IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 24, Issue 7 Ser.3 (July 2025), PP 08-14
www.iosrjournals.org

A Survey on Vaccination for Covid-19 And Its Effects on People's Health and The Society.

Arunavarsini K[1], Logeshwaran V[2], Sornambiga R[3], Sashtika AC [4], Sonali Pathak P[5] and Mahenthiran R[6*]

[1]*PhD Research Scholar, Department of Microbiology, Dr. N.G.P Arts And Science College, Coimbatore, India*
[2]*Assistant Professor, Department of Biotechnology, AJK College of Arts And Science , Coimbatore, India*
[3]*PhD Research Scholar, Department of Microbiology, PSG College of Arts And Science, Coimbatore, India*
[4,]*PG and Research, Department of Microbial Genetics, Bharathiar University, Coimbatore, India*
[5] *PG and Research, Department of Microbiology, Dr. N.G.P Arts And Science College, Coimbatore, India*
[6*]*Assistant Professor, Department of Microbiology, Dr. N.G.P Arts And Science College, Coimbatore, India**

Abstract:
The world was profoundly affected by the COVID-19 pandemic, which started in 2019 as an outbreak of a new respiratory disease in Wuhan, China. The World Health Organization declared it a global pandemic after the outbreak rapidly grew out of control and was caused by a virus belonging to the coronavirus family. In addition to putting a strain on public health systems, COVID-19 also changed daily life and upended economy. There were differing views on how it should be handled, particularly with relation to the vaccines that were created and made available in less than a year. This study investigates public perceptions of the epidemic, vaccination campaigns, and its impacts on the welfare of individuals and society as a whole. 250 people of various ages participated in a survey that was carried out in and around the Coimbatore area of Tamil Nadu, India. With 50 respondents per area, the study was conducted in five significant locations: Thondamuthur, Ukkadam, Gandhipuram, Thudiyalur, and Kalapatti. These results provide insight into the experiences of communities during the epidemic and offer guidance for improving reactions to such emergencies in the future.
Keywords: *COVID-19 pandemic, Community Perceptions, Covaxin & Covidshield attitudes, Public health impact, Coimbatore District survey.*

Date of Submission: 01-07-2025 Date of Acceptance: 09-07-2025

I.Introduction

In December 2019, an outbreak of pneumonia of unknown origin was reported in Wuhan, Hubei province, China. Epidemiological investigations linked several cases to the Huanan Seafood Wholesale Market. Later, scientists found the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) after growing samples from patients in special human cells called Vero E6 and Huh7. Genome analysis revealed that this novel respiratory virus belonged to the beta-coronavirus family, specifically the subgenus Sarbecovirus, closely related to SARS-CoV. On March 12, 2020, the World Health Organization (WHO) declared a global pandemic in response to the rapid spread of SARS-CoV-2 and the mounting deaths caused by COVID-19[1]. The global research and development (R&D) effort for COVID-19 vaccines has been unprecedented in both scope and pace. While traditional vaccine development typically takes over a decade, accelerated processes aimed to deliver vaccines under emergency-use protocols by early 2021, which is a dramatic reduction compared to the 5-year timeline for the first Ebola vaccine. This shift necessitated innovative approaches and rapid scaling of manufacturing capabilities[2]. By January 2022, 114 vaccines were in clinical trials, 75 candidates had completed preclinical testing in animal models, and 48 were in advanced phases of testing. Among these, nucleic acid vaccines emerged as the most promising due to their rapid development and safety profiles. Vaccines from companies such as Pfizer-BioNTech (BNT162b2) and Moderna (mRNA-1273) received approval in the USA and Europe. Other effective vaccines developed include those by Johnson & Johnson, AstraZeneca-University of Oxford, Sinopharm, Dinovac Biotech, Gamaleya, Bharat Biotech, and Novavax. Despite significant technological advancements and fast-tracked processes, large-scale vaccine production faced numerous challenges that needed to be addressed[3]. In India, three vaccines, Covaxin, Covidshield, and Sputnik-V, have been approved for use. This study aims to understand public opinion on vaccination through a survey conducted among residents of five different locations in Coimbatore, Tamil Nadu, India.

