The Climate and COVID-19

The Climate and COVID-19:

Global Challenges and Responses

Edited by
Sultan Ayoub Meo
and Khalid Mahmood Shafi

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Contents

Preface

During the past two decades, there has been a significant shift in social demographics; people are shifting from rural to urban regions resulting in a swift upward shift in the urban population. This rapid, unplanned urbanization and industrialization has contributed to environmental pollution. Urbanization and industrialization are major contributing factors to the ongoing change in the global climate. The environment and weather conditions have a great effect on the pattern of human health and diseases.

The "Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)," also known as the COVID-19 pandemic, has also been linked with weather conditions and environmental pollution. The present pandemic has caused a global public health crisis with long-lasting economic damage. The situation and the lockdown have affected people's social and psychological health, from all ages and walks of life. The young generations who have been exposed will remember it, and be adversely affected by it, for many years. COVID-19 and climate change have collectively demonstrated that the most commanding and influential force on earth is the established natural sciences of biology, chemistry and physics versus the artificial and lust-based human targets of business and economies. The climate crisis and COVID-19 pandemic are a portal for the world. We have the option to go through it with our deeds, and conventional and traditional notions. The health, stability, and strength of future generations depend on the collective concepts of sharing and caring for our beautiful planet.

This book highlights the journey from the fog of a pandemic into the storm of climate change, that is challenging humanity. The contributors to this volume have amply highlighted the assorted aspects of this highly challenging and threatening situation of climate and the COVID-19 pandemic. The authors have covered wide-ranging topics associated with medicine, environment, weather conditions, environmental pollution, human rights, and political and emerging global scenarios. The authors of this book aim to highlight the complex dimensions of the COVID-19 pandemic and emphasize the need to synchronize the social and political order.

The global community should be prepared for COVID and climate aspects for pre-emptive policies. Suppose a single virus can smear out the huge economy in a year and completely lock down societies. In that case, this is a testimony to the fact that economies and communities are not very buoyant.

Global leaders have to understand the magnitude of such pandemics, climate crises, and conventional conflicts of the assorted aspects of human security.

Authors and contributors

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Editors, Authors, and contributors

Contributors

1. **Prof. Sultan Ayoub Meo**

   MBBS, Ph.D. (Pak), M Med Ed (Dundee), FRCP (London), FRCP (Dublin), FRCP (Glasgow), FRCP (Edinburgh).
   Professor and Consultant in Clinical Physiology, Department of Physiology, King Khalid University Hospital, College of Medicine, King Saud University, Riyadh, Saudi Arabia.

2. **Dr Khalid Mahmood Shafi**

   Ph.D., M Phil, MSc, MA (Hons)
   National Defence University, Islamabad, Pakistan

3. **Prof. David C. Klonoff**

   M.D., FACP, FRCP (Edin), Fellow AIMBE
   President, Diabetes Technology Society, USA
   Clinical Professor of Medicine, U.C. San Francisco
   Editor-in-Chief, Journal of Diabetes Science and Technology
   Medical Director, Diabetes Research Institute
   Mills-Peninsula Medical Center, 100 South San Mateo Drive, Room 5147
   San Mateo, California 94401

4. **Prof. Javed Akram**

   MRCP (U.K.), FRCP (London), FRCP (Glasgow), FRCP (Edin), FACC (USA), FACP (USA), FASIM (USA)
   Professor of Medicine and Vice-Chancellor
   University of Health Sciences, Khayaban-e-Jamia, Lahore, Punjab, 54600, Pakistan

5. **Prof. Nadia Naseem, MBBS, M.Phil, Ph.D.**

   Professor, Department of Morbid Anatomy and Histopathology,
   University of Health Sciences, Khayaban-e-Jamia, Lahore, Punjab, 54600
   Pakistan

6. **Dr. Anusha Sultan Meo, MBBS**

   Army Medical College, National University of Medical Sciences (NUMS) Rawalpindi, Pakistan

7. **Barrister Tehreem Sultan, LLB (UK), BPTC (LincoIn's Inn, London, UK)**

   Trainee, International Criminal Court, Hague, Netherlands

8. **Ruhaab Khalid, LLB**

   School of Law, Cardiff University, Cardiff, UK

Brief Biography

Prof. Sultan Ayoub Meo

MBBS, Ph.D. (Pak), M Med Ed (Dundee), FRCP (London), FRCP (Dublin), FRCP (Glasgow), FRCP (Edinburgh).

