

Novel coronavirus 2019-nCoV: prevalence, biological and clinical characteristics comparison with SARS-CoV and MERS-CoV

S.A. MEO¹, A.M. ALHOWIKAN¹, T. AL-KHLAIWI¹, I.M. MEO¹, D.M. HALEPOTO¹, M. IOBAL¹, A.M. USMANI², W. HAJJAR³, N. AHMED⁴

¹Department of Physiology, ²Strategic Centre for Diabetes Research, ³Thoracic Surgery, College of Medicine, King Saud University, Riyadh, Saudi Arabia

⁴Department of Biological and Biomedical Sciences, Aga Khan University, Karachi, Pakistan

Abstract. – OBJECTIVE: Human infections with zoonotic coronavirus contain emerging and re-emerging pathogenic characteristics which have raised great public health concern. This study aimed at investigating the global prevalence, biological and clinical characteristics of novel coronavirus, Wuhan China (2019-nCoV), Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV), and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection outbreaks.

MATERIALS AND METHODS: The data on the global outbreak of “2019-nCoV, SARS-CoV, and MERS-CoV” were obtained from World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), concerned ministries and research institutes. We also recorded the information from research documents published in global scientific journals indexed in ISI Web of Science and research centers on the prevalence, biological and clinical characteristics of 2019-nCoV, SARS-CoV, and MERS-CoV.

RESULTS: Worldwide, SARS-CoV involved 32 countries, with 8422 confirmed cases and 916 (10.87%) casualties from November 2002 to August 2003. MERS-CoV spread over 27 states, causing 2496 cases and 868 (34.77%) fatalities during the period April 2012 to December 2019. However, the novel coronavirus 2019-nCoV spread swiftly the global borders of 27 countries. It infected 34799 people and resulted in 724 (2.08%) casualties during the period December 29, 2019 to February 7, 2020. The fatality rate of coronavirus MERS-CoV was (34.77%) higher than SARS-CoV (10.87%) and 2019-nCoV (2.08%); however, the 2019-nCoV transmitted rapidly in comparison to SARS-CoV and MERS-CoV.

CONCLUSIONS: The novel coronavirus 2019-nCoV has diverse epidemiological and biological characteristics, making it more contagious than SARS-CoV and MERS-CoV. It has affected more people in a short time period compared to SARS-CoV and MERS-CoV, although the fatality rate of MERS-CoV was higher than SARS-CoV and 2019-nCoV. The major

clinical manifestations in coronavirus infections 2019-nCoV, MERS-CoV, and SARS CoV are fever, chills, cough, shortness of breath, generalized myalgia, malaise, drowsy, diarrhea, confusion, dyspnea, and pneumonia. Global health authorities should take immediate measures to prevent the outbreaks of such emerging and reemerging pathogens across the globe to minimize the disease burden locally and globally.

Key Words:

Coronavirus, SARS-CoV, MERS-CoV, 2019-nCoV, Prevalence, Outbreak.

Introduction

Human infections with zoonotic coronaviruses including Severe Acute Respiratory Syndrome (SARS)-CoV, Middle East Respiratory Syndrome Coronavirus (MERS)-CoV, and a novel coronavirus, Wuhan China (2019-nCoV), have raised great public health concern globally. Viral infections are the most frequent infectious diseases and are common triggers for constituting major biological, clinical, and socio-economic problems worldwide. Coronavirus infections including “SARS-CoV”¹, “MERS-CoV”^{2,3}, and novel Coronavirus “2019-nCoV”^{4,5} became emerging worldwide health concerns in their respective periods.

The first outbreak of SARS-CoV occurred in 2002¹, the second MERS-CoV in 2012, followed by the novel Wuhan, China Coronavirus “2019-nCoV”^{4,5} which has become the third coronavirus to emerge in the human population⁶, and has threatened the entire world. The World Health Organization (WHO) declared the novel coronavirus “2019-nCoV” outbreak as a global public health emergency, the sixth time in history⁷.

