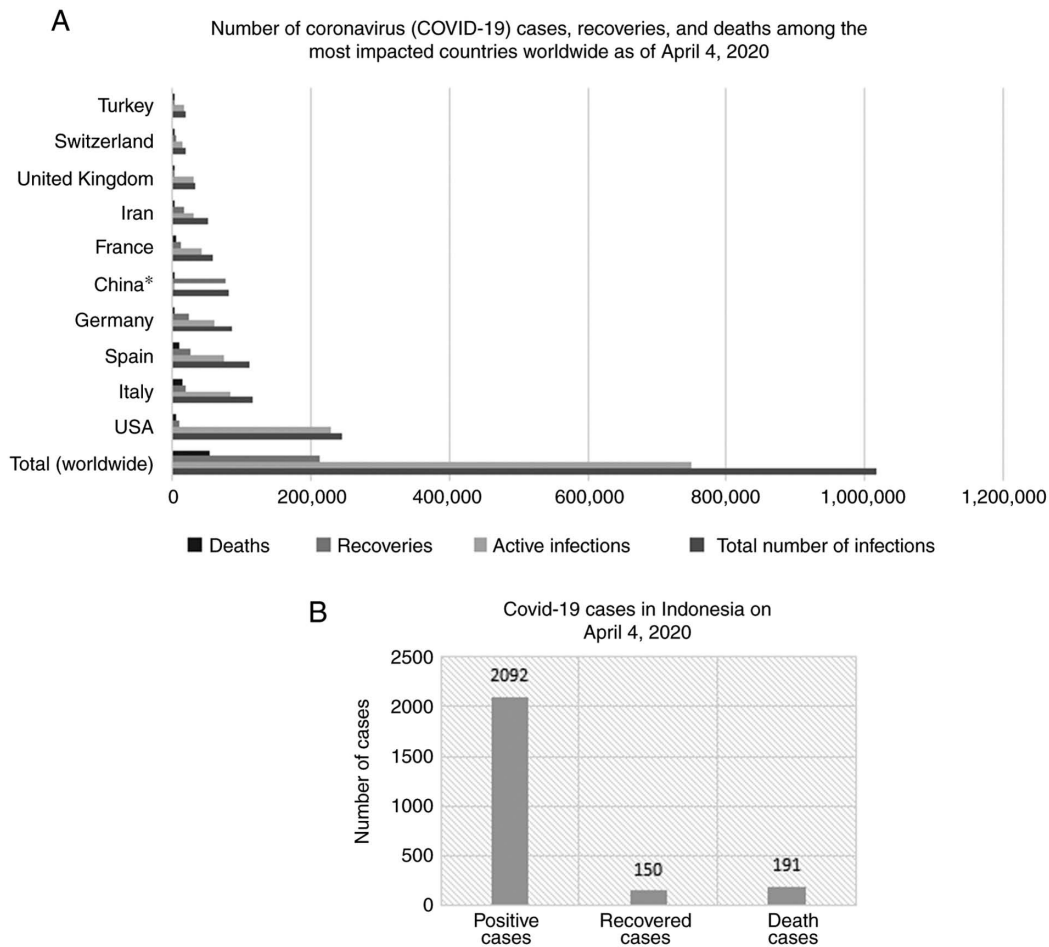


Figure 1. Number of COVID-19 cases, recoveries, and deaths among the affected countries worldwide, as of April 4, 2020. (A) The 10 highest number of COVID-19 worldwide; (B) cases in Indonesia. The asterisk (*) indicates the source of COVID-19 for the first time.