II. Covid-19 Pandemic

The coronavirus family consists of thousands of distinct viruses, of which only six—229E, NL63, OC43, HKU1, SARS-CoV, and MERS-CoV—were previously known to cause mild to severe respiratory infections in humans[4]. Two zoonotic viruses that produced severe respiratory sickness and significant fatality rates were the Middle East respiratory syndrome coronavirus (MERS-CoV) and the severe acute respiratory syndrome coronavirus (SARS-CoV). Both viruses originated in animal reservoirs5,6. In December 2019, a novel coronavirus, SARS-CoV-2, was identified in Wuhan, China, marking the beginning of what is now known as coronavirus disease 2019 (COVID-19) [7,8]. Due to its high transmissibility and rapid global spread, the World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020[9,10]. By April 18, 2020, more than 2.1 million confirmed cases and 142,229 fatalities had been reported across 213 countries, regions, and territories[11,12]. Countries with the highest number of cases included the United States, Spain, Italy, Germany, France, the United Kingdom, China, India, Iran, Turkey, Belgium, the Russian Federation, Canada, and Brazil, each reporting over 30,000 cases. Africa, the last continent to report COVID-19 cases, is particularly vulnerable due to its fragile healthcare systems and high prevalence of immunocompromising conditions such as malnutrition, anemia, malaria, HIV/AIDS, and tuberculosis. The first confirmed COVID-19 case in Africa was reported in Egypt on February 27, 2020, and in Nigeria, involving a traveler from Italy[13,14]. By April 18, 2020, the Africa CDC had recorded 19,895 confirmed cases, 1,017 fatalities, and 4,642 recoveries across 52 African nations, with only Comoros and Lesotho remaining virus-free[15]. Interestingly, most African cases were imported from Europe and the United States rather than China, the pandemic's original epicenter[16]. Experts warn that, given Africa's unique vulnerabilities, the pandemic could be particularly difficult to contain and may have devastating consequences[17]. Despite global efforts to contain the virus through precautionary measures such as social distancing, community containment, national lockdowns, and travel restrictions, COVID-19 continues to pose significant challenges. These measures have successfully slowed the spread of the virus but have also triggered severe economic repercussions, pushing many nations into recession[18,19].

III. Etiology of covid-19

Understanding the origins of the SARS-CoV-2 pandemic remains crucial for preventing future outbreaks. Initial studies suggested that the virus likely originated from bats, which are known reservoirs for several coronaviruses (CoVs), including those similar to SARS and MERS[20-24]. Phylogenetic analyses revealed a 96.2% genetic similarity between SARS-CoV-2 and BetaCoV/RaTG13/2013, a coronavirus isolated from bats[25]. Additionally, the SARS-CoV-2 genome shares over 80% similarity with SARS-CoV and 50% with MERS-CoV, confirming its classification within the Betacoronavirus genus, which infects humans, bats, and other wildlife[26,27]. Evidence suggests that SARS-CoV-2 may have been transmitted to humans through an unknown intermediate host. Recent studies using phylogenetic network analysis of 160 full SARS-CoV-2 genomes identified three distinct variants, labeled A, B, and C[28,29].

Type A: The ancestral variant, most closely related to bat coronaviruses, was predominantly found in the United States and Australia.

Type B: Predominant in China and East Asia, differing from Type A by two mutations.

Type C: Found mainly in Europe, with limited overlap with Type B.

While these findings offer insights into the genetic diversity of SARS-CoV-2, the exact origin and transmission pathway remain unclear. Some evidence challenges the initial hypothesis linking the virus's emergence solely to Wuhan, China. To resolve this mystery, further genomic sequencing of samples from potential intermediate hosts such as pangolins, turtles, and snakes is necessary. Globally, over 7,700 SARS-CoV-2 genome sequences have been analyzed, but Africa has contributed only 90 genomes, representing just five of the 51 affected countries[30]. This gap in genomic data poses significant challenges for understanding viral mutations and tailoring vaccines for the continent. The importance of inclusive genomic research is underscored by the example of the rotavirus vaccine, which was developed primarily using strains prevalent in Europe and North America. While effective in these regions, the vaccine demonstrated reduced efficacy in Africa, likely due to strain differences. Similarly, insufficient genomic data from Africa may hinder the development of effective COVID-19 vaccines tailored to the continent's unique viral strains[31,32].

