Coronavirus COVID-19: A Short Review on the Psychological Effects of Coronavirus, How It Disturbs Social Life, Its Mechanism to Affect the Central Nervous System, Possible Modes of Transmission, and the Smart Lockdown Policy of Pakistan

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Abstract

COVID-19 infection in humans has been declared as a global emergency by the World Health Organization. During the pandemic, the morbidity and mortality rate increases rapidly. COVID-19 spreads various respiratory disorders in humans. In 2019, SARS-CoV-2 spread more rapidly compared to MERS-CoV and SARS-CoV. A lot of people experienced stress, anxiety, and sleep disorders during the pandemic and the lockdown period due to financial losses and human-to-human transmission of the virus. Depression, stress, and anxiety increased during the pandemic, with even suicidal cases increasing by 30 percent. COVID-19 is a zoonotic disease. The origin of the spread of COVID-19 is not confirmed yet, but it is suggested that it was transmitted from animals to humans. Later on, human-to-human transmission became a major source of the virus spreading among human beings. COVID-19 can spread through both horizontal and vertical transmission. It can also be transmitted through organ transplantation and surgeries. The mental health of the general public was affected due to lockdown and quarantine measures, as they were required to practice

social distancing and stay at home. Financial losses, high mortality rates, social distancing, quarantine, lockdowns, and unavailability of basic needs were some of the most common factors that caused stress, anxiety, and depression. In addition to the respiratory tract, COVID-19 also affects other organs and organ systems, such as the heart, liver, urinary bladder, and even the central nervous system. ACE2 is a receptor of SARS-CoV-2 and is present in the endothelial linings of all organs. The virus enters the cell through ACE2, and furin also facilitates the entrance of the virus into the cell. Mechanoreceptors and chemoreceptors can also play a role in the spread of COVID-19 through synaptic routes in the medulla of the brain. This causes some neurological problems, which lead to psychological problems.

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1. Introduction

Coronavirus is an RNA enveloped round or spherical virus that belongs to the family Coronaviridae and subfamily Coronavirinae. It has a diameter between 60 to 140 nm. **(Shereen M. A., 2020)** It is divided into four genera: Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus**. (Tang, 2020)** Coronavirus is not new to human beings. It was already present in other animals like bats, civet cats, and rodents. It actually transfers from animals' reservoirs and causes disease in humans after some modifications in its genomic sequence. **(Corman)**

In this century, coronavirus is spreading a severe respiratory disorder in humans and has demolished all researched treatments. Out of the six known coronaviruses, Severe acute respiratory syndrome (SARS-CoV) in China in 2002 spread the disease to 8422 people, out of which 916 died, and Middle East Respiratory Syndrome (MERS-CoV) in 2012 spread in Arabian countries and infected 1800 people. In 2019, a novel coronavirus called SARS-CoV2 spread more rapidly than MERS-CoV and SARS-CoV. **(Kadam SB, 2021)**

The actual spreading origin of the novel coronavirus is unknown. There is no authentic information regarding its origin of spreading. Some scientists claim that its spreading origin was The Hunan food market in Wuhan City, China. Different animals like frogs, snakes, and bats were being sold in the market, and 50 people were affected by it. Initially, it was suggested that people already had pneumonia and they ate food from the market and experienced this disease. Later investigations revealed that people from outside Wuhan city were also infected by this virus **(Shereen M. A., 2020).**

In previous outbreaks, such as SARS and MERS, viral infection led to sleep disturbances, anxiety, and depression**.(Deng**

J, 2021) During the COVID-19 pandemic, people have also experienced stress, anxiety, and depression due to social distancing, financial losses, quarantine, and staying at home. **(Varma P, 2021)** COVID-19 is a fast-growing infection, transmitted through human to human via contacts and droplets. In the beginning of the pandemic, many countries imposed safety measures due to the lack of proper treatment and vaccination. Suicide rates had increased by 30% in populations due to these depression, traumatic stress, and anxiety. There is a gap in the treatment of people having psychological disorders in developing countries like Pakistan. 76-85% of people do not receive any treatment for mental disorders due to this gap. The level of the gap is much higher during and after the pandemic**. (Wolf S, 2021)**

In Pakistan, the first SARS-CoV-2 case was reported in February 2020 and the government of Pakistan imposed a lockdown in the second week of March 2020 to control the spread of the virus. All educational institutes, workplaces, worship places, and industries were closed. This lockdown affected the psychological health of the Pakistani people. **(Majeed S, 2021)**

The purpose of this article is to provide a review of the effects of the coronavirus SARS-CoV-2 on the psychological health of the general public. It will explain how the current COVID-19 pandemic has adversely affected the social lives of people through social distancing, lockdown conditions, and quarantine. It will also discuss the various modes of transmission of the coronavirus, its impact on the central nervous system of humans, and the smart lockdown policy implemented by Pakistan to prevent the devastating effects of the virus and minimize major economic losses.

