

**EXPLORING URBAN DIMENSIONS OF COVID-19
MITIGATION STRATEGIES IN DIFFERENT
COUNTRIES**

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**Ansumana Fallay COOMBER: EXPLORING URBAN DIMENSIONS OF COVID-19
MITIGATION STRATEGIES IN DIFFERENT COUNTRIES**

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ABSTRACT

The globe was alerted to the first instance of COVID -19 on December 31, 2019, in Wuhan, China. A sickness that could be passed from person to person as well as through the air. The urban spaces we live in were not prepared for such a pandemic and in no time it spread globally. The spaces used by humans had to be altered to allow human interaction to continue. This had many drawbacks and in short, the world that humanity knew before would change for years to come. With no cure in sight and vaccinations being produced and tested all over the world, every city deployed some type of urban containment measures to stop the virus from spreading. The cities of Chicago, Jakarta, Auckland, Nicosia, and Guangzhou are investigated in this thesis to determine the efficiency of established urban containment measures concerning the city and what can be done to enhance them. This thesis examines previous pandemics with similar characteristics to COVID -19, the impact of COVID -19 on the cityscape, non-pharmaceutical measures, recent trends in city responses to the virus, and some urban solutions that have proven effective in combating the virus using a systematic approach. The unique characteristic of each city is mentioned together with the mitigation strategy employed and an assessment of why they performed good or bad is presented. The data for the study was acquired from similar academic papers and trusted websites with updated information for academic papers. The results show that there are cities that can eradicate COVID -19 as they were able to contain it and stop its spread. The urban landscape of cities that are decentralized, with low population density, access to artificial intelligence and technological advances proved to be very effective in fighting the epidemic. It also shows how a good economy that is evenly distributed can support the effective implementation of urban containment strategies. Further studies to prove this concept are recommended.

Keywords: COVID-19, urban space, mitigation measure, decentralization,

ÖZET

Dünya, 31 Aralık 2019'da Çin'in Vuhan kentinde COVID-19'un ilk vakası ile alarına geçti. Bu insandan insana ve hava yoluyla bulaşabilen bir hastalıktı. Yaşadığımız kentsel alanlar böyle bir pandemiye hazırlıklı değildi ve kısa sürede tüm dünyaya yayıldı. İnsanlar tarafından kullanılan alanların, insan etkileşiminin devam edebilmesi için değiştirilmesi gerekiyordu. Bunun birçok dezavantajı vardı ve kısacası insanlığın daha önce bildiği dünya gelecek yıllarda değişecekti. Görünürde bir tedavi olmadığı ve tüm dünyada aşılar üretilip test edildiği için, her şehir virüsün yayılmasını durdurmak için bir tür kentsel sınırlama önlemleri uyguladı. Bu tezde Şikago, Jakarta, Auckland, Lefkoşa ve Guangzhou şehirleri yerleşik kentsel çevreleme önlemlerinin etkinliğini ve bunları geliştirmek için neler yapılabileceğini belirlemek için araştırılmıştır. Araştırma, COVID -19'a benzer belirtilere sahip önceki pandemileri, COVID -19'un şehir yapısı üzerindeki etkisini, ilaç içermeyen önlemleri, şehirlerin virüse verdiği tepkilerdeki son eğilimleri ve virüsle mücadelede etkili olduğu kanıtlanmış sistematik bir yaklaşım kullanan bazı kentsel çözümleri incelemektedir. Kullanılan azaltma stratejisi ile birlikte her şehrin kendine özgü karakteristiklerinden bahsedilmiş ve neden iyi veya kötü performans sergilediklerine dair bir değerlendirme sunulmuştur. Çalışmanın verileri, benzer akademik makalelerden ve akademik makaleler için güncellenmiş bilgiler içeren güvenilir web sitelerinden elde edilmiştir. Sonuçlar, COVID-19'u kontrol altına alabildikleri ve yayılmasını durdurabildiklerinden dolayı bu hastalığı ortadan kaldıracabilecek şehirler olduğunu göstermektedir. Merkezi olmayan, nüfus yoğunluğu düşük, yapay zekaya erişim ve teknolojik gelişmelere daha az sahip şehirlerin kentsel yapısının salgınla mücadelede çok etkili olduğunu kanıtlanmıştır. Aynı zamanda, eşit olarak dağıtılmış iyi bir ekonominin, kentsel çevreleme stratejilerinin etkin bir şekilde uygulanmasını nasıl destekleyebileceğini de göstermektedir. Bu bakış açısını kanıtlamak için daha fazla araştırma yapılması önerilmektedir.

Anahtar Kelimeler: COVID-19, kentsel alan, azaltma önlemi, merkeziyetsizlik.

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LIST OF ABBREVIATIONS

| | |
|--------------------|--|
| AI : | Artificial Intelligence |
| AQI : | Air Quality Index |
| BBC : | British Broadcasting Cooperation |
| COVID -19 : | Coronavirus Disease |
| CSSE : | Centre for Systems Science and Engineering |
| DOT's : | Directly Observed Treatment |
| GDP : | Gross Domestic Product |
| H5N1 : | Highly Pathogenic Avian Influenza A Virus |
| ICTs : | Information Communication Technologies |
| IMF : | International Monetary Fund |
| MERS : | Middle East Respiratory Syndrome |
| NIC : | National Infrastructure Commission |
| NMT : | Non-motorized Transportation |
| NYC : | New York City |
| OWID : | Our World in Data |
| RNA : | Ribonucleic Acid |
| SARS : | Severe Acute Respiratory Syndrome |
| SDGs : | Sustainable Development Goals |
| UK : | United Kingdom |
| UN : | United Nations |
| UNEP : | United Nations Environmental Program |
| WHO : | World Health Organization |
| WMO : | World Meteorological Organization |
| WWII : | World War Two |
| AR : | Augmented Reality |
| BEA : | Bureau of Economic Analysis |
| BRTs : | Bus rapid Transits |
| CBD : | Central Business District |
| CDPH : | Chicago Department of Public Health |
| CG : | Computer Generated |

| | |
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| CNY : | Chinese New Year |
| CSA : | Central Statistical Agency |
| HGH : | Human Growth Hormone |
| HIV-c-V : | Human Immunodeficiency Virus |
| KKTC : | Kuzey Kıbrıs Türk Cumhuriyeti |
| NPIs : | Non-pharmaceutical Inventions |
| NZ : | New Zealand |
| OECD : | Organisation for Economic Co-operation and Development |
| PUA : | Primary Urban Area |
| REINZ : | Real Estate Institute of New Zealand |
| TTT : | Testing, Tracking and Tracing |
| USA : | United States of America |
| VR : | Virtual Reality |

CHAPTER 1

INTRODUCTION

Throughout history, urban forms have been affected by disease and health. It is natural to assume that when large groups of people dwell together, the chances of new transmittable illnesses become stronger. The effects of a pandemic on cities is not a new topic as it has long urban history itself (Colomina, B. (2019). The covid-19, however, is the first time that a collective global response with strong spatial dimensions has been observed. Hence, exploring the effects of the pandemic on urban space might help to create guidelines for future pandemics. Urban settlements are places for the accumulation of the human population, hence, they are critical grounds for the spread of viral diseases. This thesis explores the spatial dimensions of the fight against a pandemic and its relation with urban characteristics and forms. This chapter illustrates an outline of the thesis and its related materials and methods.