IV. SARS-CoV-2: Structure and Mechanism of Host Entry

Coronaviruses, members of the Coronaviridae family, frequently infect both animals and humans. Among them, four endemic human coronaviruses, HCoV-NL63, HCoV-229E, HCoV-OC43, and HCoV-HKU1, are commonly associated with upper respiratory tract infections and cold-like symptoms. Over the past 20 years, three zoonotic coronaviruses have emerged, causing severe respiratory illnesses in humans: SARS-CoV (originated in China and caused an epidemic in 2003), MERS-CoV (continues to cause sporadic outbreaks in the Middle East), and SARS-CoV-2 (discovered in late 2019 following a cluster of pneumonia cases in Wuhan, China, and identified as the causative agent of COVID-19[33-37].

SARS-CoV-2, which shares 79% genetic similarity with SARS-CoV, belongs to the genus Sarbecovirus[38]. Its genome encodes, Structural proteins: Membrane, nucleocapsid, envelope, and spike glycoproteins, Non-structural proteins: Mainly involved in viral replication and transcription, Auxiliary Proteins: Not essential for replication but often exhibit immunoevasive properties[39-41]. The virus forms an enveloped virion, which is a lipid bilayer derived from the host cell encasing the viral RNA. The spike glycoprotein (S) is pivotal in determining host tropism: The S1 subunit binds to the host receptor angiotensin-converting enzyme 2 (ACE2). The S2 subunit facilitates the fusion of viral and host cell membranes[42,43]. The entry mechanism has receptor binding, membrane fusion, and alternative entry pathways. The S1 subunit of the SARS-CoV-2 spike glycoprotein recognizes and binds to the ACE2 receptor on the target cell surface. This interaction involves the S1-S2 site, which contains a fusion cleavage motif cleaved by host proteases during viral assembly. Following ACE2 binding, the transmembrane serine protease TMPRSS2 cleaves the spike protein at the S2 site, triggering membrane fusion and enabling the viral ribonucleoprotein complex to enter the host cell. In addition to this primary entry mechanism, SARS-CoV-2 can utilize alternative pathways[44-50]. One such route involves endosomal entry, where cathepsins cleave the spike protein in endosomes, though this pathway is less efficient in primary epithelial cells. Furthermore, co-receptors like neuropilin-1 and additional proteases such as cathepsin L, TMPRSS11D, and TMPRSS13 may also play roles in facilitating viral entry, expanding the range of potential host cell targets. By understanding these mechanisms, we gain insight into SARS-CoV-2's infectivity and potential therapeutic targets for disrupting viral entry[50-54].

V. COVID-19 vaccines

The spike (S) protein, particularly in its prefusion (native) form, was identified as the immunodominant antigen of SARS-CoV soon after its emergence in the early 21st century. Analysis of SARS-CoV-2 patients revealed that binding and neutralizing antibodies primarily target the receptor-binding domain (RBD) of the S1 subunit. With this discovery, the key challenge became designing a vaccine to effectively stimulate an immune response against SARS-CoV-2. An optimal response would involve the activation of T-cells, production of neutralizing antibodies, and the avoidance of immune-enhanced disease, a phenomenon where vaccine-induced responses paradoxically worsen disease severity upon viral exposure[55-57]. To achieve these goals, various vaccine prototypes were explored.

The aim of the survey is to analyze the people's opinion on the COVID-19 pandemic, vaccination, and its impacts on them personally and on the society. The principal objectives of the study are to know:

i) The vaccination status of individuals.
ii) The vaccine selection by individuals.
iii) Age and gender as a factor in vaccine selection.
iv) The effects of vaccination, including the post-vaccination effects.
v) The status of COVID-19 infection pre- and post-vaccination.
vi) The impact of vaccination on individuals with existing health conditions.
vii) The awareness about sanitation and masking amongst individuals.
viii) The opinion about the requirement of booster doses.
ix) The opinion about the emerging COVID-positive cases even after the initiation of the vaccination process and following proper sanitation and masking.

VI. Approach and methodology

The survey was conducted in and around Coimbatore district, Tamil Nadu, India. Our survey was conducted at five different places in Coimbatore, including Thondamuthur, Ukkadam, Gandhipuram, Thudiyalur, and Kalapatti. The selection of these places was based on two factors, namely:

i) The busiest areas in Coimbatore.
ii) These places had a higher incidence of COVID-19 cases during the pandemic.
iii) These places were overcrowded, and the migration rate was higher during the pandemic because of the Tamil Nadu Assembly Elections.