2. Psychological Effects of COVID-19

Governments of different countries all over the world have imposed lockdowns to control the effects of the spread of the COVID-19 viral infection. All public health measures, such as social distancing and quarantine, have led to some adverse psychological disorders in the public. Fears of infection, social losses, financial losses, and an improper supply of basic things like food items and even medicines have increased the frustration in people, thereby increasing risk factors. Loneliness and social distancing have caused psychological disorders and syndromes such as hypertension and insomnia. **(Blanco C, 2020)** Different waves of coronavirus over time have produced frustration in people. The major fear has been getting infected with the virus. In some countries like India, Italy, the USA, and some European countries where COVID-19 has spread at devastating levels, people have become hopeless for their future, and complete lockdown conditions have made them powerless, unsocial, and alone. Certain social activities, such as family gatherings, meeting with friends, and outings, which help a person relax and alleviate depression, have been restricted due to public health measures. Although these measures are imposed for the betterment and safety of the general public, they have psychological effects. **(Manivannan M, 2021)** Quarantine situations especially affect the mental health of young individuals. A young individual has a vast social circle compared to an older one. Therefore, the conditions during the coronavirus pandemic have resulted in anxiety, anger, and confusion in young individuals. According to research conducted by The Angus Reid Institute, there was a disturbance in mental health for 50% of Canadians, and 42% of Canadians reported a disturbance in physical health due to limited physical activity during quarantine conditions. There was a 5.5% increase in the perception of loneliness among young individuals in the UK. Post-traumatic stress syndrome

(PTSS) was observed in the general public after the pandemic. Extended exposure to fear during the pandemic resulted in changes in emotional and behavioral patterns of people due to social distancing. **(Chen, 2021)**

3. Host Susceptibility to COVID-19

The COVID-19 induced by a virus named SARS-CoV-2 infection is characterized by a range of clinical severities. Some patients are asymptomatic, while others show mild symptoms of upper respiratory tract infection. However, in a few patients, SARS-CoV-2 develops severe pneumonia followed by cough, fever, dyspnea, acute respiratory injuries, and bilateral pulmonary infiltrates, involving multiple organs of the human body, which can cause deaths. Risk factors for the severity of COVID-19 infection include male sex, elderly persons, pre-existing comorbidities, and an increased body mass index. **(Velavan TP, 2021)** Angiotensin-converting enzyme 2 (ACE2) is an enzyme that functions as a receptor on the cell surface, and it is present in high numbers in cells of the lungs, heart, and kidneys. Through ACE2, the SARS-CoV-2 enters the host cell. This enzyme is also the main regulator of the renin-angiotensin-aldosterone system (RAAS). SARS-CoV-2 triggers ACE2 unbalancing and RAAS activation, which eventually leads to COVID-19 progression, specifically in those patients having comorbidities, such as diabetes mellitus, hypertension, and cardiovascular diseases. Therefore, ACE2 expression may have paradoxical effects and aid in SARS-CoV-2 pathogenicity. **(Beyerstedt S, 2021)** Along with ACE2, transmembrane protease serine 2 and dipeptidyl peptidase-4 also play a key role in the intensity of the disease. **(Choudhary S, 2021)**. Stress-like syndromes are also possible risk factors that are involved in the severity and susceptibility to COVID-19.

Pregnant mothers also have an increased susceptibility to COVID-19 due to stress during pregnancy. There is no evidence of transmission of SARS-CoV-2 from mother to fetus. This may be due to the amniotic fluid, lactoferrin in the placenta, and lacteal secretion. During COVID-19, there is a cytokine storm causing inflammation that leads to fetal damage. It can then cause disorders like autism and developmental abnormalities of the brain in neonates. So, COVID-19 can have serious health issues for the fetus. **(Naidu SAG, 2022)**

4. Mechanism of COVID-19 to Damage Other Organs, Especially the Brain and Central Nervous System

Coronavirus not only affects the respiratory tract but also affects other organs and organ systems such as the heart, urinary system, liver, testes, and even the CNS. The angiotensin-converting enzyme ACE2 plays a role as a receptor for SARS-CoV-2. ACE2 is present in the endothelial linings of all organs, especially the heart, lungs, liver, kidneys, and Leydig cells in the testes. ACE2 regulates fluid and electrolyte balance and blood pressure. The virus enters the cell through these receptors. Another protein that facilitates the entrance of the coronavirus into host cells is furin. **(Tancheva, 2020)** Patients also experience insomnia, headaches, and dizziness during viral infection, indicating the effect of the virus on the nervous system. Neuro-COVID is a new term used for COVID that relates to neurological disorders. In one study, 78 out of 214 patients with SARS-CoV-2 had neurological symptoms like impaired consciousness and cerebrovascular

disease. **(Mao L, 2020)** Coronavirus can also spread via mechanoreceptors and chemoreceptors through synaptic routes in the medulla of the brain.