1.1 Background to the Study

From the end of December 2019 to May 2021, the world has been struggling to find a cure for the COVID-19 pandemic. The world as has been designed was not fully prepared to handle the pandemic and as with the previous pandemic, the citizens of the world have had to adjust their ways of living around the prevention and transmission of the virus.

Every sector of the world is currently working to find a cure or solution in their different fields. As currently there has been no pharmaceutical cure to the virus the most popular preventive strategy employed to prevent the spread of the virus is employing social distancing. This has created many different approaches in urban cities around the world by urban planners to achieve the principle behind social distancing. Social distancing comes with its share of inconveniences to the way people are used to living their lives so different governments and cities use different strategies to bring the least strain upon their economy and the citizens. In the research, these methods used to mitigate the spread of the current pandemic have been investigated and some cities have been studied along with the methods they employed to mitigate the spread of the virus. The main method used for the paper is

systematic analysis. Scholarly articles, journals, newspapers, videos, and government websites

for the report of the state of the country during the pandemic have been used to properly investigate the issue. The information about the cases of each country has been Sourced from (*Our World in Data*, n.d.) to make it as fair as possible. (*Our World in Data*, n.d.), is a trusted open Source website that collects information about every global problem in the world and makes it accessible on one page.

1.2 Aims

Covid-19 pandemic pushed the global communities into unprecedented despair. The circumstances of the pandemic have affected the socio-spatial and socio-economic life of the cities among many other aspects. Governments all across the world are attempting to restore the status quo, but it is proving tough and sluggish. The current pandemic has shown that public space is of big importance to humanity. Urban planners, architects, and every other profession all over the world are busy finding a different solution to make these public spaces accessible to the public once again. Governments in cities around the world are employing one or a combination of these methods to give their citizens access to these public spaces while keeping them safe from the COVID-19 pandemic. The aim is to investigate the urban methods currently employed and with the aid of data from different cities trying to combat the spread, understand the effectiveness of these methods, the different variations of their employment, and discover how to make them more effective. This thesis is looking into the urban design solutions that can be employed in the planning and building of cities to reduce or prevent the spread of diseases that will cause a pandemic.

1.3 Research Question

1. What are the current and most non-pharmaceutical strategies employed to prevent and eliminate the spread of the current pandemic?
2. What methods are cities using to mitigate the spread of the virus in their urban spaces?
3. What is the most common approach used by each city and what are the variables in their execution if any?
4. What is the best and most effective urban mitigation strategy to prevent the spread of the virus

1.4 Objectives

1. Research into the current and most popular non-pharmaceutical urban strategies employed to prevent and eradicate the spread of the pandemic.
2. Study the cities to understand the different methods they have employed to mitigate the spread of the current pandemics and assess the success level of each country.
3. From the research done, try to understand the most common mitigation strategy and the various ways in which different cities would execute these measures.
4. Discover the best and most effective urban mitigation strategy used to prevent the spread of the current pandemic.

1.5 Research Method

For this study, the research method used is systematic analysis. It is a method of bringing together the bits and pieces of knowledge available to get a comprehensive view of what is going on in the local community (wherever it could be), as well as cultures and environments around the world. Knowledge (that is, what teaches us) may come from a variety of places and in a variety of forms: personal experiences, other people's experiences, information from the media and science, thoughts and emotions, and so on. To keep the study as consistent as possible, the main data used to compare the status of the global pandemics amongst the cities selected was Sourced from (Our World in Data, n.d.). Our World in Data (OWID) is an online science journal that reports on major global issues such as poverty, obesity, malnutrition, climate change, conflict, existential threats, and injustice (Our World in Data n.d.). The online publication illustrates research results with dynamic charts and maps, frequently using a long-term perspective to demonstrate how global living conditions have evolved. Other Sources such as scholarly articles, newspaper articles, government announcements, local websites, etc. have been used to gather information for the study. Such references are referenced where necessary to demonstrate where they came from.

1.6 Research Scope and Limitation

The study looked at some of the mitigation strategies and methods applied by different cities for the current pandemic. The methods and strategies in question here are strictly non-pharmaceutical. The research was focused on urban strategies employed to mitigate the

spread of the COVID-19 pandemic. The urban strategy referred to any strategy that had some form of spatial dimension to it.

Some of the cities studied in this research have a better-documented database than others so it was easier to find all the urban strategies employed as compared to other cities.

The analysis does not take into account the cities' various climatic data and how they could influence the findings.

CHAPTER 2

LITERATURE REVIEW

This chapter explores the existing literature on the topic of cities and pandemics. First, the past pandemics and their effect on city life have been explored. Second, the emerging literature around the COVID-19 outbreak is explored. The analysis and studies targeting the 2020 pandemic have been unprecedented in the scientific communities. Many aspects of everyday life have been addressed and explored. The chapter tries to address some of these emerging discussions concerning urban space.

2.1 Brief Background

Imagine living in a world that contains all the sicknesses and diseases of the current world but a redesigned urban space that is so designed to prevent the transmission of any disease.

Sars, Mers, Ebola, Avian flu, Swine flu, and now Covid-19 have all been observed in the twenty-first century effecting the lives and wellbeing of humankind. How may we construct future cities such that the outdoors does not become a no-go zone but remains a safe and inhabited environment if we have reached a pandemic era? (BBC Future, 2021, How Do You Build a City for a Pandemic.) The world has faced quite a lot of adversities in the form of pandemics caused by diseases. It is hard to argue with the logic that if humanity can become immune to the diseases he can nullify the need to redesign his space just to ensure his continued survival. The truth of the matter is that we are very far from such a future and what we can do now is to take precautionary measures until a more sustainable solution is available.

2.1.1 Different Pandemics and Their Mode of Transmission

i. Avian Influenza

More accurately identified as H5N1 by the World Health Organization, bird flu has killed nearly 60 percent of all those infected. It is the most common form of bird flu. The virus, which is spread from birds to humans, is transmitted through direct contact with an infected bird. The mouth, eyes, nostrils, and droppings of these infected birds are known to contain the virus and once a human is exposed to any of these, they are at risk of getting the virus. Given how the population of poultry has increased over the years this was certainly a very

worrying situation. Influenza is an infectious disease produced by RNA viruses that typically manifest as respiratory signs and symptoms. Influenza viruses with influenza A strains have the greatest impact on humans. A diversified pool of viruses found in aquatic wild bird populations, known as avian influenza (AI) viruses, serves as a natural reservoir for influenza A strains (Facts about Human Avian Influenza, n.d.).

ii. Middle East Respiratory Syndromes (MERS)

This is an illness caused by a virus. It has very similar signs and symptoms as the current Covid-19 pandemic because it is a form of coronavirus. Patients have been known to develop severe respiratory symptoms of fever, cough, and shortage of breath. It was first discovered in the year 2012 in Saudi Arabia. It is believed to be a zoonotic virus. The mode of transmission for MERS is through close contact with an animal (dromedary camels) or persons infected with the virus. Currently, there is still no cure for this type of coronavirus but the preventive measures are very similar to that of Covid-19.