Professor Meo is a professor and consultant in Clinical Physiology, Department of Physiology, King Khalid University Hospital, College of Medicine, King Saud University, Riyadh, Saudi Arabia. Prof Meo is credited with ten books and over 190 scientific papers in peer-reviewed national/ International, pub-med, and Web of Science indexed bio-medical Journals.

Professor Meo has been appointed as a Ph.D. supervisor and examiner in various universities of Saudi Arabia and Malaysia. In an Editorial capacity, Prof Meo served as an Associate Editor of many Web of Science Indexed international journals. Prof Meo has been invited as a speaker and keynote speaker to deliver the talk in more than 125 National / International conferences in different states, including Pakistan, Saudi Arabia, Bahrain, United Arab Emirates, China, Turkey, Indonesia, United Kingdom, and the USA. Prof. Meo received an Excellency award in Medicine in the year 2017.

Dr. Khalid Mahmood Shafi

Ph.D, M Phil, MSc, MA (Hons)

Dr. Khalid is an academician and a practitioner with over thirty years of field experience. His main areas of specialization include Climate Change, Global policy, and Security Sector reforms. He has served in a field where in addition to an active leadership role in peacebuilding operations, he has contributed to disaster risk management and people-centric sustainable development. He has written articles in national and international journals on topics of Policy reforms, Climate Change, Air Pollution, COVID-19, Civil Society, UN, Peacebuilding, and environmental issues in the Global South. He has also served in United Nations. His second book titled, ”UN, Pakistan and Climate crisis” is under publication..

Prof. David C. Klonoff

M.D., FACP, FRCP (Edin), Fellow AIMBE

Prof. David C Klonoff is an endocrinologist specializing in diabetes

technology. He is the Medical Director of the Dorothy L. and James E. Frank Diabetes Research Institute of Mills-Peninsula Health Services in San Mateo, California, and a Clinical Professor of Medicine at UCSF. Dr. Klonoff graduated from UC Berkeley; his postgraduate training included two years at UCLA Hospital and three years at UCSF Hospitals. Dr. Klonoff is cited as among the top 1% of U.S. endocrinologists by Castle Connolly Medical Ltd. He received an FDA Director's Special Citation Award in 2010 for outstanding contributions to diabetes technology. In 2012 Dr. Klonoff was elected a Fellow of the American Institute of Medical and Biological Engineering and cited as among the top 2% of bioengineers worldwide. He received the 2012 Gold Medal Oration and Distinguished Scientist Award from the Mohan's Diabetes Specialties Centre and Madras Diabetes Research Foundation of Chennai, India. He was elected a Fellow of the Royal College of Physicians (Edinburgh) in 2015. Dr. Klonoff has advised FDA and FTC, grant review for NIH, CDC, NASA, NSF, U.S. Army, ADA, JDRF, and five foreign governments. He has been invited to scientific meetings at the White House and the European Parliament. He is the author of dozens of books, book chapters, and over 250 research articles.

Prof. Javed Akram

MRCP(U.K.), FRCP(London), FRCP(Glasgow),

FRCP(Edin), FACC(USA), FACP(USA), FASIM(USA)

Prof Javed Akram is an eminent Professor of Medicine, outstanding physician, renowned medical educationist, innovative researcher, and policymaker in Pakistan. He is an author of six medical books and over 100 research papers and supervised over 120 postgraduate students. Prof. Akram graduated from King Edward Medical College, Lahore, in 1979. He completed his postgraduate training from RCP (U.K.). He obtained a Fellowship of the Royal College of Physicians of London, Glasgow, and Edinburgh. He served as the Principal of Allama Iqbal Medical College and the Chief Executive Jinnah Hospital, Lahore. He was elevated as Vice-Chancellor (Rector) of Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad, and CEO of the Pakistan Institute of Medical Sciences (PIMS). After that, he was appointed as Vice-Chancellor, University of Health Sciences (UHS) Lahore, where he is currently working. In recognition of his clinical and community services, the president of Pakistan awarded him with a civil award, "Tamgha-e-Imtiaz."

Prof. Nadia Naseem

MBBS, M.Phil, Ph.D.

Professor, Department of Morbid Anatomy and Histopathology, University of Health Sciences (UHS), Lahore, Pakistan
She has teaching experience of about two decades in medical universities. She is an Editor In-chief of Bio-Medica journal, University of Health Sciences (UHS), Lahore. She is credited with over 100 research articles in peer-reviewed national and international biomedical journals.