These coronaviruses “MERS-CoV”, “SARS-CoV”, and “2019-nCoV” are positive-sense single-stranded enveloped RNA viruses. These coronaviruses are zoonotic, and can be transmitted from animal to animal, animal to human, and human to human. Presumably, MERS-CoV transmission originated from bats to camels and then to humans, causing respiratory, enteric, hepatic, and neurologic diseases^{7,8}. The Wuhan, China Coronavirus “2019-nCoV” first appeared in late December 2019. The 2019-nCoV infection cases were originated from bats, snakes, seafood among people living in or visiting Wuhan, China and human-to-human transmission has also been confirmed^{7,9}. Similarly, “SARS-CoV” was originated from bats, civet cats, and humans. Literature is available on the incidence and biological characteristics of these major global infectious outbreaks, but despite recent efforts, the understanding of Novel Coronavirus 2019-nCoV, MERS-CoV, and SARS-CoV has been quite insufficient. The world is keen on further knowledge over these coronaviruses. This study aimed at investigating the global prevalence, biological and clinical characteristics of novel Coronavirus 2019-nCoV, SARS-CoV, and MERS-CoV infection outbreaks.

Materials and Methods

The present study was conducted in the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia. We recorded the data on global prevalence, biological and clinical characteristics of novel Coronavirus (2019-nCoV), SARS-CoV, and MERS-CoV outbreaks. The data were obtained from the World Health Organization (WHO)⁷⁻⁹, Centers for Disease Control and Prevention (CDC)¹⁰, and reports from various countries and their allied ministries to the WHO⁷⁻⁹. For biological and clinical characteristics of 2019-nCoV, SARS-CoV, and MERS-CoV infection, we also reviewed literature published in the Institute of Scientific Information (ISI) Web of Knowledge, Thomson Reuter journals¹¹. “Pub-Med, Medline”¹² and characteristics were recorded. The relevant studies were explored through keywords including 2019-nCoV, SARS-CoV, and MERS-CoV outbreaks. The studies were determined by the title and abstract of the article. After the studies had been shortlisted, the appropriate biological characteristics and findings were recorded.

Ethical Statement

In this study the information on the global prevalence, biological and clinical characteristics of novel Coronavirus 2019-nCoV, SARS-CoV, and MERS-CoV infection outbreaks was obtained from the World Health Organization, 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.

Statistical Analysis

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

Results

The global epidemiological updates on the prevalence of novel coronaviruses 2019-nCoV, SARS-CoV, and MERS-CoV are presented in Table I, II, and Figures 1, 2, 3. The novel coronavirus 2019-nCoV crossed the global borders of 27 countries and infected 34799 people (Table I, Figure 1) and has caused 724 (2.08%) casualties during the period Dec 29, 2019 to Feb 7, 2020. Similarly, the SARS-CoV involved 32 countries, with 8422 confirmed cases and 916 (10.87%) casualties from November 2002 to August 2003 (Table I, Figure 2). However, MERS-CoV spread over 27 states, causing 2494 cases and 868 (34.77%) fatalities during April 2012 to Dec 2019 (Table I, Figure 3).

Most of these coronavirus cases were reported from the concerned epicenters, novel coronaviruses “2019-nCoV” from Wuhan China, SARS-CoV was found in Southern, China, and “MERS-CoV” from Saudi Arabia, Middle East (Table I). The outbreak of MERS-CoV was mainly found during the summer period (May to June), whereas the SARS-CoV and 2019-nCoV cases were reported during the winter season (Table II). The age group with highest risk for acquiring primary and secondary cases of infection was 50-65 years.

The clinical characteristics of “2019-nCoV” infection vary individually, ranging from no clinical symptoms (asymptomatic), or mild to severe respiratory illness symptoms. Most of the 2019-nCoV, SARS-CoV, and MERS-CoV patients had complains of respiratory illness, gastrointestinal symptoms, central nervous system and cardiovascular system allied symptoms. The major clinical characteristics of these coronavirus infections are fever, chills, generalized myalgia, drowsy, cough, dyspnea, shortness of breath abdominal pain, nausea, vomiting, and diarrhea” (Table II).

Table I. Worldwide number of laboratories confirmed cases of Coronavirus 2019-nCoV, MERS-CoV and SARS-CoV.