50 persons per area were surveyed. A total of 250 people were surveyed for the study. The survey contained a questionnaire of 20 questions. Google Forms was used as a mode for data collection. Google Forms was selected as it is convenient for data compiling, and our team members were involved directly in helping elderly and uneducated people to fill out the forms. The data collection was done only with the consent of each individual. The obtained data were designed as a pie for data analysis. The questionnaire contained 22 questions as listed below:

1. Name
2. Age
3. Gender
4. Place

5. Vaccinated or not?
6. If not vaccinated what is the reason for not getting vaccinated?
7. If vaccinated, name of the vaccine?
8. Month of first dose administration.
9. Month of second dose administration.
10. Number of doses administered.
11. Was there a proper time gap between the doses?
12. Post vaccination effects.
13. Are you taking any medications for pre-existing conditions?
14. Do you have any pre-existing body conditions?
15. Infected with COVID?
16. Do you have any allergies?
17. Did you follow social distancing and masking during COVID-19 pandemic?
18. What was the frequency of hand sanitation during the COVID-19 pandemic?
19. What is your opinion about the requirement of booster doses?
20. What was the reason for you to get vaccinated?
21. What is your opinion about the incidence of COVID-19 positive cases even after the initiation of vaccine administration?
22. Reason for choosing the vaccine type.

VII. Data analysis

The survey data shows that most participants received Covishield or Covaxin vaccines, with common post-vaccination effects including tiredness, body pain, and fever. The majority followed proper vaccination intervals, with some discontinuing due to side effects or logistical issues. Post-vaccination, many individuals reported increased self-interest in health precautions such as mask-wearing and hand hygiene. Overall, vaccination acceptance is high, though concerns about side effects influence some hesitancy.The data analysis from the survey offered comprehensive details about public perceptions, behaviors, and trends regarding COVID-19 vaccination in the Coimbatore district, Tamil Nadu, India **(Table no:1).**

S.No	Varaible	Category	Frequency (n)	Percentage (%)
1.	Vaccination status	Vaccinated	229	91.6%
		Not vaccinated	21	8.4%
2.	Gender	Male	97	38.8%
		Female	153	61.2%
3.	Vaccine type	Covishield	196	85.6%
		Covaxin	46	20.0%
		Other	3	1.2%
4.	Dose completion	One dose	28	12.2%
		Two doses	201	87.7%
5.	Reason for vaccination	Self interest	124	54.1%
		Government rules	41	17.9%
		Restrictions	52	22.7%
		Travelling purposes	10	4.4%
6.	Post- vaccination	Fever	134	58.5%
		Body pain	109	47.6%
		Tiredness	66	28.8%
		Hand pain/other	9	3.9%
		No effects	38	16.6%
7.	Booster dose opinion	Needed	122	53.3%
		Not needed	107	46.7%
8.	COVID infection status	Before vaccination	20	8.7%
		After vaccination	7	3.0%
		Not infected	202	88.2%

9.	Health conditions	None	213		93.0%
		Diabetes	6		2.6%
		Blood pressure	6		2.6%
		Allergies	4		1.7%
10.	Mask usage	Always	218		95.2%
		Rarely/ never	11		4.8%
11.	Hand sanitation	Frequent	216		94.3%
		Rare	13		5.7%
12.	Perceived in COVID cases after vaccination	Reduced	171		74.7%
		Remains the same	51		22.3%
		Increased	7		3.0%
13	Age	Mean	28.7 years	Std deviation	10.2 years

Table no: 1 Descriptive Statistics of Vaccination Survey Respondents

VIII. Discussion

The survey conducted in Coimbatore provides valuable insights into public perceptions, attitudes, and behaviors concerning COVID-19 vaccination and its broader societal impacts. One of the key strengths of this work is its comprehensive approach, analyzing factors such as vaccination status, vaccine preferences, reasons for vaccine acceptance or hesitancy, and adherence to preventive measures like masking and sanitation. The varied demographic composition, including data on age and gender, allows for an understanding of how these factors influence vaccine choices and perceptions.

The findings indicate a high rate of vaccine acceptance, with 91.6% of respondents vaccinated, predominantly with Covishield and Covaxin, reflecting the availability and trust in these vaccines within the community. Post-vaccination effects such as tiredness, body pain, and fever were common but generally mild, aligning with global reports. Notably, awareness and compliance with public health guidelines, including social distancing and sanitization, appeared to improve post-vaccination, suggesting that vaccination campaigns might positively influence health-conscious behaviors.