Dr. Anusha Sultan Meo, MBBS

Army Medical College, National University of Medical Sciences (NUMS), Rawalpindi, Pakistan.
Anusha is a research-oriented young physician, currently completing her internship. She has authored dozens of research articles in different web of science indexed science journals. During her university tenure, she won multiple awards at different debating/writing competitions and MUNs, later which she also chaired and presided over. She has also served as the President of the Debates and Literary Society at Army Medical College.

Barrister Tehreem Sultan, LLB (UK), BPTC (LincoIn's Inn, London, UK), Trainee, International Criminal Court, Hague, Netherlands

Barrister Tehreem Sultan is a First Class Law Graduate with a particular interest in Criminal and International Human Rights Law. She is currently working as an intern at the International Criminal Court. She has been actively involved in the criminal justice system and is the Director for the UK award winning prison teaching programme, Vocalise. She frequently writes for the Oxford Human Rights Hub, UK Human Rights Blog.

Ruhaab Khalid, LLB

School of Law, Cardiff University, Cardiff, UK

Ms. Ruhaab is a young, motivated writer and law student at Cardiff University, U.K. She has written articles in journals such as Cardiff Law Review and Pakistan Horizon. She has been working on climate change-associated research articles in one of the leading newspapers of Wales, the Gairrhydd. Currently, she is a research advocate at the organizations of Hope and Victim Support.

COVID-19 Pandemic: Biological and Epidemiological Trends

Chapter 01

Sultan Ayoub Meo

Abstract

The Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) infection outbreak has posed a significant threat to the global health care system and economy. The novel coronavirus, also known as the COVID-19 pandemic, is highly contagious and has affected over 110 million people worldwide, with a mortality of about 2.4 million. The disease is swiftly spreading, with fluctuating prevalence and mortality trends. Regional and international health officials have taken priority measures to prevent further outbreaks of this emerging pathogen across the globe and to minimize the prevalence and mortality. However, the growing number of cases and deaths is demonstrating a need to further enhance public health mediations, vaccinations, good hygiene conditions, social distancing, use of masks, and movement limitations in order to control the COVID-19 pandemic. This manuscript highlights the biological and epidemiological trends of SARS-CoV-2.

Keywords: Coronavirus, SARS-CoV-2, COVID-19 pandemic, Epidemiology

Introduction

Over the past two decades, worldwide, people have been facing several infectious disease outbreaks, including Ebola, Influenza A (H1N1), Severe Acute Respiratory Syndrome Coronavirus (SARS), Middle East Respiratory Syndrome (MERS), and the Zika virus. Most recently, the global outbreak of novel coronavirus 2019, also known as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), has enhanced to a globally threatening pandemic [1]. SARS-CoV-2, also known as the COVID-19 pandemic, is a highly contagious infection, reported for the first time in Wuhan, China, in Dec 2019 [2]. The SARS-CoV-2 infection has spread through transmission from animal to animal, animal to human, and human-to-human, through droplets, via direct or indirect contact, culminating in a devastating pandemic [3].

The recent outbreak of the COVID-19 pandemic has caused a severe global threat. As per the World Health Organization (WHO) report on February

18, 2021, the novel coronavirus has affected over 110 million people, with a mortality of about 2.4 million people worldwide. In March 2020, the World Health Organization declared the COVID-19 outbreak a pandemic [4]. The disease is diffusing across the world has crossed all the earlier statistical facts and figures. [5]. The global evidence indicates its initial circulation in bats, before transmitting via an intermediate host to humans [3]. The risk of a reverse spread from companion animals to humans could also increase the risk of COVID-19 infection and its chances of mutation [6]. The science community is facing the challenging issue of further mutations, and the prevalence and mortality have not settled down.

Biology of the Novel Coronavirus

Coronaviruses belong to the family "Coronaviridae" and "subfamily Coronavirinae". Coronaviruses are classified into four genera: "Alpha, Beta, Gamma, and Delta coronavirus" [7]. SARS-CoV-2 is a highly pathogenic coronavirus that emerged among human populations. The previous coronaviruses that have affected humans are: "the Middle East Respiratory Syndrome Coronavirus (MERS-CoV), coronaviruses (HCoVs) including HCoV-229E, HCoV-NL63, HCoV-OC43, and HCoV-HKU1". These viruses have been scattered in the human population for hundreds of years and cause mild respiratory illness, with 5-30% having clinical features like the common cold [8].