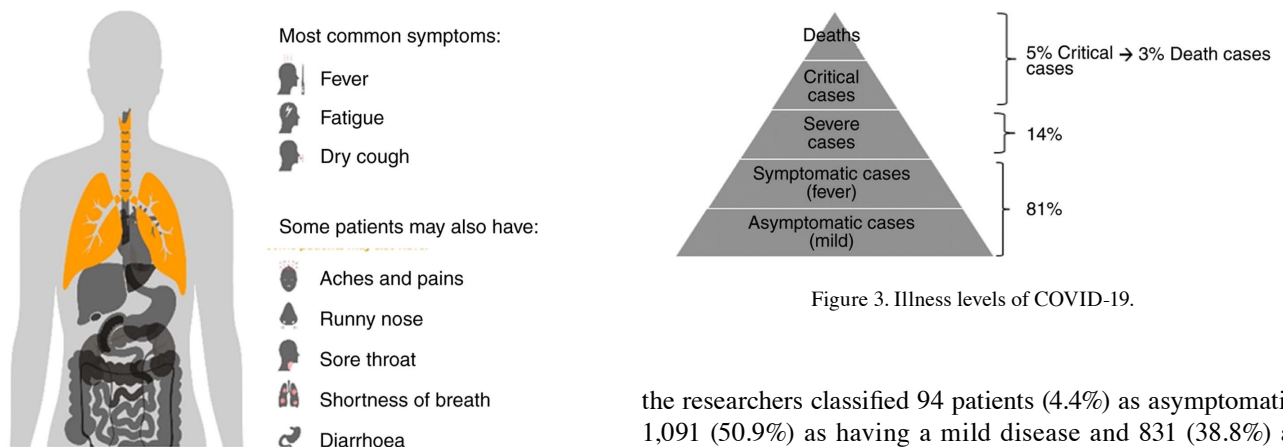


Figure 3. Illness levels of COVID-19.

Figure 2. Symptoms of COVID-19 (source, World Health Organization).

epidemiologic analysis of disease spread and severity in 2,143 confirmed or possible paediatric COVID-19 infection cases reported to the Chinese Centre for Disease Control and Prevention (China CDC) from January 16 to February 8, 2020. Of the 2,143 cases, 731 (34.1%) were laboratory-confirmed and 1,412 (65.9%) were suspected. The median patient age was 7 years (range, one day to 18 years) and 1,213 (56.6%) were boys. Using clinical signs, laboratory testing and chest X-rays,

the researchers classified 94 patients (4.4%) as asymptomatic, 1,091 (50.9%) as having a mild disease and 831 (38.8%) as having a moderate illness (36). Other findings indicated that COVID-19 symptoms among paediatric patients are much milder than those in adults (37). Among younger individuals, patients who have mild to moderate symptoms or are asymptomatic can pose potential risks for the virus to be transmitted to older individuals and furthermore, are likely to become symptomatic cases, even leading to fatalities.

The older age group continues to be at risk of severe diseases and death. Moreover, this condition can be worsened by the comorbidities of older individuals. Compared to adults, children rarely exhibit comorbidities, such as hypertension, cardiovascular diseases, diabetes, etc. Early reports suggest

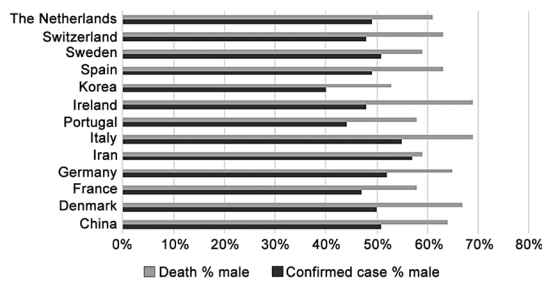


Figure 4. COVID-19 cases (confirmed cases and deaths) by male sex, as of April 4, 2020. The number of female cases can be calculated by subtracting the number of male cases from 100%.

that illness severity and death caused by COVID-19 are associated with age (>60 years old) and comorbid diseases (38). The data published by Statista (19) revealed that cardiovascular diseases, diabetes and hypertension are most commonly found comorbidities in deaths caused by COVID-19 at 13.2, 9.2 and 8.4%, respectively (Fig. 6). Similarly, certain studies (22-28) have demonstrated the comorbidities that contribute to illness severity and deaths caused by COVID-19 (Table I). There are the unique pathological features of COVID-19 cases in comparison with non-COVID-19 caused pneumonia cases. The complete blood count (the number of lymphocytes and platelets) was significantly decreased in both severe and non-severe COVID-19 patients in comparison with non-COVID-19 infected pneumonia patients, indicating that COVID-19 patients can have lymphopenia and thrombocytopenia (39). Certain studies (22-28) included in the present review also demonstrated that the number of lymphocytes and platelets notably decreased when compared to the normal range of lymphocytes (1,000-4,800 in 1 μ l of blood) and platelet (150,000-450,000 in 1 μ l of blood) counts.