Country	2019-nCoV	SARS-CoV	MERS-CoV
Algeria			2
Australia	15	6	
Austria			2
Bahrain			1
Brazil		1	
Cambodia	1		
Canada	7	251	
China	34500	5327	1
China, Hong Kong, Macao	15	1756	
China, Taiwan	16	665	
Colombia		1	
Egypt			1
Finland		1	
France	6	7	2
Germany	13	9	3
Greece			1
India	3	3	
Indonesia		2	
Iran			6
Ireland		1	
Italy	3	4	1
Ivory Coast	1		
Japan	89		
Jordan			28
Kuwait		1	4
Lebanon			2
Malaysia	12	5	2
Mongolia		9	
Nepal	1		
Netherlands			2
New Zealand		1	
Oman			24
Philippines	3	14	2
Qatar			19
Romania		1	
Russia	2	1	
Saudi Arabia			2106
Singapore	30	238	
South Africa		1	
South Korea	24	3	186
Spain	1	1	
Sri Lanka	1		
Sweden	1	3	
Switzerland		1	
Thailand	25	9	3
Tunisia			3
Turkey			1
UAE	4		87
United Kingdom	4	4	5
United States	12	33	2
Vietnam	10	63	
Yemen			1
Total number of cases	34799	8422	2496
Total number of deaths	724 (2.08%)	916 (10.87%)	868 (34.77%)

SARS-CoV data is presented from Nov 2002 to August 2003; MERS-CoV data is presented from June 2012 to Jan 31, 2019; Novel Coronavirus "2019-nCoV" data is presented from Dec 29, to Feb 7, 2020-9,13.

Table II. Biological and clinical characteristics of coronavirus: 2019-nCoV, MERS-CoV, and SARS-CoV infections.

Characteristics	2019-nCoV	SARS-CoV	MERS-CoV
Biological Characteristics			
Incubation period	2-14 (5.2) days	2-10 (7) days	2-10 (5.5) days
Median age of effected individuals	59 years	65 years	50 years
Male/Female	Male predominance	Male predominance	Male predominance
Virus	Positive-sense single-stranded RNA	Positive-sense single-stranded RNA	Positive-sense single-stranded RNA
Source of origin	Seafood, snakes, bats	Bats, civet cats	Bats, camel
Transmission	Animal-human Human-human Zoonotic disease	Animal-human Human-human Zoonotic diseases	Animal-human Human-human Zoonotic disease
Speed of spread	High	Moderate	Low
Seasonal occurrence	Winter (Dec-Jan)	Winter (Dec-Jan)	Summer (May-July)
Clinical characteristics			
Headache	+	+	+
Fever	++	++	++
Chills or rigors	++	++	++
Generalized myalgia	++	++	++
Malaise	+	+	+
Drowsy	+	+	+
Confusion	+	+	+
Pulmonary characteristics			
Dyspnea	+	+	+
Cough	++	++	++
Shortness of breath	+	+	+
Pneumonia	++	++	++
Hemoptysis	+	+	+
Extra-pulmonary characteristics			
Abdominal pain	+/-	+/-	+/-
Nausea and vomiting	+	+	+
Diarrhea	+/-	+/-	+/-
Acute renal failure	+/-	+/-	+/-
Blood analysis			
White blood cells count	↑	↑	↑
Lymphocytes count	↓	↓	↓
Platelets count	↓	↓	↓
Red blood cells count	↓	↓	↓
Overall fatality	2.08%	10.77%	34.77%

Ref:^{2-5, 7-9, 13-17}. [+Mild; ++Moderate; +++severe; ↑ increase; ↓ decrease; +/-on and off].