Table 1.1: Biological Characteristics of Coronavirus.

Family: Coronaviridae
Subfamily: Coronavirinae
Types: Alpha, Beta, Gamma, and Delta coronavirus
Coronavirus: Round, globular, oval, elliptic in shape with a size of about 60 to 220 nm
Toroviruses: Kidney or rod-shaped, disk-like in appearance with a size of about 120 to 140 nm
Envelope: Envelope in large, widely spaced club-shaped peplomers
RNA Genome: Linear, plus sense ssRNA genome 27 to 33 kb, polyadenylated sequences
Structural proteins: "Nucleoprotein (N)," "Peplomer glycoprotein (S)," "Transmembrane glycoprotein (M)," and "Hemagglutinin-esterase (HE)."
The genome encodes three to ten non-structural proteins.
Replication: Replicates in the cytoplasm [9, 10]

The coronaviruses are positive-strand RNA viruses, with an approximate size of about 60-220 nm. The biological features are a crown-like appearance due to spike glycoproteins radiating from the virus envelope [9, 10]. Coronaviruses virions contain three major structural proteins. The very large 200 K glycoprotein S for a spike provides large 15-20 nm peplomers in the viral envelope. The second one is a transmembrane glycoprotein (M), and the third one is an internal phosphorylated nucleocapsid protein (N). There is also a minor transmembrane protein E, and some coronaviruses contain envelope protein with hemagglutination and esterase functions [9, 11].

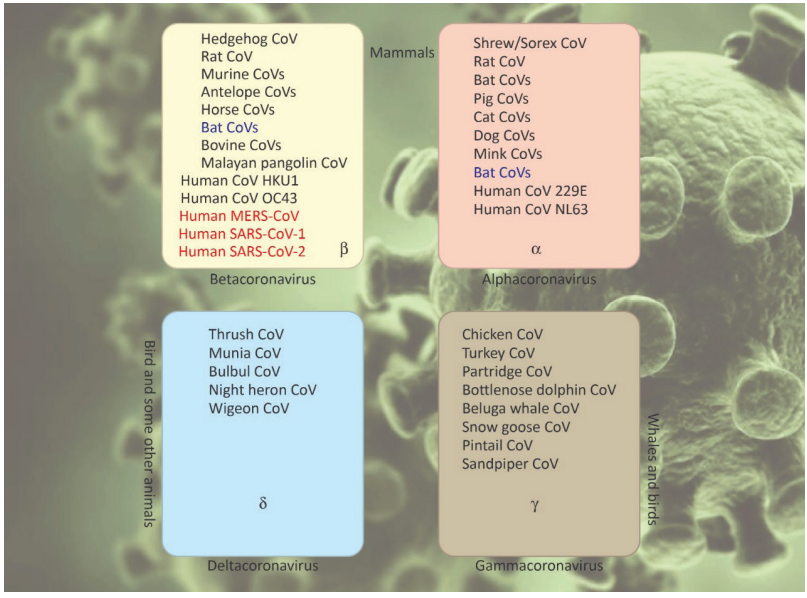

Figure 1.1: Phylogeny of coronaviruses.

Transmission Trends of Coronavirus

Coronaviruses may be found in a highly diverse range of different mammalian and bird host species. The combined impact of swift and unplanned urbanization, industrialization, farming, transportation systems, and climate change have provided a multiplicity of routes for coronaviruses to spill over into human populations [11-13]. In particular, a large proportion of coronaviruses are thought to reside in bats and

seafood reservoirs, which are particularly adept at facilitating cross-species transmission [11]. Coronaviruses can easily circulate through various avian and mammalian species and reservoirs, including "bats, birds, cats, dogs, pigs, rodents, and humans" [14]. The global population has a long history of contagious infectious diseases by a coronavirus. The viral infections are highly contagious and easily spread through inhalation or ingestion of viral droplets during close communication or gathering, coughing, sneezing, and direct or indirect touching of infected surfaces with primary sources of infection [1].