5. Prevention and control of COVID-19 spreading

Scientists use the reproduction number (R_0) to describe the intensity of an infectious disease outbreak. If the R_0 is <1, the disease will die out in a population as on average, an infectious individual will transmit the disease to <1 other susceptible individual. On the other hand, if the R_0 is >1, the disease will spread. A number of groups have estimated the R_0 for this novel coronavirus, SARS-CoV-2, to range between 2.6 to 4.71 (11). As is known, the basic properties of SARS-CoV-2 are yet unclear, and furthermore, researchers consider that a number of mild cases or infections that result in symptoms have been missed by surveillance, but nevertheless have caused the spread of the disease. Moreover, the susceptibility of the population affected by the infection is unclear. SARS-CoV-2 spreads due to the ability of the virus to move into new regions and communities. It encounters individuals with varying health conditions that affect their susceptibility to disease, as well as different social structures, both of which affect its transmissibility. However, the majority of individuals who have been infected with SARS-CoV-2 do recover.

Preventive measures are the current strategy used to limit the rise in cases. Steps for prevention have been implemented by certain countries and efforts have influenced the continued spread of the virus, particularly for communities (40). These

measures are the following: i) Social and physical distancing, travel restrictions, self-quarantine and lockdown; ii) personal and environmental protection, such as the washing of hands, recommendations for individuals with symptoms of acute airway infections to keep their distance, covering one's mouth when coughing or sneezing and disinfecting the surroundings, and wearing a mask; iii) enhancement of the body's immune system through the consumption of nutritious food, getting sufficient rest and taking supplements or vitamins; iv) screening tests for tracing contact from positive cases; and v) vaccine development.

Social and physical distancing, travel restrictions, self-quarantine and lockdown measures are aimed to avoid direct contact with individuals infected with SARS-CoV-2 and help to significantly reduce one's chances of being infected by aerosol droplets. However, there is still a possibility for the virus to contaminate surfaces that have been touched or coughed on by infected individuals. Therefore, the aforementioned methods need to be combined with other prevention steps, such as the sterilization of surroundings using disinfectants or alcohol and the frequent washing of hands. Some countries with an increasing number of COVID-19 cases have applied not only social and physical distancing, but have also imposed a lockdown. A lockdown is a state of isolation or restricted access area as a security measure, according to which individuals are prohibited from going out or traveling in defined areas freely due to virus outbreaks. These countries are China (in the Hubei province), Italy, India, Malaysia, Philippines, Poland, Ireland, Spain, Denmark, Lebanon, France, Belgium, New Zealand and El Salvador, where lockdowns were implemented for a period of at least 14 days, as China previously succeeded in decreasing their COVID-19 cases by imposing a lockdown. Moreover, Korea, which had reported a significant number of COVID-19 cases, successfully controlled the spread of infection with social distancing without lockdown. However, in Korea, aggressive testing has been carried out to evaluate the health of individuals, even on the road. It becomes crucial to stop COVID-19 from spreading by contact-tracing positive cases, even the ones that do not exhibit any symptoms. The key to the success of Korea thus far has been its decision to respond aggressively from the outset. Furthermore, Singapore, Hongkong and Taiwan banned travellers from mainland China in the early stages of the outbreak itself. Countries imposing containment and mitigation measures can make a difference according to demographic, social, economic and cultural conditions.

Notably, the immune system plays an important role in COVID-19 infection. This immune system ultimately determines whether the patient will fall ill, recover or die. In fact, the majority of the deaths related to COVID-19 are caused by a previously damaged immune system, not damage caused by the virus itself. COVID-19 is known as a self-limiting disease, depending on the body's immunity. Younger individuals can become infected by COVID-19, exhibit mild to moderate symptoms and become cured. Nevertheless, they can spread the virus with no exception to parents or older individuals, whose condition can deteriorate following infection. Therefore, social distancing along with staying at home can help to protect vulnerable older and immunocompromised populations who are at a higher risk of becoming severely infected with COVID-19. Stopping the spread of COVID-19