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 global prevalence, biological and clinical characteristics of novel Coronavirus

2019-nCoV, SARS-CoV, and MERS-CoV infection outbreaks. The novel coronavirus 2019-nCoV, SARS-CoV, and MERS-CoV are the major global outbreaks of coronavirus infections. In this study, it was identified that worldwide SARS-CoV spread into 32 countries, with 8422 confirmed cases and 916 (10.87%) casualties from November

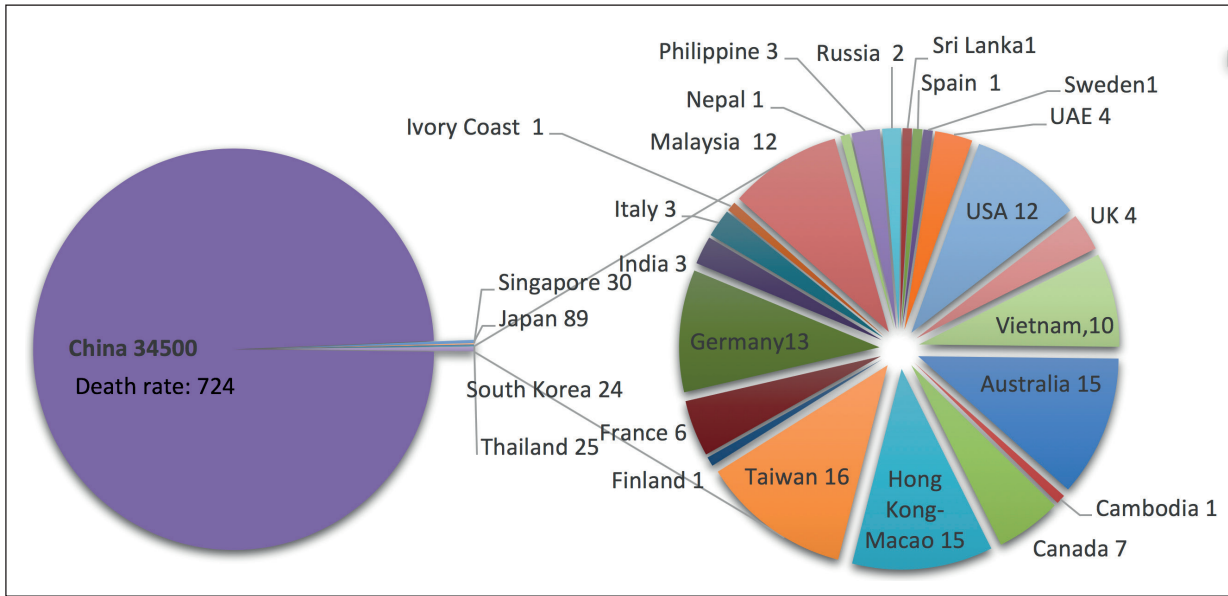


Figure 1. Prevalence of novel coronavirus 2019- nCoV infection. (Note: Novel coronavirus “2019-nCoV” data is presented from Dec 29, 2019 to Feb 7, 2020,13).

2002 to August 2003. MERS-CoV spread over 27 states, resulting in 2496 cases and 868 (34.77%) fatalities during April 2012 to Dec 2019. However, this novel coronavirus 2019-nCoV crossed the global borders of 27 countries and infected 34799

people and has caused 724 (2.08%) casualties during the period Dec 29, 2019 to Feb 7, 2020. The coronavirus 2019-nCoV is still in its spreading phase with predictions as high as 50000 people getting infected globally.