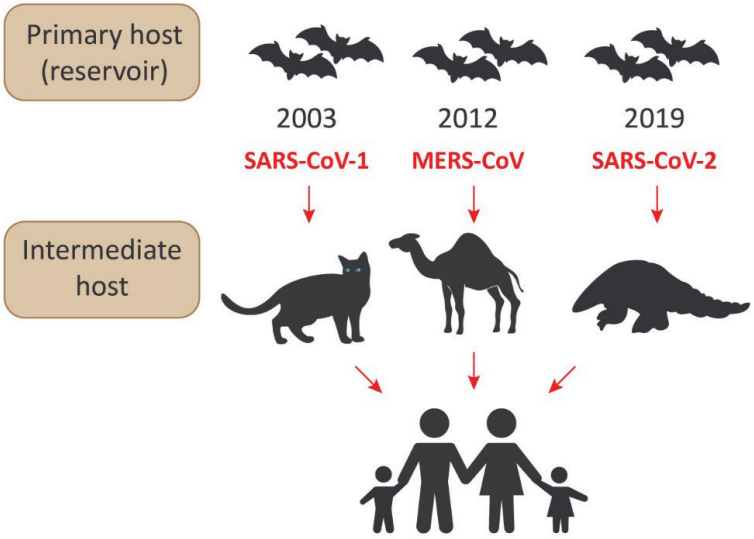

Figure 1.2: Transmission of coronavirus SARS-CoV-1, MERS-CoV, and SARS-CoV-2 infection.

The human respiratory system is highly vulnerable to infectious diseases. Pulmonary infections are transmitted through respiratory droplets. The droplet particles, with a size of about 5-10 μm or more in diameter, are known as respiratory droplets. On the other hand, droplets smaller than five μm in diameter are called "droplet nuclei" [15]. SARS-CoV-2 is mainly transmitted in people through respiratory droplets and direct and indirect contact routes. The transmission of droplets occurs when people are in close contact of about 1 meter with people who are suffering from SARS-CoV-2 infection, with or without respiratory symptoms. The chances of exposure to respiratory droplets are high during a close gathering, communication,

coughing, or sneezing. These droplets can stay in the environment and, therefore, can easily spread from person to person [16].

The transmission of SARS-CoV-2 can occur through direct contact with infected people, or indirect contact with surfaces in the immediate environment [17], or with the kinds of stuff used by the infected person [15]. There is some evidence that SARS-CoV-2 infection involves the gastrointestinal system, causing intestinal disease, and the virus presents in feces, and may spread through fecal-oral and aerosol-borne routes [18].

The air pollutants, mainly particulate matter (PM) with a size of about PM2.5, enter into the human body, and are absorbed by human tissues or dissolved in body fluids based on their hydrophilic and hydrophobic characteristics. Environmental pollutants, particulate matter (PM2.5), constitute a significant risk factor for exaggerating the transmission of SARS-CoV-2 and markedly impairing human health [19]. More recently, it has also been reported that people prone, and exposed, to a high concentration of environmental pollution, PM2.5, are at increased risk of developing chronic respiratory diseases, including SARS-CoV-2 infection and mortality [20, 21]. Exposure to environmental pollutants, PM 2.5, carbon monoxide (CO), and ozone (O_3) increases the susceptibility to infections that damage human airways and potentially facilitate viral infections. Exposure to environmental pollution, PM2.5 pollutants, impairs the human immune system by decreasing the human body's ability to fight against viral infections, including the SARS-CoV-2 infection. The literature shows that outdoor and indoor pollutants, including PM2.5, carbon monoxide (CO), nitrogen dioxide (NO_2), and ozone (O_3), contribute to more severe SARS-CoV-2 infection and mortality. These facts demonstrate that various biological and physical factors spread the SARS-CoV-2 infection [20].

Epidemiological Trends of SARS-CoV-2 Infection

Since the appearance of the first case of SARS-CoV-2 infection in Wuhan, China, the spread of the disease has not settled down. The biological and epidemiological trends in the prevalence and mortality rate are swiftly changing on a daily basis. Initially, China was the disease's epicenter, but the disease was transmitted worldwide within 6-8 weeks. The disease burden was gradually transmitted and increased in other states, mainly Europe and the United States of America. Despite all the recent collective efforts, the COVID-19 pandemic is a highly challenging virus for the science community, policymakers, and the general public.

Meo et al., 2020 [22] conducted a study on the rising trends in the transmission, prevalence, and mortality rate due to COVID-19. The current epidemiological trends demonstrate that COVID-19 is highly contagious and has involved 109,594,835 people globally, with a mortality rate of 2,244,060 (2.21%) [4]. The authors reported the epidemiological trends from December 29, 2019, to March 31, 2020. During the study period, worldwide, the total number of infected cases was 750,890, resulting in 36,405 deaths with a mortality rate of 4.84%. The infection was more common in males over 60 years of age. The mean growth factor for the total number of cases from January 23 to March 31, 2020, was 1.20, and the growth factor for mortality was 1.12 [22].