However, the study also highlights concerns about ongoing COVID-19 cases despite vaccination efforts and the need for booster doses, which mirror global challenges of breakthrough infections and emerging virus variants. Vaccine hesitancy, although relatively low, was influenced by concerns about side effects, logistical issues, and vaccine types.

While the study provides pertinent community-specific data, it is limited by its sample size and geographical scope. Expanding similar surveys to broader regions could enhance the generalizability of these insights. Nonetheless, this work underscores the importance of transparent communication, addressing misconceptions about vaccines, and promoting sustained adherence to preventive measures. Overall, it contributes to the growing understanding needed to optimize public health strategies, enhance vaccine coverage, and prepare for future health crises.

IX. Conclusion

This study provides valuable insights into public opinions on the COVID-19 pandemic, vaccination, and associated effects. Key findings highlighted individuals' vaccination status, preferences for specific vaccines, and factors influencing vaccine selection, including age and gender. The study also explored the direct and indirect effects of vaccination, such as post-vaccination side effects and the impact on individuals with existing health conditions. Furthermore, the survey examined awareness and adherence to preventive measures like sanitation and masking, along with opinions on the necessity of booster doses and concerns over the emergence of COVID-19 cases despite vaccination efforts. The results underscore the need for continued public health education to address vaccine hesitancy, improve adherence to safety protocols, and enhance understanding of vaccination benefits and limitations. By analyzing the relationship between vaccination and infection trends, both pre- and post-vaccination, this study emphasizes the critical role of vaccines in mitigating the severity of COVID-19. However, persistent concerns about breakthrough infections highlight the importance of ongoing research, transparent communication, and tailored vaccination strategies to build public confidence.

These findings provide a foundation for designing targeted interventions and policies to improve vaccination coverage, address public concerns, and ensure preparedness for future public health challenges.

References

[1]. Ciotti, M., Ciccozzi, M., Terrinoni, A., Jiang, W. C., Wang, C. B., & Bernardini, S. (2020). The COVID-19 pandemic. *Critical reviews in clinical laboratory sciences*, *57*(6), 365-388.

[2]. Le, T. T., Andreadakis, Z., Kumar, A., Román, R. G., Tollefsen, S., Saville, M., & Mayhew, S. (2020). The COVID-19 vaccine development landscape. *Nat Rev Drug Discov*, *19*(5), 305-306.

[3]. Gasmi, A., Srinath, S., Dadar, M., Pivina, L., Menzel, A., Benahmed, A. G., ... & Bjørklund, G. (2022). A global survey in the developmental landscape of possible vaccination strategies for COVID-19. *Clinical Immunology*, *237*, 108958.

[4]. Su, S., Wong, G., Shi, W., Liu, J., Lai, A. C., Zhou, J., ... & Gao, G. F. (2016). Epidemiology, genetic recombination, and pathogenesis of coronaviruses. *Trends in microbiology*, *24*(6), 490-502.

[5]. Zhong, N. S., Zheng, B. J., Li, Y. M., Poon, L. L. M., Xie, Z. H., Chan, K. H., ... & Guan, Y. (2003). Epidemiology and cause of severe acute respiratory syndrome (SARS) in Guangdong, People's Republic of China, in February, 2003. *The Lancet*, *362*(9393), 1353-1358.

[6]. Wang, N., Shi, X., Jiang, L., Zhang, S., Wang, D., Tong, P., ... & Wang, X. (2013). Structure of MERS-CoV spike receptor-binding domain complexed with human receptor DPP4. *Cell research*, *23*(8), 986-993.

[7]. Lai, C. C., Shih, T. P., Ko, W. C., Tang, H. J., & Hsueh, P. R. (2020). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. *International journal of antimicrobial agents*, *55*(3), 105924.

[8]. Du Toit, A. (2020). Outbreak of a novel coronavirus. *Nature Reviews Microbiology*, *18*(3), 123-123.

[9]. Announces COVID, W. H. O. (19). outbreak a pandemic. Europe: World Health Organization, 2020 [cited 2020 Apr 18].

[10]. Announces COVID, W. H. O. (19). outbreak a pandemic. Europe: World Health Organization, 2020 [cited 2020 Apr 18].