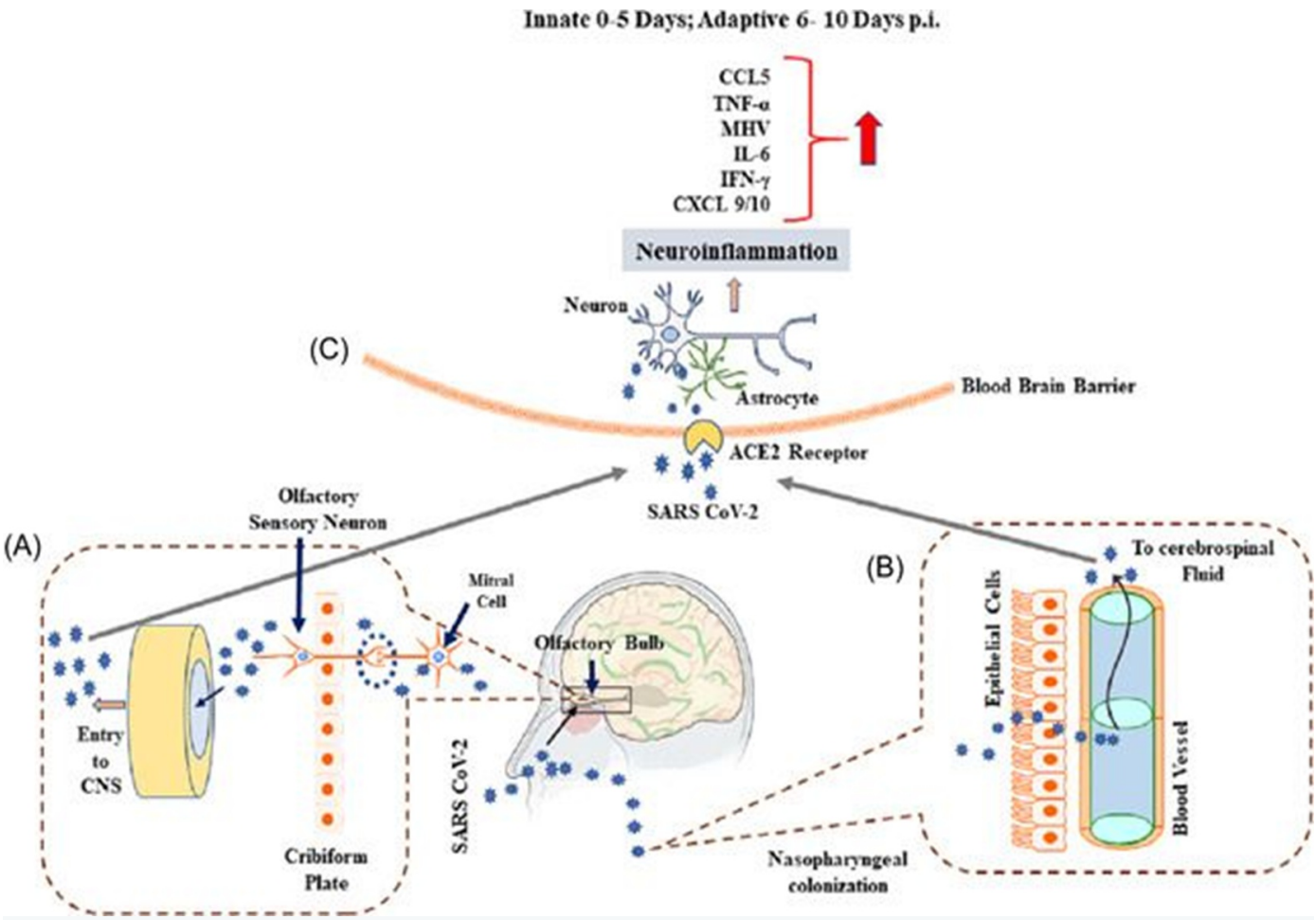

Figure 1. Possible entry routes of coronavirus in the Central Nervous System (CNS) **(Mahalakshmi AM, 2021)**

The most targeted area of the coronavirus is the brainstem. **(Li YC, 2020)** ACE2 receptors are also present in glial cells, which can be a pathway for the coronavirus to reach the brain. Gene sequencing of the cerebrospinal fluid shows the occurrence of the coronavirus, indicating its ability to affect the nervous system. **(Holshue ML, 2019)** This approach of the coronavirus to the CNS (central nervous system) has caused some neurological problems. These neurological problems lead to some serious psychological disorders in patients with the coronavirus.

5. Modes of Transmission

As mentioned above, the actual origin of transmission is from animals. So, it's a zoonotic disease that transfers from animals to humans. Human to human transmission was first studied by Chan et al. They studied the travel history of six people from a family who were infected with the coronavirus. One person from that family never traveled to Wuhan, but was also infected with COVID-19 when they came in contact with the rest of their family members. It transfers through

person to person. Its modes of transmission are aerosol, person to person contact, and through sneezing or coughing of infected person. **(Sharma, 2021)** The following are the different modes of transmission of coronavirus.

5.1. Animal-to-Human Transmission

The COVID-19 virus, which is found in bats and in humans, is similar. According to this, bats are considered as reservoirs causing acute infections of COVID-19 in humans. When studied at the genomic level, the coronavirus found in humans and bats is 96% identical. **(Peng Zhou, 2020)** Cross-species transmission occurs because of homologous recombination in the spike glycoprotein. COVID-19 and the snake *Bungarus multicinctus* have the same codon usage bias and, because of resampling similarity, snakes were also suggested as virus reservoirs causing COVID-19 in humans. **(Ji W, 2020)** Pangolins provide a partially spiked gene to COVID-19, so they are implicated as a missing link in this infection to humans. The virus isolated from a pangolin is 91.02% identical at a whole genome level to the binding site of functionality in the spike protein of the coronavirus in humans. Therefore, pangolins also play a role as a natural reservoir for the coronavirus, playing an important role in the transmission of the disease in humans. **(Matthew C. Wong, 2020) (Li Q, 2020) (Lam, 2020)** Later on, many patients who didn't have any exposure to China, Wuhan, or animals had contracted the disease, indicating that COVID-19 is not only limited to "animal-to-human transmission", but it can also transmit from humans to humans. So, the transmission pathway of COVID-19 is apparently similar to MERS and SARS, which infect and spread because of respiratory droplets through coughing and sneezing, and close contact is also a major reason for its transmission. **(Rahman HS, The transmission modes and sources of COVID-19: A systematic review, 2020)**

5.2. Human-to-Human Transmission

In the current pandemic, the major pathway of transmission of the disease is human-to-human transmission of the virus, COVID-19 **(Jin X, 2020)**. Testing and rigorous surveillance are needed to avoid further expansion of the pandemic **(RN, 2020) (COL, 2020)**. Generally, patients with COVID-19 symptoms spread the virus to those with whom they are in close contact **(She J, 2020) (Boldog P, 2020)**. Many COVID-19 patients unknowingly serve as carriers, transmitting the virus to others, even while being asymptomatic **(Rothe C, 2020) (Zhou, 2020) (Hu Z, 2020)**. This ultimately leads to an increase in COVID-19 cases in societies that lack the practice of social distancing and isolation, as well as in families with individuals who have asymptomatic infections **(Riou J, 2020) (Phan LT, 2020)**.