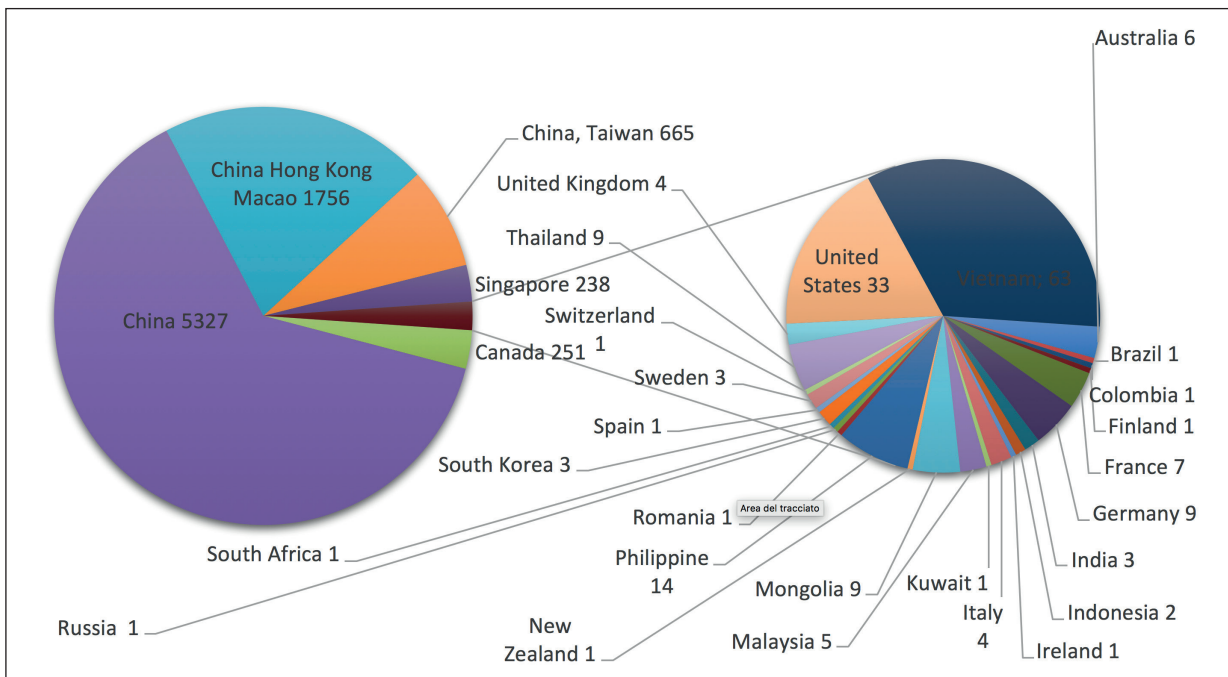


Figure 2. Prevalence of severe acute respiratory syndrome coronavirus (SARS-CoV) infection. (Note: SARS-CoV data is presented from Nov 2002 to August 2003,8).

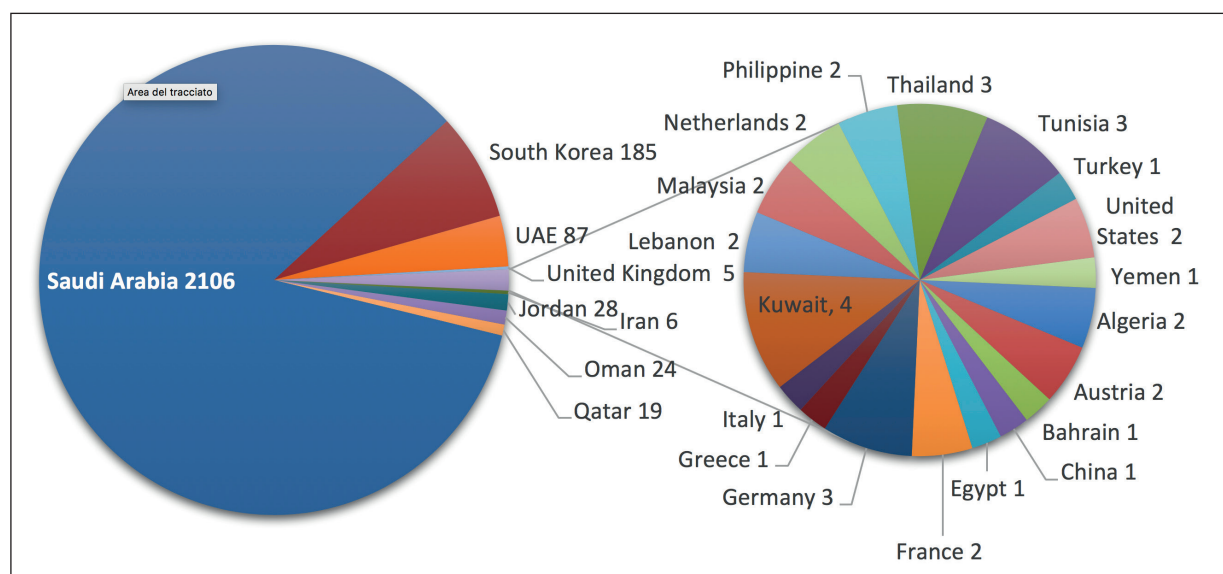


Figure 3. Prevalence of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection. (Note: MERS-CoV data is presented from June 2012 to Feb 7 2020).