[11]. Coronavirus disease (COVID-19) outbreak situation. Geneva: World Health Organization, 2020 [cited 2020 Apr 3].

[12]. Moore M, Gelfeld B, Okunogbe A, et al. Identifying future disease hot spots: infectious disease vulnerability Index. Rand Health Q. 2017;6(5).

[13]. COVID, W. (19). Cases Top 10000 in Africa. *WHO. Regional Office for Africa. Available online: https://www. afro. who. int/news/covid-19-cases-top-10-000-africa (accessed on 22 July 2020)*, *19*.

[14]. NCDC. (2020). First case of corona virus disease confirmed in Nigeria. [cited 2020 Mar 11].Available from: https://ncdc.gov.ng/news/227/first-case-of-corona-virus-disease-confirmed-in-nigeria

[15]. COVID, S. A. S. (19). *Dashboard.[Cited 2020 Apr 27]*.

[16]. Ruth, M. (2020). Africa braces for coronavirus, but slowly. *The New York Times*, *20202020*.

[17]. The World Economic Forum. Why Sub-Saharan Africa needs a unique response to COVID-19. [cited 2020 Apr 10].

[18]. United Nations Human Rights. Geneva: COVID-19: Urgent appeal for a human rights response to the economic recession. [cited 2020 Apr 21].

[19]. Richardson, P. (2020). Weekly update: Global coronavirus impact and implications. *Counterpoint Research*.

[20]. Giovanetti M, Benvenuto D, Angeletti S, et al. The first two cases of 2019-nCoV in Italy: where they come from? J Med Virol. 2020;92:518–521. doi:10.1002/jmv.25699

[21]. Paraskevis D, Kostaki EG, Magiorkinis G, et al. Full-genome evolutionary analysis of the novel corona virus (2019-nCoV) rejects the hypothesis of emergence as a result of a recent recombination event. Infect Genet Evol. 2020;79:104212. doi:10.1016/j.meegid.2020.104212.

[22]. Hampton T. Bats may be SARS reservoir. JAMA. 2005;294:2291. doi:10.1001/jama.294.18.2291.

[23]. Banerjee A, Kulcsar K, Misra V, et al. Bats and Coronaviruses. Viruses. 2019;1:E41. doi:10.3390/v11010041.

[24]. Li W, Shi Z, Yu M, et al. Bats are natural reservoirs of SARS-like coronaviruses. Science. 2005;310:676–679. doi:10.1126/science.1118391.

[25]. Zhou P, Yang XL, Wang XG, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020;579:270–273. doi:10.1038/s41586-020-2012-7.

[26]. Wu A, Peng Y, Huang B, et al. Genome composition and divergence of the novel coronavirus (2019-nCoV) originating in China. Cell Host Microbe. 2020;27:325–328. doi:10.1016/j.chom.2020.02.001.

[27]. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020;395:565–574. doi:10.1016/S0140-6736(20)30251-8.

[28]. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020;382:727–733. doi:10.1056/NEJMoa2001017.

[29]. Liu Z, Xiao X, Wei X, et al. Composition and divergence of coronavirus spike proteins and host ACE2 receptors predict potential intermediate hosts of SARS-CoV-2. J Med Virol. 2020 February 26. (Epub ahead of print). doi:10.1002/jmv.25726.

[30]. Forster P, Forster L, Renfrew C, et al. Phylogenetic network analysis of SARS-CoV-2 genomes. Proc Natl Acad Sci U S A. 2020 April 8. (pii=202004999.). doi:10.1073/pnas.2004999117.

[31]. Quartz Africa. Africa's scientists have had to pick testing over genome sequencing for a coronavirus vaccine. [cited 2020 Apr 18].

[32]. Lone, S. A., & Ahmad, A. (2020). COVID-19 pandemic–an African perspective. *Emerging microbes & infections*, *9*(1), 1300-1308.

[33]. Drosten, C. et al. Identification of a novel coronavirus in patients with severe acute respiratory syndrome. *N. Engl. J. Med.* **348**, 1967–1976 (2003).

[34]. Peiris, J. S. et al. Coronavirus as a possible cause of severe acute respiratory syndrome. *Lancet* **361**, 1319–1325 (2003).