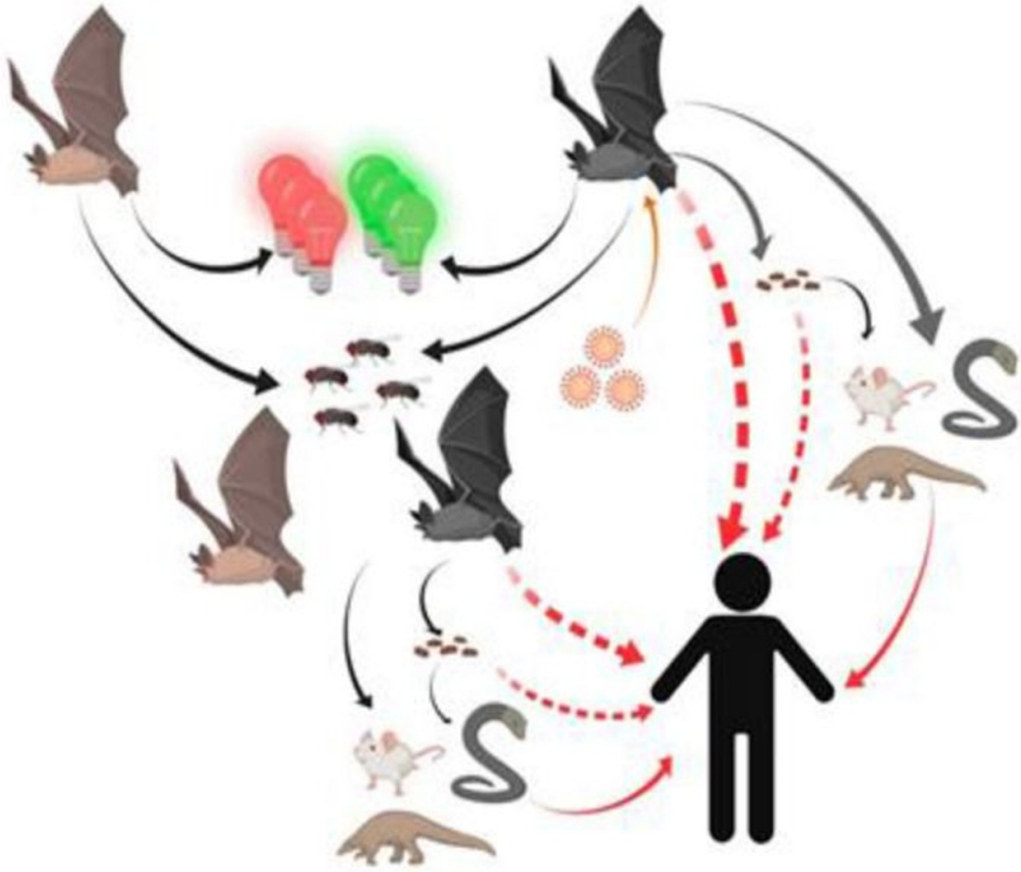

Figure 2. Primary sources of coronavirus transmission (Rahman HS, The Transmission Modes and Sources of COVID-19: A Systematic Review, 2020)

5.3. Horizontal Transmission

Based on the guidelines provided by Chinese health authorities, there are three major routes that primarily transmit the COVID-19 virus in humans. These routes include: droplets, direct contact, and aerosols. **(Yan Y, 2020) (Lu Q, 2020)**

5.3.1. Direct Contact Transmission

Direct contact transmission occurs when there is direct contact with objects and surfaces that are contaminated with the virus. People can get infected through their mouth, eyes or nose. Healthcare workers are at a higher risk of infection as they constantly attend to COVID-19 positive patients. They are particularly susceptible to infection through direct contact transmission, which is a common cause of nosocomial infections. **(Belser JA, 2013) (Koenig KL, 2020)(Li X, 2020)** In direct contact transmission, the main source of infectious particles are fomites. **(Jiang F, 2020) (Rothan HA, 2020)** Washing hands frequently with an alcohol-based hand wash and avoiding touching the nose, mouth, and eyes with contaminated hands can minimize the risk of COVID-19 transmission. **(T, 2020)**

5.3.2. Aerosol Transmission

The coronavirus is not actually an airborne virus. Aerosols, which are contained in expired air from sneezes and coughs,

contaminate the environment and serve as a medium for virus spread. (Belser JA, Ocular tropism of respiratory viruses, 2013) (Koenig KL, 2019-nCoV: The Identify-Isolate-Inform (3I) Tool Applied to a Novel Emerging Coronavirus, 2020) Patients who have symptoms of COVID-19, as well as asymptomatic COVID-19 positive patients, can be a source of infection and play a role in aerosol transmission. **(Yeo C, 2020)** Aerosols contaminated with the virus can stay in the air at high concentrations for a long time in close environments, ultimately increasing the rate of transmission. **(Wu D, 2020)** The virus can remain viable for at least 48 to 72 hours on plastic surfaces and stainless steel. **(van Doremalen N, 2020)**