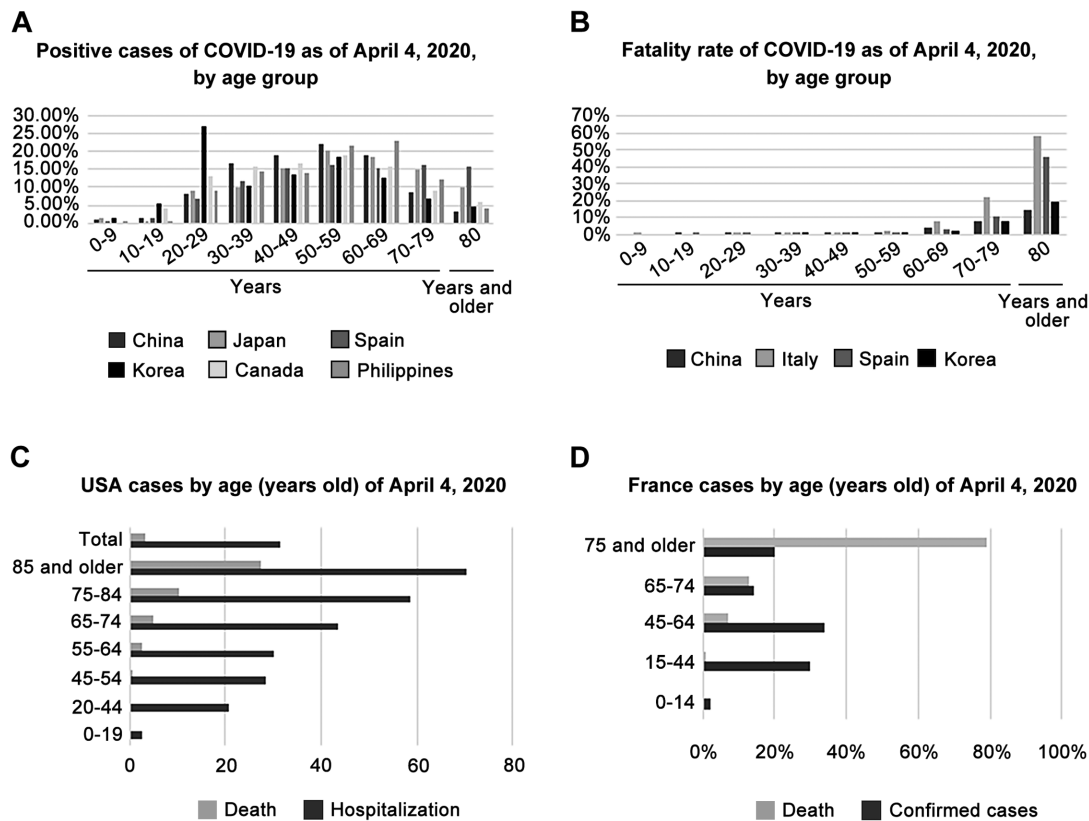


Figure 5. COVID-19 cases by age group obtained, as of April 4, 2020. (A) Positive cases; (B) fatality rate; (C) hospitalizations and deaths in the USA; (D) confirmed cases and deaths in France.

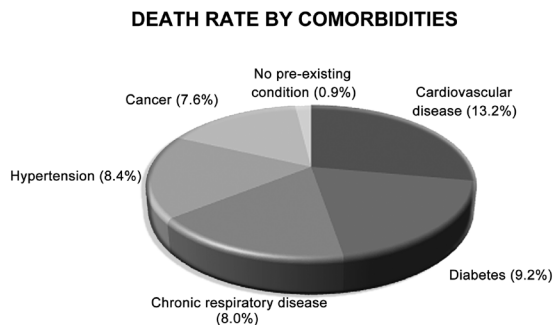


Figure 6. Mortality rate of COVID-19 by comorbidities, as of April 4, 2020.

throughout the population would protect those who have difficulties in fighting the infection. The most important strategies for individuals to undertake are to frequently wash their hands with water and soap, use portable hand sanitizers, wear masks while going outside and avoid making contact with their faces and mouths after interacting with a possibly contaminated environment. Healthcare workers who take care of infected individuals should utilize contact and airborne precautions, including Personal Protective Equipment (PPE), such as Negativity at Approximately 95 Milliseconds (N95) or Filtering FacePiece (FFP3) masks, eye protection, gowns and gloves to prevent transmission of the pathogen from patients and to other people. Moreover, scientific research is developing a vaccine and drug for COVID-19. In recent days, China has announced the first animal tests and researchers from the University of Queensland in Australia have also announced

after completing the 3-week *in vitro* study, they have moved on to animal testing. Furthermore, in the US, the National Institute of Allergy and Infectious Diseases (NIAID) has announced that a phase I trial has commenced for immunisation against the novel coronavirus in the State of Washington. All efforts are being taken to prevent widespread transmission.