[35]. Kuiken, T. et al. Newly discovered coronavirus as the primary cause of severe acute respiratory syndrome. *Lancet* **362**, 263–270 (2003).

[36]. Zaki, A. M., van Boheemen, S., Bestebroer, T. M., Osterhaus, A. D. & Fouchier, R. A. Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. *N. Engl. J. Med.* **367**, 1814–1820 (2012).

[37]. Zhu, N. et al. A novel coronavirus from patients with pneumonia in China, 2019. *N. Engl. J. Med.* **382**, 727–733 (2020).

[38]. Coronaviridae Study Group of the International Committee on Taxonomy of Viruses. The species *Severe acute respiratory syndrome-related coronavirus*: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat. Microbiol.* **5**, 536–544 (2020).

[39]. V'Kovski, P., Kratzel, A., Steiner, S., Stalder, H. & Thiel, V. Coronavirus biology and replication: implications for SARS-CoV-2. *Nat. Rev. Microbiol.* **19**, 155–170 (2021).

[40]. Wong, L. R. & Perlman, S. Immune dysregulation and immunopathology induced by SARS-CoV-2 and related coronaviruses - are we our own worst enemy? *Nat. Rev. Immunol.* **22**, 47–56 (2022).
[41]. Redondo, N., Zaldivar-Lopez, S., Garrido, J. J. & Montoya, M. SARS-CoV-2 accessory proteins in viral pathogenesis: knowns and unknowns. *Front. Immunol.* **12**, 708264 (2021).
[42]. Hulswit, R. J., de Haan, C. A. & Bosch, B. J. Coronavirus spike protein and tropism changes. *Adv. Virus Res.* **96**, 29–57 (2016).
[43]. Zhou, P. et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* **579**, 270–273 (2020).
[44]. Hoffmann, M. et al. SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. *Cell* **181**, 271–280 e278 (2020).
[45]. Li, W. et al. Angiotensin-converting enzyme 2 is a functional receptor for the SARS coronavirus. *Nature* **426**, 450–454 (2003).
[46]. Beumer, J. et al. A CRISPR/Cas9 genetically engineered organoid biobank reveals essential host factors for coronaviruses. *Nat. Commun.* **12**, 5498 (2021).
[47]. Mykytyn, A. Z. et al. SARS-CoV-2 entry into human airway organoids is serine protease-mediated and facilitated by the multibasic cleavage site. *eLife* **10**, e64508 (2021).
[48]. Lamers, M. M. et al. Human airway cells prevent SARS-CoV-2 multibasic cleavage site cell culture adaptation. *eLife* **10**, e66815 (2021).
[49]. Hoffmann, M. et al. Chloroquine does not inhibit infection of human lung cells with SARS-CoV-2. *Nature* **585**, 588–590 (2020).
[50]. Cantuti-Castelvetri, L. et al. Neuropilin-1 facilitates SARS-CoV-2 cell entry and infectivity. *Science* **370**, 856–860 (2020).
[51]. Daly, J. L. et al. Neuropilin-1 is a host factor for SARS-CoV-2 infection. *Science* **370**, 861–865 (2020).
[52]. Hoffmann, M. et al. Camostat mesylate inhibits SARS-CoV-2 activation by TMPRSS2-related proteases and its metabolite GBPA exerts antiviral activity. *EBioMedicine* **65**, 103255 (2021).
[53]. Wei, J. et al. Genome-wide CRISPR screens reveal host factors critical for SARS-CoV-2 infection. *Cell* **184**, 76–91 e13 (2021).
[54]. Lamers, M. M., & Haagmans, B. L. (2022). SARS-CoV-2 pathogenesis. *Nature reviews microbiology*, *20*(5), 270-284.
[55]. Du L, He Y, Zhou Y, et al. The spike protein of SARS-CoV—a target for vaccine and therapeutic development. *Nat Rev Microbiol*. 2009;7(3):226-236.
[56]. Premkumar L, Segovia-Chumbez B, Jadi R, et al. The receptor binding domain of the viral spike protein is an immunodominant and highly specific target of antibodies in SARS-CoV-2 patients. *Sci Immunol*. 2020;5(48):eabc8413.
[57]. Tseng CT, Sbrana E, Iwata-Yoshikawa N, et al. Immunization with SARS coronavirus vaccines leads to pulmonary immunopathology on challenge with the SARS virus. *PLoS One*. 2012;7(4):e35421.