iii. Severe Acute Respiratory Syndrome (SARS)

The SARS-associated coronavirus causes a viral respiratory illness. This outbreak first started in February 2003 originating in China and later spreading to four other countries. It is an airborne disease and droplets of it in the air in the form of saliva are enough to make it communicable from one person to another. It thrives in cold weather. It is believed to be the first readily transmissible disease in the 21st century. Transmission via contact with surfaces that contain the virus is also possible. As of May 2021, there is no vaccine for the treatment of SARS. There are preventive measures that circle increased hygienic measures and avoiding contact with infected victims.

iv. Ebola

A very rare but also very deadly virus that is caused by fever, body aches, and diarrhoea. It targets the immune system of the body and would destroy the cells that prevent blood-clotting and this would lead to internal and external bleeding and eventually death. It has a kill rate of 90 percent of anyone it infects. The mode of transmission is through contact made with the fluids of an infected person or animals. Symptoms of Ebola are very similar to that

of flu and would include high fever, headache, joint and muscle aches, sore throat, weakness, stomach pain, and lack of appetite. Currently, there is no cure for Ebola and the only way of preventing the spread is to take a precautionary measure such as dissociating with anyone or any place known to contain the virus.

v. Covid-19

The first cases of COVID-19 were reported in December of 2019 in Wuhan, People's Republic of China. The symptoms are more like that of severe cold and would include fever, cough, and fatigue. Shortness of breath, lack of appetite, disorientation, persistent discomfort or pressure in the chest, and, most typically, a high body temperature are more serious Covid-19 symptoms (above 38 degrees Celsius). The majority of persons who have symptoms (about 80%) recover without the need for hospital care. About 15% get very ill, requiring oxygen, and 5% become critically sick, necessitating intensive care (Coronavirus Disease (COVID-19), n.d.). The most common form of transmission is through droplets in the air that are contacted by people who are in close contact with each other. For this reason, the current solution to prevent the spread of this virus is social distancing. Use of a mask and regularly disinfecting our spaces is also recommended.

2.1.2 Why Covid-19 Is More Severe Than Previous Pandemics?

The world has suffered from different pandemics but very few have been as deadly as COVID-19. Flu and airborne diseases have been around for a long time now and the world has been battling it well for some time now. COVID-19 comes with it some specific traits that make it one of the most deadly form of flu ever. Figure 2.1 below shows a summary of why COVID-19 is more dangerous than the normal influenza that the world has come to know and live with.

A major contrast between the two viruses is their rate of transmission. Influenza has a shorter median incubation period (time between infection and start of symptoms) and a shorter serial interval (time between successive cases) than COVID-19 virus. The estimated serial interval between COVID-19 viruses is 5-6 days, whereas the predicted serial interval between influenza viruses is 3 days. This suggests that influenza has a higher transmission potential than COVID-19.

Additionally, transmission during the first three to five days of illness, or even pre-symptomatic transmission – the spread of the virus before to the development of symptoms – is a key driver of influenza transmission. By contrast, while we are learning that some individuals can shed COVID-19 virus 24–48 hours prior to developing symptoms, this does not appear to be a substantial driver of transmission at the time.

While both viruses cause a similar range of symptoms, the percentage of individuals who develop serious disease appears to be different. According to COVID-19 infection data thus far, 80% of infections are mild or asymptomatic, 15% are severe and require oxygen, and 5% are critical and require breathing. These percentages of severe and critical infection would be higher than those observed for influenza infection.

COVID-19 appears to be more lethal than influenza, especially seasonal influenza. While it will take time to fully understand COVID-19's true mortality, available data indicate that the crude mortality ratio (number of reported deaths divided by the number of reported cases) will be between 3-4 percent, while the infection mortality rate (number of reported deaths divided by the number of infections) will be lower. Although seasonal influenza mortality is frequently far below 0.1 percent, access to and the quality of health care have a significant impact on death.

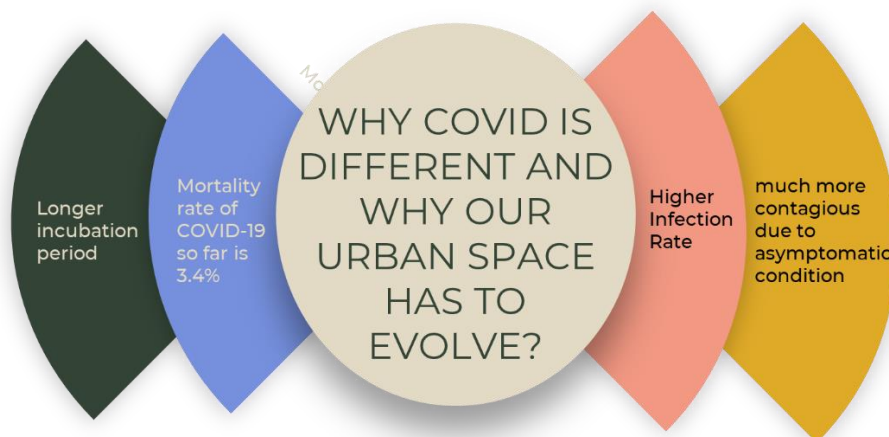


Figure 2.1: Severity of COVID-19. SOURCE: Author

2.2 The Effects of the Pandemic on the Urban Space

With the pandemics of recent years, one very common thing is their preventive measures. It is suggested that people practice some form of social distancing to prevent the spread of the virus or disease. This in one way or the other has led to humanity modifying his lifestyle and

with this modification comes to some benefits as well as downsides. In a world where avid shoppers have been restricted to shop from behind the screens of their electronic devices, board meetings are held online and university students can no longer walk along the corridors of their library but are forced to access it remotely there is going to be both an advantage and a disadvantage to this lifestyle. For this topic, we would be looking into four major criteria. These as demonstrated in figure 2.2 are; environmental impacts, socio-economic impacts, transportation, and urban impacts, and administrative impacts.

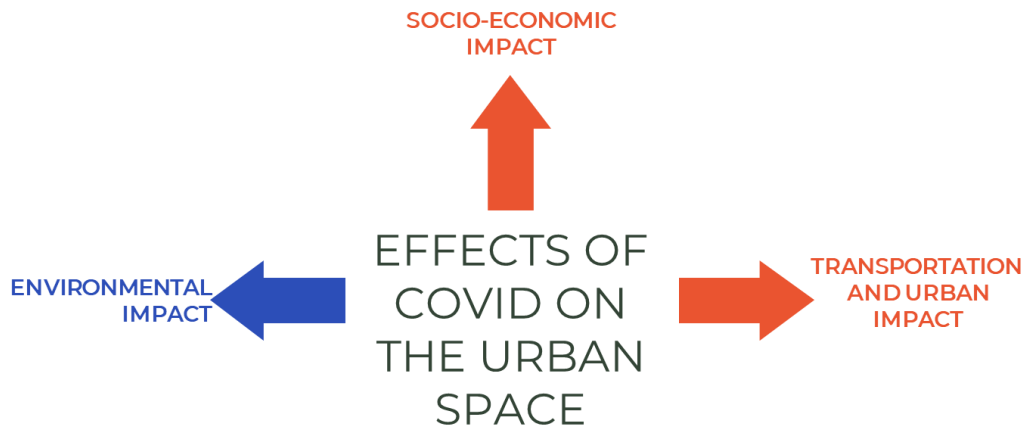


Figure 2.1: the effects of COVID-19 on the urban space. SOURCE: Author

2.2.1 Environmental Impacts

The results are immediately transferred to the built community while the guideline for residents of urban communities to exercise social distancing is followed. Humans getting into contact with other humans is a natural way for pandemics to spread. Limiting the number of people who can congregate in one place means fewer people can come into contact with whatever illness or disease is in the air at the moment. Also, by doing so, we are reducing the number of resources they would have to use to get access to the room. Environmental conditions such as air quality, water quality, and other environmental factors are impacted.