A significant risk to healthcare workers and doctors is the transmission of nosocomial infections**(Wang, Y., 2020)**. Nosocomial infections are transmitted through aerosols during respiratory pathways and dental care procedures **(Peng, X., 2020)**, as well as hemodialysis **(Basile, C., 2020)**. These infections are most commonly observed in intensive care units. To minimize the risk of infection, it is suggested to use personal protective equipment (PPE), and in severe cases, a powered air-purifying respirator (PAPR) should be used. **(Rahman, H.S., The transmission modes and sources of COVID-19: A systematic review, 2020)**

5.3.3. Droplet Transmission

Droplets are abundant in respiratory air, and their size is less than 5mm in diameter. Sneezing and coughing increase the expulsion of droplets from the oral cavity and respiratory tract. These droplets are contaminated with the virus in COVID-19 positive people. When healthy people inhale or ingest these droplets, they become infected with COVID-19. **(Wang C, 2020)** It is the most dangerous form of transmission for healthcare workers.**(Tran K, 2012)** If personal protective equipment is used with proper barriers to droplets, the risk of infection can be reduced. Maintaining personal and environmental hygiene is also recommended to limit the transmission of infection. **(MA, 2020)**

5.4. Transmission of Coronavirus Through Surgical Operations and Organ Transplantation

The coronavirus primarily inhabits the respiratory tract and its secretions. If COVID-19 patients require surgery, they pose a risk of infection to healthcare workers, for example, in organ transplantation procedures. Organ recipients are in an immunocompromised state, which is required for the procedure, so they are at a greater risk of infection **(Tian S, 2020)** **(Kumar D, 2020)**. Therefore, cases in which organ transplantation is not necessary are suggested to be delayed until the COVID-19 pandemic is no longer a health threat.

However, it is necessary to perform emergency surgical interventions in COVID-19 population for severe appendicitis, cases of abortions needing strangulated inguinal hernias, caesarian sections, intestinal/respiratory obstructions, aggressive tumors, painful kidney stones, severe toothache, and even severe trauma caused by a car accident or gunshot. **(Patriti A, 2020)**

There was no published data on cases of virus transmission from patients to doctors, healthcare workers, surgeons, and other hospitalized patients during treatment, surgical operations, and hospitalization **(Wang W, 2020)**. But later on, it was confirmed by the Chinese Center for Disease Control and Prevention that healthcare personnel were infected in 3.8% of cases, of which 15% were severe cases and the mortality rate was 0.2%. In COVID-19 positive patients, it is obvious that

the virus is present in sputum (93%), stool (29%), blood (1%), and some organs may also contain the virus, which can ultimately expose surgeons or operating room staff **(Wu, 2020)**. Upper respiratory and pulmonary surgeries are at a greater risk, and gastrointestinal and colorectal surgeries can also pose a higher risk of virus transmission **(Ortega, 2020)**.

6. Smart Lockdown Policy of Pakistan

In Pakistan, people give a lot of importance to social life. The lockdown disturbed the social activities and increased the pressure on the psychological health of people. The poverty rate in Pakistan is 33%. Many people are daily wage earners. When the government of Pakistan imposed a complete lockdown during the first wave of COVID-19, all daily wage earners became jobless due to the shutdown of industries and construction sites. Small private companies and schools reduced the pay of their employees, which led to severe financial problems for a large population of Pakistan. **(Majeed S, 2021)** After a complete lockdown, the Pakistan Government reviewed the socio-economic situation of the country and implemented a smart lockdown at both federal and provincial levels on June 13, 2020. This concept was based on a new strategy of trace, track, and quarantine. According to this policy, healthcare workers identified the high-risk areas where the number of cases was too high, and the health department declared those areas as hotspots. These areas were declared as quarantine zones for all the residents. Everyone stayed at their houses for two to three weeks for quarantine. After a suitable period of quarantine and proper testing, all the people came out and continued their normal life routines. When healthcare staff identified a patient, they traced their previous two weeks' history of travel and meetings with other people. After a complete checkup and identification, an affected person was sent to the nearest quarantine facility. The government of Pakistan also supported its low-income and jobless citizens due to COVID-19 by launching an Emergency Cash Program, which was known as the "EHSAAS EMERGENCY CASH PROGRAM". **(Abbas, 2022)** Industries and construction sites were opened under the smart lockdown policy with strict SOPs. This way, all the income sources of daily wage earners had resumed.

Conclusion

COVID-19 is an infectious disease caused by a virus named SARS-CoV-2. The COVID-19 pandemic has created a global health crisis. The infection is characterized by a range of severity, from mild to moderate and severe infections in human beings. Europeans mostly develop severe infections due to their cold weather, which affects their immunity and ability to maintain body temperature. Asians, on the other hand, tend to develop mild or moderate infections and report a comparatively smaller number of deaths compared to Europe. There are two ways in which anxiety is linked to COVID-19. Firstly, patients develop anxiety due to isolation and fear of the deadly COVID-19. Secondly, in cases of severe COVID-19 infection, the level of oxygen decreases, leading to inadequate oxygen supply to the body's tissues. This can result in damage to various body parts, including the brain, and can lead to serious mental issues. As Coronavirus affects the central nervous system, it is also a major factor in causing serious psychological and brain malfunctioning. Pakistan, being an Asian country with a long hot span in its weather pattern, has prevented major economic losses and witnessed a

decline in the number of positive cases due to its smart lockdown policy and strict implementation of SOPs in all waves of the coronavirus.