6. Conclusion and future perspectives

The COVID-19 pandemic caused by a novel strain of coronavirus is newly reported worldwide. The pandemic has occurred for approximately 3 months; however, the number of new cases of COVID-19 is still increasing. The disease characterisation of COVID-19, as regards both the virus itself and the infected host, is still under investigation, as several aspects of the virus remain unclear. In numerous countries, efforts are underway to prevent the transmission of this disease with interventions being made based on the host and viral characteristics, while continuing to investigate vaccines and therapeutic drugs. The majority of countries affected by COVID-19 may be able to take effective measures. A rapid response to COVID-19 spreading is required by all countries in order to protect the groups at risk to avoid death tolls. Unified efforts are required from all countries in order to combat COVID-19 and prevent the virus from spreading.

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Authors' contributions

LNy and FS were involved in the conceptualisation of the study, data curation and formal analysis, writing, reviewing and editing of the manuscript. Both authors have read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

- World Health Organization: Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>, 2020.
- Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Wang W, Song H, Huang B, Zhu N, *et al*: Genomic characterisation and epidemiology of 2019 novel coronavirus: Implications for virus origins and receptor binding. *Lancet* 395: 565-574, 2020.
- Reed KD, Meece JK, Henkel JS and Shukla SK: Birds, migration and emerging zoonoses: West Nile virus, Lyme disease, influenza A and enteropathogens. *Clin Med Res* 1: 5-12, 2003.
- Woo PC, Lau SK, Lam CS, Lai KK, Huang Y, Lee P, Luk GS, Dyrting KC, Chan KH and Yuen KY: Comparative analysis of complete genome sequences of three avian coronaviruses reveals a novel group 3c coronavirus. *J Virol* 83: 908-917, 2009.
- Fong IW: Emerging animal coronaviruses: First SARS and now MERS. *Emerging Zoonoses*: Feb 8, 2017 (Epub ahead of print). doi: 10.1007/978-3-319-50890-0_4.
- World Health Organization: Director-General's remarks at the media briefing on 2019-nCoV on 11 February 2020. World Health Organization [Internet]. 2020 [cited 2020 Feb 11]. Available from: <https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020>.
- Hui DS, Azhar EI, Madani TA, Ntoumi F, Kock R, Dar O, Ippolito G, Mchugh TD, Memish ZA, Drosten C, *et al*: The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health—the latest 2019 novel coronavirus outbreak in Wuhan, China. *Int J Infect Dis* 91: 264-266, 2020.
- Centers for Disease Control and Prevention: Symptoms of Novel Coronavirus (2019-nCoV). [www.cdc.com](https://www.cdc.gov/coronavirus/2019-ncov/about/symptoms.html) [Internet]. [cited 2020 Jan 30]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/about/symptoms.html>, 2020.
- Centers for Disease Control and Prevention: Frequently asked question about SARS. Centers for Disease Control and Prevention [Internet]. Available from: <http://www.cdc.gov/sars/about/faq.html>, 2005.
- World Health Organization: Middle East respiratory syndrome coronavirus (MERS-CoV). Available from: <http://www.who.int/emergencies/mers-cov/en>.
- Liu Y, Gayle AA, Wilder-Smith A and Rocklöv J: The reproductive number of COVID-19 is higher compared to SARS coronavirus. *J Travel Med* 27: taaa021, 2020.
- World Health Organization: Coronavirus disease 2019 (COVID-19): Situation report, 29 [Internet]. [cited 2020 Feb 19]. Available from: <https://apps.who.int/iris/handle/10665/331118>, 2020.
- World Health Organization: Q&A on coronaviruses (COVID-19): How long is the incubation period for COVID-19? [Internet]. [cited 2020 Feb 26]. Available from: <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>, 2020.
- Chowell G, Abdirizak F, Lee S, Lee J, Jung E, Nishiura H and Viboud C: Transmission characteristics of MERS and SARS in the healthcare setting: A comparative study. *BMC Med* 13: 210, 2015.
- Centers for Disease Control and Prevention: How COVID-19 Spreads [Internet]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html>.
- World Health Organization: Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. Available from: <https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations>, 2020.
- World Health Organization: Similarities and differences—COVID-19 and influenza [Internet]. 2020. Available from: https://www.who.int/docs/default-source/coronavirus/situation-reports/20200306-sitrep-46-covid-19.pdf?sfvrsn=96b04adf_2.
- World Health Organization: Consensus document on the epidemiology of severe acute respiratory syndrome (SARS) [Internet]. Available from: <https://apps.who.int/iris/handle/10665/70863>, 2003.
- Statista. COVID-19/Coronavirus [Internet]. Available from: <https://www.statista.com/page/covid-19-coronavirus>.
- World Health Organization: Coronavirus disease (COVID-2019) situation reports [Internet]. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>.
- Worldometer. Covid-19 Coronavirus Pandemic. Available from: <https://www.worldometers.info/coronavirus/>.
- Arentz M, Yim E, Klaff L, Lokhandwala S, Riedo FX, Chong M and Lee M: Characteristics and outcomes of 21 critically ill patients with COVID-19 in Washington State. *JAMA* 323: 1621-1614, 2020.
- Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, Wang B, Xiang H, Cheng Z, Xiong Y, *et al*: Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA* 323: 1061-1069, 2020.
- Chang D, Lin M, Wei L, Xie L, Zhu G, Dela Cruz CS and Sharma L: Epidemiologic and clinical characteristics of novel coronavirus infections involving 13 Patients outside Wuhan, China. *JAMA* 323: 1092-1093, 2020.
- Young BE, Ong SWX, Kalimuddin S, Low JG, Tan SY, Loh J, Ng OT, Marimuthu K, Ang LW, Mak TM, *et al*: Epidemiologic features and clinical course of patients infected with SARS-CoV-2 in Singapore. *JAMA* 323: 1488-1494, 2020.
- Wu C, Chen X, Cai Y, Xia J, Zhou X, Xu S, Huang H, Zhang L, Zhou X, Du C, *et al*: Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. *JAMA Intern Med*: Mar 13, 2020 (Epub ahead of print).
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, *et al*: Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 395: 497-506, 2020.
- Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, *et al*: Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. *Lancet* 395: 507-513, 2020.
- Kemenkes RI: Coronavirus Disease 2019. Available from: <https://covid19.kemkes.go.id/situasi-infeksi-emerging/info-corona-virus/situasi-terkini-perkembangan-coronavirus-covid-19-5-april-2020/#.Xu0kymgzbiU>, 2020.
- World Health Organization: Media Statement: Knowing the risks for COVID-19. Available from: <https://www.who.int/indonesia/news/detail/08-03-2020-knowing-the-risk-for-covid-19>, 2020.
- Kogan A, Segel MJ, Ram E, Raanani E, Peled-Potashnik Y, Levin S and Sternik L: Acute respiratory distress syndrome following cardiac surgery: Comparison of the American-European consensus conference definition versus the Berlin definition. *Respiration* 97: 518-524, 2019.