The virus's persistence on infected surfaces and/or airborne dispersion can be influenced by environmental factors (Zoran et al., 2020a). The literature will look into several environmental and climatic parameters such as temperature, humidity, wind speed, and emission levels. There have been varied results when it comes to the influence of temperature. According to certain data from China, Brazil, and Italy, lower temperatures are

more favourable to viral transmission Lin et al. (2020) discovered a negative and exponential relationship between transmission and the number of confirmed cases from the Johns Hopkins University Centre for Systems Science and Engineering (CSSE) data repository, as well as meteorological data from the World Meteorological Organization (WMO) global telecommunications system ground-based monitoring network.

To prevent the virus from spreading and to reduce the number of people who died, the governments of most of the nations impacted began imposing travel restrictions. Except for emergency services (e.g., medical, fire, police, food supply, and so on), all other organizations, including educational institutions, are closed to allow people to remain at home. All public transportation services (e.g., buses, trucks, trains, aircraft, etc.) were suspended save for the evacuation of crucial goods and emergency services (Tripathi, 2020). Italy established the most severe travel restrictions following WWII (Cellini et al., 2020). London's regularly bustling cafés, restaurants, and theatres have been closed, and citizens have been advised to remain at home.

Overall, the pandemic has caused widespread worldwide socioeconomic upheaval and has had a direct or indirect influence on the environment, including enhanced air and water quality, pollution management, and ecological regeneration (Chakraborty and Maity, 2020; Somani et al., 2020; Saadat et al., 2020).

i. Quality of The Air

Pollution has for the longest time being a worry of man. Our dependency on fossil fuels and the environment has led to the release of some very harmful gases into our atmosphere. A major contributing agent of this is our means of transportation. People have to go to work, children have to go to school, humanity needs electricity, packages have to be delivered and factories have to run and produce some of the desired needs and wants of man. One thing they all have in common is their reliance on fossil fuel for energy for their operation. Most cars, buses, trains, etc. use some form of energy that gives off harmful gases into the atmosphere that will end up causing pollution. With pandemics limiting the mobility of humans, this means that few people will have to travel and hence fewer of these manmade creations that rely solely on these harmful gases for their energy are used. This translates directly to better air quality.

When compared to the preceding three years, PM_{2.5}, PM₁₀, and NO₂ concentrations declined by 31%, 61%, and 33% during the COVID-19 epidemic. The PM_{2.5}/PM₁₀ ratio, in an instance, dropped by 24.5 percent when social distancing was implemented, indicating a reduction in anthropogenic emissions. Furthermore, the air quality index (AQI) has greatly improved, with an emphasis on limiting exposure to vulnerable groups. (2020, Seo et al.)

ii. Quality of the Water

According to literature and data from research made by other researchers, the current epidemic of Covid-19 has seen a positive impact relating to water quality. Lockdowns have enhanced water quality in general by decreasing pollution of upstream and downstream water Sources. Non-point pollution Sources such as NO₂, SO₂, and NH₃ are less affected in headwaters that are generally located far from cities due to lower human activity. Sharifi and Khavarian-Garmsir (Sharifi & Khavarian-Garmsir, 2020).

Amidst these positive reports lingers the fear of what can happen in the future. There is the question of humans not polluting the water with chemicals that will be used in the treatment of the current epidemic. More so than polluting our natural water with strains of the current epidemic is how we can improve on the current wastewater treatment to reduce the possibility of transmitting the current epidemic through our wastes.

2.2.2 Socio-Economic Impacts

According to the UN Framework for the Immediate Socio-Economic Response to the COVID 19 Crisis, "the COVID-19 pandemic is much more than a health crisis: it is affecting communities and economies at their core." While the impact of a pandemic would vary depending on where it happens, it will almost surely aggravate global vulnerability and inequality, emphasizing the need for the SDGs. The impact of the COVID-19 problem on individuals, markets, and disadvantaged groups must be evaluated to advice and change government and partner solutions to the problem, ensuring that no one is left behind.

Unless quick socioeconomic remedies are implemented, global poverty will grow, putting lives and livelihoods in peril for years to come. In this case, quick planning responses with an eye on the future are critical. Current policies, as well as the money they receive, can have an impact on a country's long-term economic trajectory.”

i. Social Impacts

Pandemics have historically hurt minorities and those at the bottom of the socioeconomic ladder (Wade, 2020; Duggal, 2020). Because of their increased risk perception, economic constraints, and restricted access to healthcare, they are more likely to have pre-existing diseases (Wade, 2020). The fast development of COVID-19 has brought to light some of these long-standing issues and injustices (Kihato and Landau, 2020). According to recent data from New York City, Black and Latino's inhabitants have a mortality rate that is double that of White ones (Wade, 2020). COVID-19 has disproportionately impacted minorities and other vulnerable populations, such as the urban poor. COVID-19 transmission in slums is difficult, if not impossible, to control due to a combination of factors including high population density, a lack of access to basic infrastructure, and low incomes. Encouragement of social seclusion and quarantine measures might be advantageous (Wasdani and Prasad, 2020). Lack of access to medical services (e.g., hospital beds) and essential utilities like clean water to comply with handwashing standards exacerbates the issue in slums and informal settlements (Biswas, 2020; de Oliveira and de Aguiar Arantes, 2020). Furthermore, unstable economic situations and the fact that many communities (for example, in Sub-Saharan Africa) rely on close social links for survival make "stay home" commands difficult to enforce (Kihato and Landau, 2020; Finn and Kobayashi, 2020). In general, there are fears that inequality would not only make it impossible to contain the virus but will also encourage it to spread. As a result, social distancing tactics must be connected to economic aid systems. The current Covid-19 pandemic has had a devastating impact on the community's mental and social health. As a result of their exposure, youngsters, college students, and healthcare employees are more likely to acquire post-traumatic stress disorder, anxiety, depression, and other distress symptoms, according to research. People's connections and sentiments of empathy for others have been influenced by psychological isolation and security laws (Saladino et al., 2020). SARS, Ebola, H1N1, Equine Flu, and the most recent COVID-19 pandemics have all shown that the psychological repercussions of infection and confinement extend far beyond the fear of catching the virus (Barbisch et al., 2015). Any aspect of the pandemic, such as isolation from loved ones, a lack of rights, a sense of powerlessness, and misunderstandings about the disease's progression, has a greater impact on society (Li and Wang, 2020; Cao et al., 2020). These factors have far-reaching ramifications (Weir, 2020), such as an increase in suicides (Kawohl and Nordt, 2020). In light of these ramifications, a comprehensive assessment of the quarantine's positive effects is necessary, taking into