References

- Abbas, A. (2022). Reasons behind declining of cases during the COVID-19 wavelets in Pakistan: public healthcare system or government smart lockdown policy? *Ciência & Saúde Coletiva, 27*(8), 2973–2984. https://doi.org/10.1590/1413-81232022278.06012022
- Basile, C., & Combe, C. (2020). Recommendations for the prevention, mitigation and containment of the emerging SARS-CoV-2 (COVID-19) pandemic in haemodialysis centres. *Nephrology Dialysis Transplantation, 35*(5), 737-741. https://doi.org/10.1093/ndt/gfaa069
- Belser, J. A., & Rota, P. A. (2013). Ocular tropism of respiratory viruses.*Microbiology and Molecular Biology Reviews, 77*(1), 144-156. https://doi.org/10.1128/MMBR.00058-12
- Beyerstedt, S., & Casaro, E. B. (2021). COVID-19: angiotensin-converting enzyme 2 (ACE2) expression and tissue susceptibility to SARS-CoV-2 infection. *European Journal of Clinical Microbiology & Infectious Diseases, 40*(5), 905-919. https://doi.org/10.1007/s10096-020-04138-6
- Blanco, C., & Wall, M. M. (2020). Psychological aspects of the COVID-19 pandemic.*Journal of General Internal Medicine, 35*(9), 2757-2759. https://doi.org/10.1007/s11606-020-05955-3
- Boldog, P., & Tekeli, T. (2020). Risk assessment of novel coronavirus COVID-19 outbreaks outside China.*Journal of Clinical Medicine, 9*(2), 571. https://doi.org/10.3390/jcm9020571
- Chen, P. (2021). An overview of mental health during the COVID-19 pandemic.*Diagnosis (Berlin, Germany), 8*(4), 403–412. https://doi.org/10.1515/dx-2021-0046
- Choudhary, S., & Sharma, K. (2021). Role of genetic variants and gene expression in the susceptibility and severity of COVID-19. *Annals of Laboratory Medicine, 41*(2), 129-138. https://doi.org/10.3343/alm.2021.41.2.129
- Col, U. (2020). Community pharmacist in public health emergencies: Quick to action against the coronavirus 2019-nCoV outbreak. *Research in Social and Administrative Pharmacy, 16*(4), 583-586. https://doi.org/10.1016/j.sapharm.2020.02.003
- Corman, V. M. (n.d.). Coronaviren als Ursache respiratorischer Infektionen [Coronaviruses as the cause of respiratory infections]. *Der Internist, 61*, 1136–1145. https://doi.org/10.1007/s00108-019-00671-5
- Deng, J., & Zhou, F. (2021). The prevalence of depression, anxiety, and sleep disturbances in COVID-19 patients: a meta-analysis. *Annals of the New York Academy of Sciences* https://doi.org/10.1111/nyas.14506
- Holshue, M. L., & DeBolt, C. (2020). Washington State 2019-nCoV Case Investigation Team. First case of 2019 novel coronavirus in the United States. *The New England Journal of Medicine, 382*(10), 929-936. https://doi.org/10.1056/NEJMoa2001191
- Hu, Z., & Song, C. (2020). Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. *Science China Life Sciences, 63*(5), 706-711. https://doi.org/10.1007/s11427-020-1661-4
- Ji, W., & Li, X. (2020). Response to comments on “Cross-species transmission of the newly identified coronavirus 2019-

nCoV" and "Codon bias analysis may be insufficient for identifying host(s) of a novel virus. *Journal of Medical Virology, 92*(10), 1440. https://doi.org/10.1002/jmv.26048