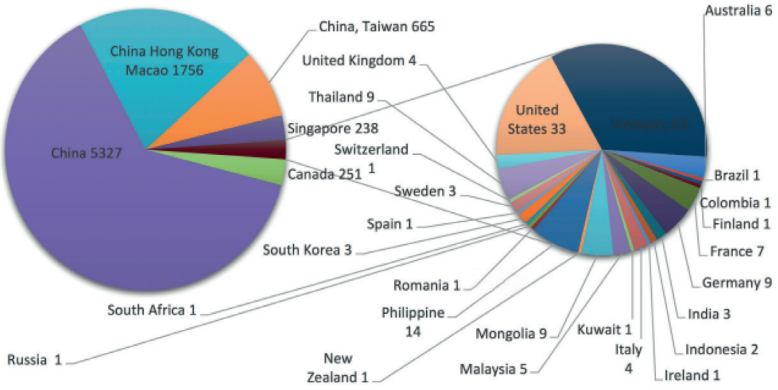

Figure 1.3: SARS-CoV-1 data presented from November 2002 to August 2003 [Figure adopted after permission from author and publisher] [2].

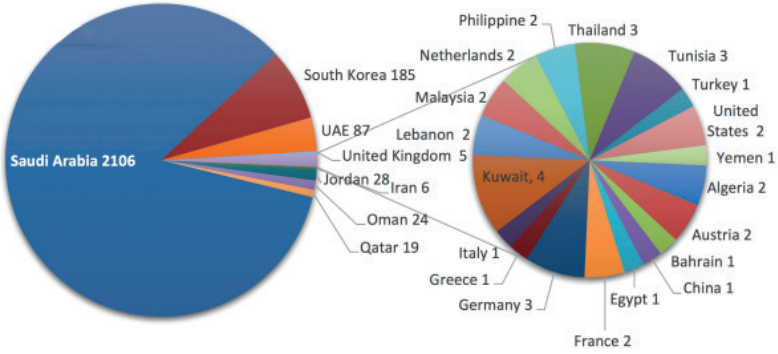

Figure 1.4: Worldwide prevalence of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection.
Note: MERS-CoV data presented from June 2012 to February 7, 2020 [Figure adopted after permission from author and publisher] [2].

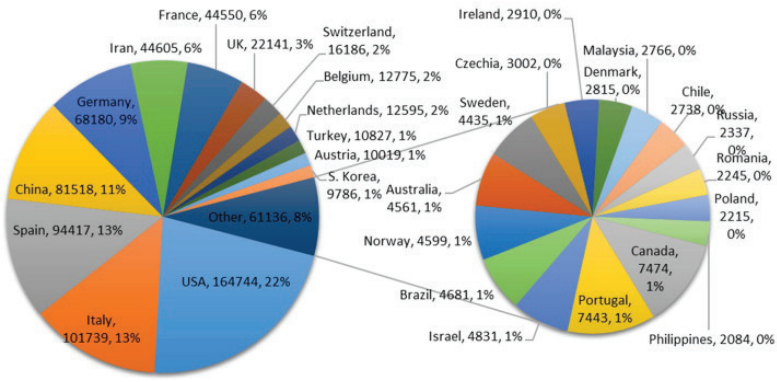

Figure 1.5: Worldwide prevalence of SARS-CoV-2.
The data was presented from December 29, 2019, to March 31, 2020. [Adopted after permission from author and publisher] [22].

After one year of this study, the number of SARS-CoV-2 confirmed cases are 109,594,835 with a mortality rate of 2,244,060 (2.21%) [4]. The findings suggest that the number of SARS-CoV-2 cases is continuously rising; however, the mortality rate decreases [Figures 1.6 and 1.7].