consideration the perceived stress costs (Day et al., 2006; Mazza et al., 2020). The growth in the severity of social conflicts is another issue that has been discussed in several papers. Migrants' freedom of movement has been impeded by stigmatization, which has resulted in mental health difficulties (Castillo and Amoah, 2020; Zhang, 2020). Pandemics have generated social differences between migrant groups and host communities in China and Hong Kong, for example (Castillo and Amoah, 2020; Zhang, 2020). As a result, COVID-19 response and control mechanisms mustn't result in human rights breaches, discrimination, classism, or pro-rich government (Kihato and Landau, 2020; Finn and Kobayashi, 2020). Although the majority of the literature presented focuses on the potential consequences, some promising examples of collective creativity and teamwork have been addressed as well. In Lisbon, Portugal, civic protests and community-driven events have sprung up in response to the pandemic to resolve social inequality and housing problems (Mendes, 2020). Ultimately, the pandemic revealed inequality and social fault lines that occur in many countries, making pandemic preparation, reaction, and recovery difficult.

ii. Economic Impact

The extent of the economic impacts of the covid-19 are still unfolding and might be influencing cities in years to come. From the large-scale demise of the industry and city's income to individuals losing their jobs, houses, and livelihood, the covid-19 pandemic has affected the economic aspects of cities. Many of these economic impacts are caused by the de-population processes of public spaces that are the engine of the micro-economy. It can be assumed that proper anti-disease urban policies can allow for urban space to keep some of its functionalities in potential similar events in the future.

a. The Impact on Countries Economy

The COVID-19 pandemic's long-term economic shutdowns have wreaked havoc on the city's infrastructure. The ramifications are many and appear on a variety of scales. While further research is needed, preliminary results suggest that the epidemic has had a substantial impact on city tax revenues, resident jobs, hospitality and tourism, micro-enterprises, the urban supply of services, and foreign workers. Furthermore, a growing body of study has focused on the pandemic's uneven and unequal socioeconomic and geographical impacts. COVID-19 is being contained and lives are being saved as a result of it. However, that has come at the expense of economic growth (Stannard et al., 2020) According to (Stannard et

al., 2020) each of the COVID-19 warning thresholds was estimated to have a direct effect on GDP. Under warning level 1, the effect ranges from a 4% reduction in GDP to a 37% reduction in GDP under alert level 4 (Stannard et al., 2020). The influence is not evenly distributed across the country, with some industries, such as tourism, being more severely impacted than others (Stannard et al., 2020). As the virus spreads through cities, they each go into different phases of lockdowns and apply different measures but as they do this, they experience a reduction in their GDP. Figure 2.3 shows an average on a global scale how much percentage of the GDP that cities lose at each alert level. Figure 2.4 shows the percentage drop in the economy of cities on a global scale.

TABLE 1: GDP REDUCTION WHILE COVID-19 ALERT LEVELS ARE IN PLACE

| Alert level | GDP reduction (%) |
|-------------|-------------------|
| 1 | 3.8 |
| 2 | 8.8 |
| 3 | 19 |
| 4 | 37 |

Figure 2.3: GDP Reduction. Source: (Stannard et al., 2020)

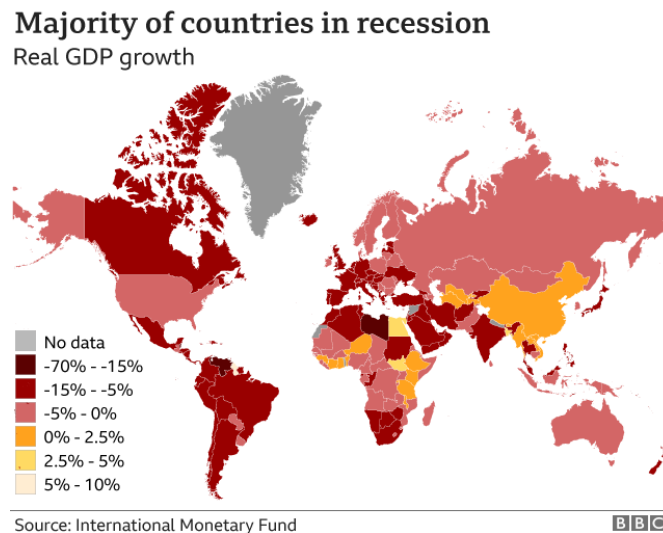


Figure 2.4: Countries in Recession. Source: International Monetary Fund

b. The Impact on Travel and Tourism

Worldwide travel bans and 'stay at home' policies have posed unprecedented obstacles to tourism-dependent cities. These cities have been hit particularly hard by the global economic downturn (de Oliveira and de Aguiar Arantes, 2020; Earl and Vietnam, 2020). The

pandemic, according to Rutynskyi and Kushniruk (2020), reduced tourism in L'viv, Ukraine by 40 to 60%. They calculated that a drop in visitor numbers of 1–1.5 million would result in financial losses ranging from 80 to 135 million euros. Figure 2.5 shows some destination countries in the world for tourists and the percentage drop in touristic activities in each country. This is as a result in the reduction of movement of people especially with flights as seen in Figure 2.6.



Figure 2.5: Global Tourism. Source: (See Transparent, 24 January 2020)

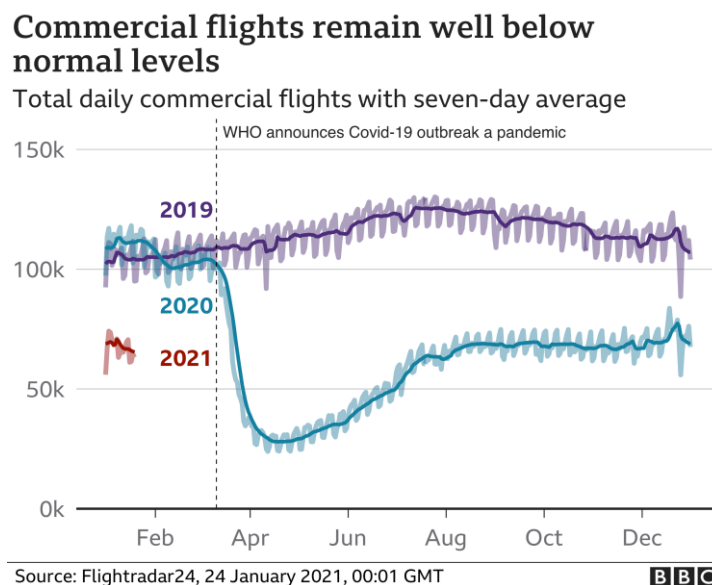


Figure 2.6: Commercial Flight Pattern. Source (Flightradar24, 24 January 2021)

c. The Impact on Global Shopping

The global COVID-19 epidemic has had a significant impact on cultures and economies all around the world, affecting many sectors of society in a variety of ways. This one-of-a-kind circumstance has had a significant impact on customers' everyday lives, as well as a significant shift in the way businesses and consumers interact (Donthu and Gustafsson, 2020; Pantano et al., 2020). According to polls performed since the first rise, consumers throughout the world are viewing goods and companies through a different lens (Accenture, 2020; McKinsey, 2020).