Due to the epidemic situation of this novel coronavirus, global flight systems have been interrupted, and many cities have been quarantined. About 60 million people have been locked into their homes, with all shops, restaurants, and workplaces shut down to prevent the disease spreading even further^{7,13}.

The patterns of 2019-nCoV, SARS-CoV, and MERS-CoV infections have been observed to have seasonal variations. Nassar et al³ reported that the outbreak of MERS-CoV was mainly during the summer period. The highest global seasonal occurrence of MERS-CoV outbreak was found in the month of June, while the lowest was found in the month of January during the period of 2012 to 2017. Whereas the 2019-nCoV and SARS-CoV infection outbreak took place in the winter season (Table I). The outbreak of this novel coronavirus “2019-nCoV” has been observed in the winter season, in strong contrast to outbreaks of SARS-CoV and MERS-CoV. These coronaviruses spread across many geographical regions of the globe. The gender-based analysis demonstrates that the cases consisted mostly of men with median age range of 50-65 years^{4,13}.

Li et al⁴ reported that the novel coronavirus 2019-nCoV infection was found in China, and later spread to more than 27 countries. The virus mainly occurred among old aged people with the median age of 59 years. The mean incubation period was 5.2 days, with the 95th percentile of

the distribution at 12.5 days. Aly et al¹⁸ reported that MERS-CoV infections mainly occurred in MERS-CoV epicenter (Saudi Arabia). Similarly, in the present study, it was identified that majority of these coronavirus cases were reported from the concerned epicenters, novel coronaviruses “2019-nCoV” from Wuhan China, SARS-CoV was from Southern China, and “MERS-CoV” from Saudi Arabia, Middle East (Table I).

There is a heterogeneity in the transmissibility of 2019-nCoV, SARS, and MERS outbreaks and in particular the occurrence of super-spreading events. The 2019-nCoV spread is faster than the previous outbreaks events SARS-CoV, and MERS-CoV. The SARS-CoV spread into 32 countries, with 8422 confirmed cases from November 2002 to August 2003. MERS-CoV spread over 27 states, resulting in 2496 cases during April 2012 to Feb 7, 2020. However, this novel coronavirus 2019-nCoV spread into 27 countries and infected 34799 people during the period from Dec 29, 2019 to Feb 7, 2020. Moreover, the coronavirus 2019-nCoV is still in its spreading phase with predictions as high as 50000 people getting infected globally.

The clinical appearances of 2019-nCoV, SARS-CoV, and MERS-CoV infection characterize a wide-ranging spectrum fluctuating from asymptomatic presentation and mild to severe acute respiratory illness to death. A distinctive presentation of these coronavirus symptoms is fever of

38°C or more, fever with chills or rigors, generalized myalgia, malaise, drowsy, confused, dyspnea, cough, shortness of breath and radiological pulmonary presentation of pneumonia (Table II). The extra-pulmonary features include abdominal disorders, nausea, vomiting, diarrhea, and acute renal failure. The other clinical findings are an increase in white blood cells, mainly neutrophils, and decrease in lymphocytes, platelets, and red blood cells. The clinical characteristics are similar to 2019-nCoV, SARS-CoV, and MERS-CoV infection.

Conclusions

The novel coronavirus 2019-nCoV is highly contagious as compared to SARS-CoV and MERS-CoV. Although, fatality rate of MERS-CoV was higher than SARS-CoV and 2019-nCoV; however, in a small period of time, the 2019-nCoV affected more people worldwide compared to SARS-CoV and MERS-CoV. The major clinical manifestations in these coronavirus infections include fever, chills, cough, shortness of breath, generalized myalgia, malaise, drowsy, diarrhea, confusion, dyspnea, and pneumonia. These coronavirus infections cause more severe diseases amongst children, old age individuals, pregnancy, people with chronic debilitating diseases such as diabetes mellitus, cardiovascular diseases, and malignancy. The global health authorities should take immediate measures to prevent the outbreaks of such emerging and re-emerging pathogens across the globe to minimize the disease burden locally and globally.

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Conflict of Interests

The authors declare that they have no conflict of interests.

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