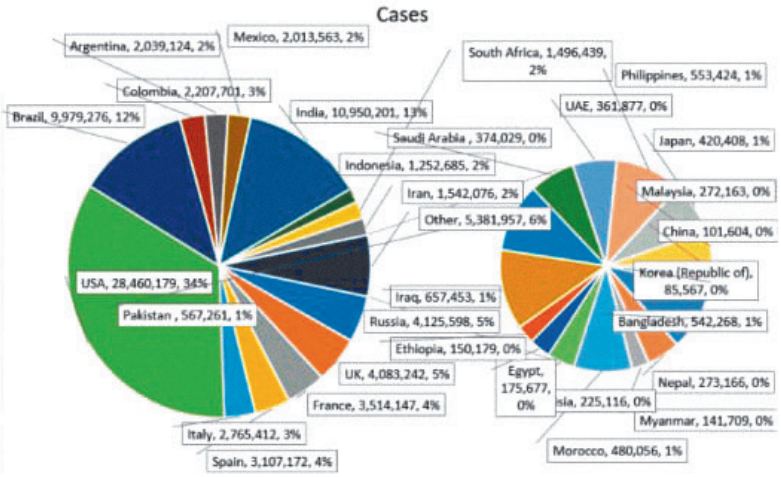

Figure 1.6: The worldwide cases of COVID-19 pandemic [Figure based on WHO data, February 18, 2021] [4].

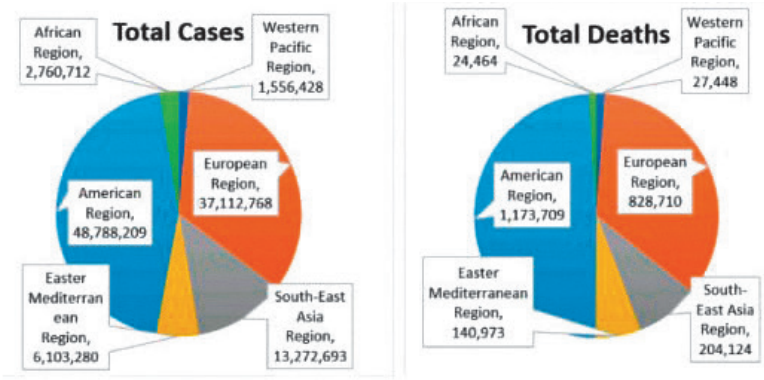

Figure 1.7: Worldwide cases and deaths due to COVID-19 pandemic [Figure based on WHO data, February 18, 2021] [4].

Table 1.2: Biological characteristics of coronavirus: 2019-nCoV, MERS-CoV and SARS-CoV

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
The median age of affected 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, snake, bats	Bats, civet cats	Bats, camel
Transmission	Animal-human human-human Zoonotic disease	Animal-Human Human-Human Zoonotic disease	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	2.11%	10.77%	34.77%

[+Mild; ++ Moderate; +++ severe; ⇧increase; ⇩decrease; +/- on and off]
[Table adopted after permission from author and publisher] [2].

The patterns of SARS-CoV-2, SARS-CoV-1, and MERS-CoV infections have been observed to have seasonal variations. Nassar and Meo et al., 2020 [2] reported that the outbreak of MERS-CoV was mainly during the summer period. The highest global seasonal occurrence of the MERS-CoV outbreak was found in June, while the lowest prevalence of disease was found in January from 2012 to 2017 [2]. In comparison, the SARS-CoV-1 and SARS-CoV-2 infection outbreaks took place mainly in winter weather (Table 1.2). The outbreak of this novel coronavirus "2019-nCoV" has been seen in the winter season, in strong contrast to the outbreaks of MERS-CoV. The gender-based analysis demonstrates that the cases mainly consisted of men with a median age range of 50-65 years [4, 13]. The virus mainly occurred among older people with a median age of 59 years.

There is heterogeneity in the transmissibility of "2019-nCoV, SARS, and MERS" outbreaks and, in particular, the occurrence of super-spreading events. The 2019-nCoV spread faster than the events of the previous epidemics "SARS-CoV-1, and MERS-CoV". SARS-CoV-1 spread into 32 countries, with 8,422 confirmed cases from November 2002 to August 2003. MERS-CoV spread over 27 states, resulting in 2,496 cases from April 2012 to February 7, 2020 [2]. However, the novel coronavirus SARS-CoV-2 spread worldwide and infected 109,594,835 people with a mortality rate of 2,424,060 (2.21%) from December 29, 2019, to February 17, 2021 [4]. The SARS-CoV-2 coronavirus is still in its spreading phase.