Most shoppers, for example, have been forced to switch to internet ordering, home delivery, or cashless payment as a result of the unprecedented containment policies, which they had never contemplated before (Pantano et al., 2020). Retailers and advertisers, as well as industry and public policymakers, must understand consumers' shopping behaviour in the face of the pandemic and beyond to adopt policies and tactics to retain loyal customers and draw new ones (Eger et al., 2021). Figure 2.7 shows the drop of shoppers from different countries in the world.

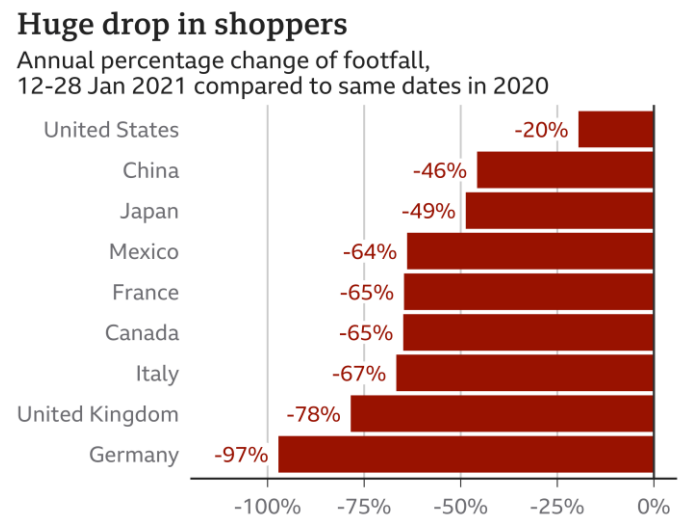


Figure 2.7: Statistics for global shoppers. Source:(ShopperTrack, 2021)

d. The Impact on Stock Markets

In this era of globalization, the removal of foreign operations, revolutions, and trades has unfortunately led to the division of countries. Goods transportation by air, sea, and land has come to a standstill. There have been no buying transactions in the travel and airline businesses for weeks and months. This miscalculation has also harmed the sports business

(Chowdhury et al., 2021). For example, the Tokyo 2020 Olympics have been postponed (“Coronavirus: What sports events,” 2020).

A catastrophic financial disaster has developed from the world's "resting" mode. In terms of economic uncertainty, it has now outpaced the 2008–09 depression (Chowdhury et al., 2021). Furthermore, the International Monetary Fund (IMF) has declared that the globe is in the midst of the greatest economic downturn since the Great Depression of the 1930s (“Coronavirus: Worst economic crisis,” 2020). To combat the crisis and restore their economy, policymakers are creating contingency plans and recovery initiatives (Fernandes, 2020). Figure 2.8 shows the drop in stock market prices in some cities.

The impact of coronavirus on stock markets since the start of the outbreak

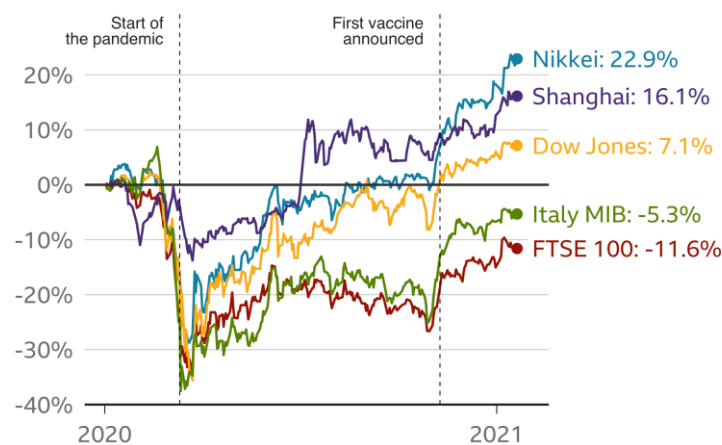


Figure 2.8: Effects on Stock markets. Source: (Bloomberg, 2021)

e. The Impact on Pharmaceuticals

As a result of Covid-19's impact on global economies, businesses are losing money, employees are losing employment, and many individuals are experiencing a complete lifestyle shift. However, as the battle for drug approval for a Covid-19 medicine heats up, pharmaceutical behemoths like Gilead and Eli Lilly, which are at the vanguard of the Covid-19 conflict, are seeing good stock price improvements and a new burst of inventiveness in the infectious illness sector (The Impact Covid-19 on Pharmaceutical Companies Worldwide, n.d.). The COVID-19 pandemic had a large impact on the health market and the pharmaceutical business, and was related to a variety of severe short- and long-term consequences that need foresight and proper planning to limit their socio-economic impact

(Ayati et al., 2020). Short-term repercussions of the COVID-19 pandemic on the pharmaceutical sector include market alterations, regulatory changes, research and development mechanism changes, and a move to telecommunication and telemedicine. Long-term effects of the COVID-19 pandemic on the pharmaceutical industry, both globally and locally, could include slowed business growth, clearance delays, a push toward self-sufficiency in the pharmaceutical supply chain, and shifts in health-market commodity use patterns, as well as ethical dilemmas (Ayati et al., 2020)

The epidemic of COVID-19 is causing havoc on the healthcare system and the pharmaceutical business. Understanding the implications will assist policymakers in developing better evidence-based solutions to address the issues that arise (Ayati et al., 2020). Figure 2.9 helps to understand the direct translation that COVID-19 has contributed to the boom in the pharmaceutical industry. There is a drastic spike in 2020.

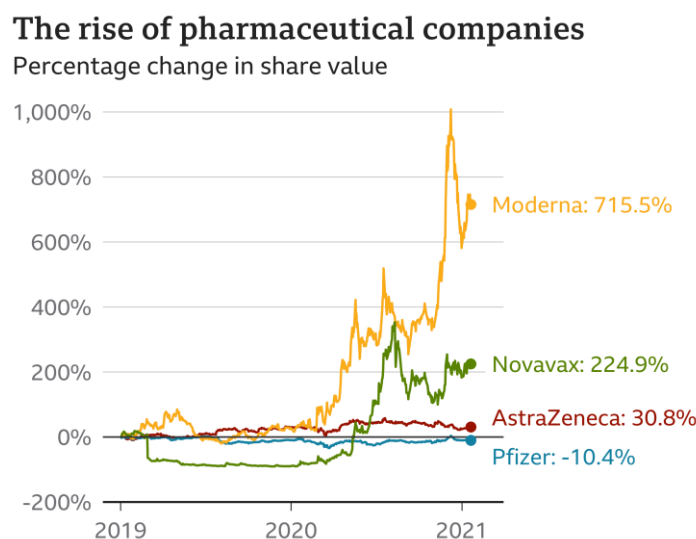


Figure 2.9: Effects on global pharmaceutical. Source: (Bloomberg, 2021)

f. The Impact on Employment

Many people have lost their jobs or had their salaries cut. Unemployment rates have grown across the board. In the short term, Beland et al (2020) looked at the effects of COVID -19 on jobs and incomes in the United States. They discovered that COVID -19 increased unemployment, decreased hours worked, and labour force participation, but had no effect on wages. Women, non-natives, individuals on non-standard contracts (self-employed and temporary workers), the less educated, micro-enterprise workers, and low-wage workers

will be affected by socially distancing policies and practices as a result of the COVID -19 pandemic, according to Pouliakas and Branka (2020) and Fana et al. (2020). The entertainment business, as well as the hotel and tourist industries, are undergoing substantial supply and demand shocks, according to reports from the United States (del Rio-Chanona et al. 2020). Furthermore, as a result of convergence in dynamic value chains, each country's position in the international division of labour will become increasingly important in the medium future (Fana et al., 2020). This is especially true for European nations whose industrial systems have shifted asymmetrically in recent decades, with both the southern and eastern peripheries becoming increasingly reliant on the centre, owing to the German production paradigm (Simonazzi et al. 2013).