32. WorldHealthOrganization: Consensus document on the epidemiology of severe acute respiratory syndrome (SARS) [Internet]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200301-sitrep-41-covid-19.pdf?sfvrsn=6768306d_2, 2020.
33. Cai H: Sex difference and smoking predisposition in patients with COVID-19. *Lancet Respir Med* 8: e20, 2020.
34. GBD 2016 DALYs and HALE Collaborators: Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: A systematic analysis for the global burden of disease study 2016. *Glob Health Met* 390: 1260-1344, 2017.
35. Márquez EJ, Chung CH, Marches R, Rossi RJ, Nehar-Belaid D, Eroglu A, Mellert DJ, Kuchel GA, Banchereau J and Ucar D: Sexual-dimorphism in human immune system aging. *Nat Commun* 11: 751, 2020.
36. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z and Tong S: Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. *Pediatrics* 145: e20200702, 2020.
37. Qiu H, Wu J, Hong L, Luo Y, Song Q and Chen D: Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: An observational cohort study. *Lancet Infect Dis* 20: 689-696, 2020.
38. Yuki K, Fujiogi M and Koutsogiannaki S: COVID-19 pathophysiology: A review. *Clin Immunol* 215: 108427, 2020.
39. Zheng Y, Huang Z, Ying G, Zhang X, Ye W, Hu Z, Hu C, Wei H, Zeng Y, Chi Y, *et al*: Comparative study of the lymphocyte change between COVID-19 and non-COVID-19 pneumonia cases suggesting uncontrolled inflammation might not be the main reason of tissue injury. *MedRxiv*, 2020.
40. Adhikari SP, Meng S, Wu YJ, Mao YP, Ye RX, Wang QZ, Sun C, Sylvia S, Rozalle S, Raat H, *et al*: Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: A scoping review. *Infect Dis Poverty* 9: 29, 2020.



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