- Jiang, F., & Deng, L. (2020). Review of the clinical characteristics of coronavirus disease 2019 (COVID-19).*Journal of General Internal Medicine, 35*(5), 1545-1549. https://doi.org/10.1007/s11606-020-05762-w
- Jin, X., & Liu, L. J. (2020). Epidemiological, clinical and virological characteristics of 74 cases of coronavirus-infected disease 2019 (COVID-19) with gastrointestinal symptoms. *Gut, 69*(7), 1002-1009. https://doi.org/10.1136/gutjnl-2020-320926
- Kadam, S. B., & Sukhramani, G. S. (2021). SARS-CoV-2, the pandemic coronavirus: Molecular and structural insights. *Journal of Basic Microbiology, 61*(3), 180-202. https://doi.org/10.1002/jobm.202000537
- Koenig, K. L., & Beÿ, C. K. (2020). 2019-nCoV: The Identify-Isolate-Inform (3I) Tool Applied to a Novel Emerging Coronavirus. *Western Journal of Emergency Medicine, 21*(2), 184-190. https://doi.org/10.5811/westjem.2020.1.46760
- Kumar, D., & Manuel, O. (2020). COVID-19: A global transplant perspective on successfully navigating a pandemic. *American Journal of Transplantation, 20*(7), 1773-1779. https://doi.org/10.1111/ajt.15876
- Lam, T. T., & et al. (2020). Identifying SARS-CoV-2-related coronaviruses in Malayan pangolins.*Nature, 583*(7815), 282–285. https://doi.org/10.1038/s41586-020-2169-0
- Li, Q., & Guan, X. (2020). Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *The New England Journal of Medicine, 382*(13), 1199-1207. https://doi.org/10.1056/NEJMoa2001316
- Li, X., & Zai, J. (2020). Potential of large "first generation" human-to-human transmission of 2019-nCoV.*Journal of Medical Virology, 92*(4), 448-454. https://doi.org/10.1002/jmv.25693
- Li, Y. C., & Bai, W. Z. (2020). The neuroinvasive potential of SARS-CoV2 may play a role in the respiratory failure of COVID-19 patients. *Journal of Medical Virology, 92*(6), 552-555. https://doi.org/10.1002/jmv.25728
- Lu, Q., & Shi, Y. (2020). Coronavirus disease (COVID-19) and neonate: What neonatologist need to know.*Journal of Medical Virology, 92*(6), 564-567. https://doi.org/10.1002/jmv.25740
- Ma, L. (2020). What we know so far: COVID-19 current clinical knowledge and research.*Clinical Medicine (London), 20*(2), 124-127. https://doi.org/10.7861/clinmed.2019-coron
- Mahalakshmi, A. M., & Ray, B. (2021). Does COVID-19 contribute to development of neurological disease?*Immunity, Inflammation and Disease, 9*(1), 48-58. https://doi.org/10.1002/iid3.387
- Majeed, S., & Shah, E. (2021). The Psychological Impact of COVID-19 Among Pakistani Adults in Lahore.*Frontiers in Public Health, 9*, 578366. https://doi.org/10.3389/fpubh.2021.578366
- Manivannan, M., & Joseph, M. (2021). Mini-review on the effects of COVID-19 on younger individuals.*Experimental Biology and Medicine (Maywood), 246*(3), 293-297. https://doi.org/10.1177/1535370220975118
- Mao, L., & Jin, H. (2020). Neurologic Manifestations of Hospitalized Patients With Coronavirus Disease 2019 in Wuhan, China. *JAMA Neurology, 77*(6), 683-690. https://doi.org/10.1001/jamaneurol.2020.1127
- Wong, M. C., & et al. (2020). Evidence of recombination in coronaviruses implicating pangolin origins of nCoV-2019. https://doi.org/10.1101/2020.02.07.93920
- Naidu, S. A. G., & Clemens, R. A. (2022). COVID-19 during Pregnancy and Postpartum.*Journal of Dietary Supplements, 19*(1), 115-142. https://doi.org/10.1080/19390211.2020.1834049

- Ortega, R., & Gonzalez, R. G. (2020). Personal Protective Equipment and Covid-19.*The New England Journal of Medicine*. https://doi.org/10.1056/NEJMvcm2014809
- Patriti, A., & B. G. (2020). Emergency general surgery in Italy during the COVID-19 outbreak: first survey from the real life. *World Journal of Emergency Surgery, 15*, Article 36. https://doi.org/10.1186/s13017-020-00314-3
- Peng, X., & X. X. (2020). Transmission routes of 2019-nCoV and controls in dental practice.*International Journal of Oral Science, 12*, Article 9. https://doi.org/10.1038/s41368-020-0075-9
- Zhou, P., Yang, X.-L., Wang, X.-G., Hu, B., Zhang, L., Zhang, W., Si, H.-R., Zhu, Y., Li, B., Huang, C.-L., Chen, H.-D., Chen, J., Luo, Y., Guo, H., Jiang, R.-D., Liu, M.-Q., Chen, Y., Shen, X.-R., Wang, X., Zheng, X.-S., Zhao, K., Chen, Q.-J., Deng, F., Liu, L.-L., Yan, B., Zhan, F.-X., Wang, Y.-Y., Xiao, G.-F., & Shi, Z.-L. (2020). Discovery of a novel coronavirus associated with the recent pneumonia outbreak in humans and its potential bat origin. *bioRxiv*. https://doi.org/10.1101/2020.01.22.914952
- Phan, L. T., Nguyen, T. V., Luong, Q. C., Nguyen, T. V., Nguyen, H. T., Le, H. Q., Nguyen, T. T., Cao, T. M., & Pham, Q. D. (2020). Importation and Human-to-Human Transmission of a Novel Coronavirus in Vietnam. *The New England Journal of Medicine, 382*(9), 872-874. https://doi.org/10.1056/NEJMc2001272
- Rahman, H. S., Aziz, M. S., Hussein, R. H., Othman, H. H., Omer, S. H. S., Khalid, E. S., Abdulrahman, N. A., Amin, K., Abdullah, R., & Abdulateef, D. S. (2020). The transmission modes and sources of COVID-19: A systematic review. *International Journal of Surgery Open, 26*, 125-136. https://doi.org/10.1016/j.ijso.2020.08.017
- Riou, J., & Althaus, C. L. (2020). Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV). *Eurosurveillance, 25*(4), Article 2000058. https://doi.org/10.2807/1560-7917.ES.2020.25.4.2000058
- Rn, T. (2020). Novel Coronavirus Outbreak in Wuhan, China, 2020: Intense Surveillance Is Vital for Preventing Sustained Transmission in New Locations. *Journal of Clinical Medicine, 9*(2), Article 498. https://doi.org/10.3390/jcm9020498
- Rothan, H. A., & Byrareddy, S. N. (2020). The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *Journal of Autoimmunity, 109*, Article 102433. https://doi.org/10.1016/j.jaut.2020.102433
- Rothe, C., Schunk, M., Sothmann, P., Bretzel, G., Froeschl, G., Wallrauch, C., Zimmer, T., Thiel, V., Janke, C., Guggemos, W., Seilmaier, M., Drosten, C., Vollmar, P., Zwirglmaier, K., Zange, S., Wölfel, R., & Hoelscher, M. (2020). Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany. *The New England Journal of Medicine, 382*(10), 970-971. https://doi.org/10.1056/NEJMc2001468
- Sharma, A., Ahmad Farouk, I., & Lal, S. K. (2021). COVID-19: A Review on the Novel Coronavirus Disease Evolution, Transmission, Detection, Control and Prevention. *Viruses, 13*(2), Article 202. https://doi.org/10.3390/v13020202
- She, J., Jiang, J., Ye, L., Hu, L., Bai, C., & Song, Y. (2020). 2019 novel coronavirus of pneumonia in Wuhan, China: emerging attack and management strategies. *Clinical and Translational Medicine, 9*, Article 19. https://doi.org/10.1186/s40169-020-00271-z
- Shereen, M. A., Khan, S., Kazmi, A., Bashir, N., & Siddique, R. (2020). COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. *Journal of Advanced Research, 24*, 91–98. https://doi.org/10.1016/j.jare.2020.03.005
- T, S. (2020). A Review of Coronavirus Disease-2019 (COVID-19). *Indian Journal of Pediatrics, 87*(4), 281-286.