Working remotely has helped to reduce some of the negative consequences of social isolation and activity limitations during the present crisis. Working from home involves considerable lifestyle changes for employees, offering new challenges in terms of work-life balance, mental health, and organizational procedures. Although it is a norm that encourages individuals to continue their activity (and income) even when the strictest limits are enforced, it is a norm that encourages individuals to continue their activity (and income) even when the strictest limits are enforced, at least for those with traditional work contracts. Working remotely helps people who are willing to perform their technical practice from a distance escape the recession's economic consequences (Fana et al., 2020). However, not all occupations are fit for this type of work. Yearly unemployment has increased as can be seen in Figure 2.10.

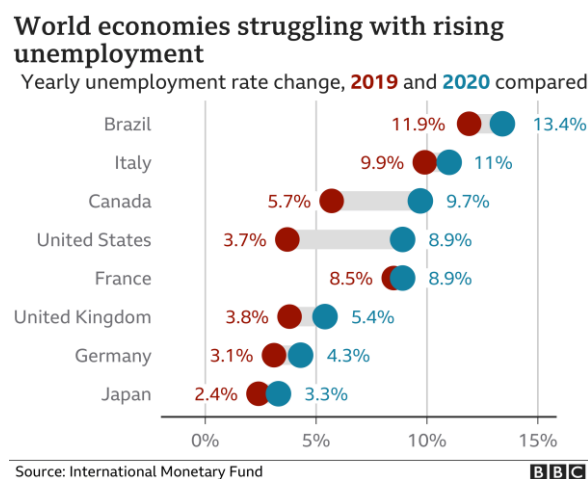


Figure 2.10: Impact on Unemployment. Source: (International Monetary Fund)

2.2.3 Transportation and Urban Impacts

i. Transportation

Inter- and intra-urban mobility, as well as human movement and transportation networks, are all thought to be important elements in the transmission of infectious illnesses, and their role in prior disease outbreaks (such as Ebola) has been documented (Connolly et al., 2020b). As a result, numerous municipal governments have enforced partial or entire mobility restrictions to curb COVID -19's spread (Carten et al., 2020; Ai et al., 2020). Empirical study reveals a considerable fall in social mobility following the adoption of COVID-19 and the enforcement of movement restrictions. According to Hadjidemetriou et al. (2020), frequent journeys in the UK reduced by 80% after the imposition of limitations. Similar findings have been reported in other situations. Several studies have looked at how successful travel bans are at stopping the spread of the virus. Human movement limitations seem to have hindered the transmission of the virus in China (Kraemer et al., 2020; Tian et al., 2020) and the United Kingdom (Kraemer et al., 2020). (Kraemer et al., 2020). Hadjidemetriou and colleagues (Hadjidemetriou et al., 2020). The stability and transmission risk of various forms of transportation are the subject of a growing amount of research. Zhang et al. (2020) found a substantial link between the number of infected people in destination cities and the number of flights and high-speed trains departing Wuhan. They say that not only do these forms of transportation enhance the chances of passengers being infected, but they also lead to an increase in the number of cases recorded in destination cities. Cycling and bike-sharing had the smallest drops in demand in Budapest (23 percent and 2 percent, respectively), according to Bucsky (2020), whereas mass transportation had the largest fall (80 percent). Non-motorized forms of transportation are more resistant to pandemics. Investing in such infrastructure not only helps to prevent the virus's transmission, but also helps to increase service accessibility and reduce strain on already overburdened transportation networks during emergencies (Biswas, 2020). According to the literature reviewed, COVID -19 can have long-term and systemic effects on travel behaviour and mobility. According to some polls, the recession has a two-edged effect on people's routines and travel behaviour (Aloi et al., 2020; Bucsky, 2020; de Haas et al., 2020). The good news is that overall traffic loads have fallen, and more people are opting to walk or cycle instead. However, COVID -19's experience may have the unintended result of raising pessimism about public transportation and a preference for independent means of transportation. Overall, the preliminary data on COVID -19's influence on the transportation industry reveals three key points: To begin,

sensible mobility limits based on the danger of viral propagation in various forms of transportation are critical for viral management. Second, officials should be cognizant that the crisis may exacerbate prejudiced attitudes toward public transportation. It was detailed how, in the early stages of the epidemic, public transportation use had fallen, prompting individuals to convert to other forms of transportation such as cycling and driving their automobiles. Long commutes in cities are unavoidable, even with sensible urban planning strategies like neighbourhood-oriented design (which encourages the use of active transportation). As a result, public transportation should be changed to decrease future health concerns and to restore the public interest by addressing users' safety demands. Third, it has been demonstrated that active transportation options are more efficient in addressing residents' mobility demands during a pandemic (de Haas et al., 2020). They offer services at an affordable price. As a result, more funds should be allocated to cycling and walking networks to encourage more environmentally friendly modes of transportation (Hadjidemetriou et al., 2020; De Vos, 2020).

ii. Technologically Advanced Urban Spaces

Overall, the pandemic has sparked interest in smart city growth by highlighting the numerous advantages of smart technologies, like being able to detect infectious people, predicting where the disease will spread, and reducing human-to-human interaction, while also making it easier to comply with and monitor laws on social distancing and quarantine. Prior to the pandemic, interest in and major improvements in deploying smart solutions, supported by ICTs and big data analytics, were being made to increase efficiency and effectiveness in urban operations, as well as to improve the quality of life (Chen et al., 2020). The COVID-19 project has offered an ideal chance to investigate and evaluate innovative solutions to solve global social concerns, while these innovations are implemented alongside significant technological developments (Kummitha, 2020). While teleworking, telemedicine, security services, and online shopping all employ smart city technology, the implementation of online shopping has resulted in an uptick in city growth, which was proved by the usage of teleworking, telemedicine, and security services (Kunzmann, 2020). Because of this, it is projected that COVID-19 will aid in the development of smart city projects (Kunzmann, 2020).