The clinical appearances of 2019-nCoV, SARS-CoV, and MERS-CoV infections cover a wide-ranging spectrum fluctuating from asymptomatic presentation and mild to severe acute respiratory illness, to death [2]. A distinctive presentation of these coronavirus symptoms is "fever of 38°C or more, fever with chills or rigors, generalized myalgia, malaise, drowsiness, confusion, dyspnea, coughing, shortness of breath and a radiological pulmonary presentation of pneumonia" (Table 1.2). The extra-pulmonary features include "abdominal disorders, nausea, vomiting, headache, diarrhea, neurological features, and acute renal failure." The other laboratory-based findings are an "increase in white blood cells, mainly neutrophils, and a decrease in lymphocytes, platelets, and red blood cells." The novel coronavirus, SARS-CoV-2, is highly contagious with various biological and epidemiological trends.

Conclusion

SARS-CoV-2 is highly contagious compared to earlier coronaviruses and has affected a large number of people worldwide. The infection has mainly affected older individuals and people with chronic debilitating diseases such as diabetes mellitus, cardiovascular diseases, and malignancy. International health officials have taken high-priority preventive measures to stop the outbreak of this emerging pathogen across the globe. However, SARS-CoV-2 is swiftly spreading, with mutable biological trends and rising epidemiological incidence. The rising epidemiological facts and figures are signifying a need to enhance the public health mediations, vaccination, good hygienic conditions, social distancing, and movement limitations, in order to control the COVID-19 epidemic across the globe.

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Climate and the COVID-19 Pandemic: Effects of Heat and Humidity

Chapter 02

Sultan Ayoub Meo | Javed Akram

Abstract

The "Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)" infection, also known as the COVID-19 pandemic, has swiftly involved the entire world with devastating consequences. The COVID-19 pandemic has caused a global public health crisis with long-lasting social, psychological, and economic damage. The weather-related dynamics have an impact on the pattern of human health and disease. This chapter highlights the effects of climate, heat, and humidity on daily case incidences and the mortality rates due to the COVID-19 pandemic in various world regions. In countries with high temperatures and low humidity, the mean daily case incidences, cumulative cases, and cumulative deaths were low compared to low temperatures and high humidity. Moreover, COVID-19 cases and fatalities per million population were significantly lower in countries with high temperatures than countries with low temperatures. The findings on the weather changes and epidemiological trends of the COVID-19 pandemic have aftermaths for policymakers and health officials.

Keywords: COVID-19 Pandemic, Climate, Temperature, Heat, Humidity, Incidence, Mortality

Introduction

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection, also more famously known as the COVID-19 pandemic, has caused global damage to human health, lives, and socio-economic conditions [1]. The COVID-19 pandemic has been highly predominant and more devastating than some previous pandemics, such as the "Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-1) and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV)" [2]. On February 12, 2021, worldwide it involved 216 countries and infected 107,423,526 people with a mortality rate of 2,360,280 (1.19%) [3].

The biological and epidemiological trends in the prevalence and mortality rates due to the COVID-19 pandemic are swiftly changing. Initially, China bore the largest burden of the coronavirus, but the incidence is gradually

increasing in other countries, mainly the United States of America and Europe. The severe contagious nature of COVID-19 has developed an unprecedented and unpredictable situation in the world [2].

The world's current population is 7.6 billion in 2020 [4], and approximately half of the world's population (3.9 billion people) are currently facing lockdown and quarantine measures in their homes [5]. However, despite the safety measures, the transmission of the disease and its subsequent mortalities have continued [6]. A year later, in February 2021, there is still no availability of a specific recommended drug therapy to treat SARS-CoV patients. However, Pfizer/BioNTech, Moderna, and a few other recommended vaccines have recently become available and are being used to contain the virus. These vaccines have been advised to people 16 years of age and older, and they provide immunogenicity for at least 119 days after the first vaccination.

Some meteorological factors are involved in the transmission and magnitude of the spread of viruses [7, 8]. More recently, a few published studies demonstrated that these factors include respiratory droplets of various sizes [9], warm weather, and humidity [10]. These factors are involved in the coronavirus's further spreading, which has already infected over 110 million people worldwide [3]. Despite recent efforts to understand the epidemiological trends of a novel coronavirus, the science community, researchers, policymakers, and the general population search for more information about the transmission and current biological and epidemiological situation [1] and its association with weather conditions, including heat and humidity.

Transmission of COVID-19

The first case of SARS-CoV-2 appeared in the last week of December 2019, amongst people living in and visiting Wuhan, China [3]. COVID-19 initially originated from bats, and seafood and has an "animal to animal, animal to human, and human to human" transmission [Figure 2.1] [6].