https://doi.org/10.1007/s12098-020-03263-6

- Tancheva, L., Petralia, M. C., Miteva, S., Dragomanova, S., Solak, A., Kalfin, R., Lazarova, M., Yarkov, D., Ciurleo, R., & Bramanti, P. (2020). Emerging Neurological and Psychobiological Aspects of COVID-19 Infection. *Brain Sciences, 10*(11), Article 852. https://doi.org/10.3390/brainsci10110852
- Tang, X., Wu, C., Li, X., Song, Y., Yao, X., Wu, X., Duan, Y., Zhang, H., Wang, Y., Qian, Z., Cui, J., & Lu, J. (2020). On the origin and continuing evolution of SARS-CoV-2. *National Science Review, 7*(6), 1012–1023. https://doi.org/10.1093/nsr/nwaa036
- Tian, S., Hu, N., Lou, J., Chen, K., Kang, X., Xiang, Z., Chen, H., Wang, D., Liu, N., Liu, D., Chen, G., Zhang, Y., Li, D., Li, J., & Lian, H. (2020). Characteristics of COVID-19 infection in Beijing. *Journal of Infection, 80*(4), 401-406. https://doi.org/10.1016/j.jinf.2020.02.018
- Tran, K., & Cimon, K. (2012). Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: A systematic review. *PLOS ONE*, 7(4), e35797. https://doi.org/10.1371/journal.pone.0035797
- van Doremalen, N., Bushmaker, T., & Munster, V. J. (2020). Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *The New England Journal of Medicine*, 382(16), 1564-1567. https://doi.org/10.1056/NEJMc2004973
- Varma, P., & Junge, M. (2021). Younger people are more vulnerable to stress, anxiety, and depression during COVID-19 pandemic: A global cross-sectional survey. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, 109, 110236. https://doi.org/10.1016/j.pnpbp.2020.110236
- Velavan, T. P., & Pallerla, S. R. (2021). Host genetic factors determining COVID-19 susceptibility and severity. *EBioMedicine*, 103629. https://doi.org/10.1016/j.ebiom.2021.103629
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health*, 17(5), 1729. https://doi.org/10.3390/ijerph17051729
- Wang, W., Xu, Y., Gao, R., Lu, R., Han, K., Wu, G., & Tan, W. (2020). Detection of SARS-CoV-2 in different types of clinical specimens. *JAMA*, 323(18), 1843-1844. https://doi.org/10.1001/jama.2020.3786
- Wang, Y., Wang, Y., Chen, Y., & Qin, Q. (2020). Unique epidemiological and clinical features of the emerging 2019 novel coronavirus pneumonia (COVID-19) implicate special control measures. *Journal of Medical Virology*, 92(6), 568-576. https://doi.org/10.1002/jmv.25748
- Wolf, S., & Seiffer, B. (2021). Is physical activity associated with less depression and anxiety during the COVID-19 pandemic? A rapid systematic review. *Sports Medicine*, 51(8), 1771-1783. https://doi.org/10.1007/s40279-021-01468-z
- Wu, D., & Wu, T. (2020). The SARS-CoV-2 outbreak: What we know.*International Journal of Infectious Diseases*, 94, 44-48. https://doi.org/10.1016/j.ijid.2020.03.004
- Wu, Z., & McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72,314 cases from the Chinese Center for Disease Control and Prevention. *JAMA*, 323(13), 1239–1242. https://doi.org/10.1001/jama.2020.2648
- Yan, Y., Chen, H., Chen, L., Cheng, B., Diao, P., Dong, L.,... & Guo, J. (2020). Consensus of Chinese experts on protection of skin and mucous membrane barrier for health-care workers fighting against coronavirus disease 2019.

Dermatologic Therapy, e13310. https://doi.org/10.1111/dth.13310

- Yeo, C., Kaushal, S., & Yeo, D. (2020). Enteric involvement of coronaviruses: Is faecal-oral transmission of SARS-CoV-2 possible? *The Lancet Gastroenterology & Hepatology*, 5(4), 335-337. https://doi.org/10.1016/S2468-1253(20)30048-0
- Zhou, C. (2020). Evaluating new evidence in the early dynamics of the novel coronavirus COVID-19 outbreak in Wuhan, China with real time domestic traffic and potential asymptomatic transmissions. *medRxiv*. https://doi.org/10.1101/2020.02.15.20023440