The ability to watch and identify events and people in real-time and leverage large data sets are critical for adaptive approaches to disruptive situations. Early data shows that several

smart technologies, some of which have been previously developed, have been repurposed to alert effective reaction methods, decrease human-to-human interaction, categorize infected people, predict disease dispersion patterns, and encourage quarantine measures. There have also been stories of smart technology being utilized to decrease human-to-human interaction while service delivery is taking place. The city of Newcastle in the UK serves as a powerful example of how technological improvements (i.e. IoT cameras, smart city technology, and machine learning approaches) may be used to facilitate considerable growth. The city has had an Urban Observatory in operation for some years and is presently utilizing it to collect and preserve real-time data on several metrics, including automobile traffic, foot traffic, and air quality. COVID-19 crisis –The platform's live data streams were repurposed in response to the COVID-19 crisis to create a data dashboard that notified local authorities of improvements in societal behaviours and enabled them to make data-driven and evidence-based adaption decisions. for example, it was able to rapidly identify numerous anomalous movement and interaction behaviours, which needed to be addressed, and it also served as a foundation for rapid data exchange amongst various stakeholders (James et al., 2020). all three China-based endeavours are drones for the delivery of medical and industrial products in times of lockdown (Chen et al., 2020), clinical treatment with AI to shield healthcare staff from direct patient contact (Chen et al., 2020), and CT scanning aided by AI to keep healthcare workers shielded from patients (Chen et al., 2020) (Chen et al., 2020). Another benefit is that performance and speed are improved. Additionally, smart technologies have proven useful in the process of classifying persons infected with pathogens and implementing appropriate containment methods. Three main approaches to these positions may be distinguished based on the social and political circumstances, each of which bears a unique feature: 'techno-driven,' 'human-driven,' and 'combined' (Kummitha, 2020). The futuristic views held by Kummitha (2020) suggest that whereas China's policy is "techno-driven," Western democracies have opted for a "human-driven" strategy. Smart technologies are applied from the top down in the effort to battle the pandemic using tools like surveillance and media regulation to force individuals into behaving properly and stopping the flow of information (Kummitha, 2020). In contrast to the human-driven method, the government-focused strategy has tried to help the public combat the virus by informing and educating them, as well as promoting two-way communication between citizens and the government. Since democracy is often seen in Western nations, this is more common there (Kunzmann, 2020; Kummitha, 2020).

Concerning controlling the virus's dissemination, the techno-driven strategy has seen greater effectiveness. On the other hand, the strategy with greater use of technology, extensive use of technology, using widespread technology, avoiding the spread of disinformation, and working to organize various actors' activities has proven far more effective. Nevertheless, there are some topics that it has raised concerning anonymity, responsibility, and the veracity of information. According to these theories, the virus may have disseminated even faster because of the limited transparency in the early stages of the outbreak and attempts to suppress data. Concerns have been raised that authoritarian rulers will consolidate their power connections in response to this expansion of democratic rights (Kummitha, 2020). According to this school of thinking, a human-driven approach is seen to be more effective in encouraging people to address existing and emerging social and environmental concerns. It looks like a blend of both methods is required to deploy effective solutions for pandemic containment, while also addressing privacy issues, fostering collaboration, and maximizing knowledge exchange. At the same time, a disinformation system must be in place to ensure the flow of reliable information (Kummitha, 2020).

2.2.4 What Are Mankind's Rights and How Are They Affected by the Pandemic?

Because the World Health Organization announced in March of 2020 that the new strain of influenza, which they have designated as COVID-19, would soon go pandemic, so many related health professionals have prepared by putting in place precautionary measures to help combat and minimize the spread of the virus. It is quite understandable that those who had a more 'normal' life story before their injury or illness may not be as open to adjusting their expectations to maintain quality of life. While certain proposed changes are on the immediate horizon, our current manner of interacting socially is dictated by the pace of such changes. It is true that man is not just a physical being, but also a social person. This is why he does things in the context of society. Regulations were implemented because of the current epidemic, and consequently, people are required to follow the social distance norms while they are in public venues like banks, religious worship places, schools, and companies. Reducing the number of individuals that will be accommodated in a particular location not only limits the number of individuals who will be at the event but also tends to discourage larger gatherings, which are often more beneficial for a deeper feeling of community.

The great majority of the economies in the globe today found themselves suffering from a major economic crisis with far too many struggling to get their footing after being

destabilized by the global financial crisis. Many people who rely on commerce for a living have had their human rights violated, which is in violation of Article 23 of the Universal Declaration of Human Rights, which states that everyone has the right to work, has a free choice of employment, has a favourable and just working environment, and is protected from unemployment (Assembly, U.G 1948). It is common for companies to go out of business just so that they may cut down on personal connections. While a great number of firms have lost large amounts of money due to this, it is very evident that some will never be put back into operation, other than they need special help from pertinent stakeholders to keep it afloat. The economic conditions resulting from these occurrences might lead to an increase in the overall unemployment rate, which in turn might adversely influence people's lives and also the state of the economy.

The disease has significantly diminished the enjoyment, fulfilment, and knowledge travellers get from traveling the world. Since some countries have established policies that involve quarantines and self-isolation for anyone, who enters their country, the enjoyment, fulfilment, and knowledge of international travel have decreased. For this tourist, there would be a scenario where the visa allows them to enter the nation for three weeks, but they are required to stay for 10 days with no one else and nothing physical to do. Research has demonstrated that isolation without social connection has been found to negatively affect human emotional health, cognitive health, and physical health (Hawkley & Capatino, 2015). It is unclear if this theory of isolation is successful in reducing the transmission of the virus, but it is also necessary to remember that it has the side effect of causing other problems. As previously said, it is critical to establish a balance and search for alternative less risky avenues of social engagement, especially because it is likely that this notion might be viable if other avenues remain unexplored.

It is one of the major preventive measures in place in the event of a pandemic. The regulation has required the usage of a facemask in public settings. Laws that compel the use of a facemask force people to follow certain rules or they face a penalty. Studies conducted in the past decade have demonstrated that using a facemask for a long period may have damaging effects on one's health. Individuals have an increase in the level of CO₂ they breathe out, because of the CO₂ they exhale, which is called hypercapnia. This is extremely hazardous and might result in human life loss. Many times, usage of this face mask can be

uncomfortable, and in some cases, it will hinder communication and lead to heat stress as well as psychological tension, especially when utilized in the office (Wilkins, 2020).

Over the past year, there have been several arguments for and against the idea of making vaccinations mandatory for all people. While the notion of vaccination may be helpful, it is critical that vaccine usage be not required for everyone because everyone's views on the topic may be different, and the choice to use the vaccination should be voluntary and not by any means of coercion. Expanding vaccinations to the point that they become a requirement for other benefits, such as social amenities, or other things, violates the right of the people. People are able to exercise their right to take the vaccine of their own volition since this is backed up by Article 19 of the Universal Declaration of Human Rights, which grants each individual the right to express their freedom of opinion without interference (Assembly, U.G, 1948)

Accordingly, while the epidemic has presented a challenge to human wellness, it is equally crucial that the methods implemented to control its consequences are long-term and do not infringe on the basic human rights of people. When there is no balance between these two factors, there will inevitably be more turmoil for humankind.

2.3 Non-pharmaceutical Mitigation Measures Against Covid-19:

This paper is focused mainly on strategies and measures outside of the medical realm. Measures and strategies that have some form of spatial dimension to them is what is being investigated within this paper. Measures that affect the spaces are also considered as non-pharmaceutical measures. These have been classified into four different categories as seen in Figure 2.11 below.

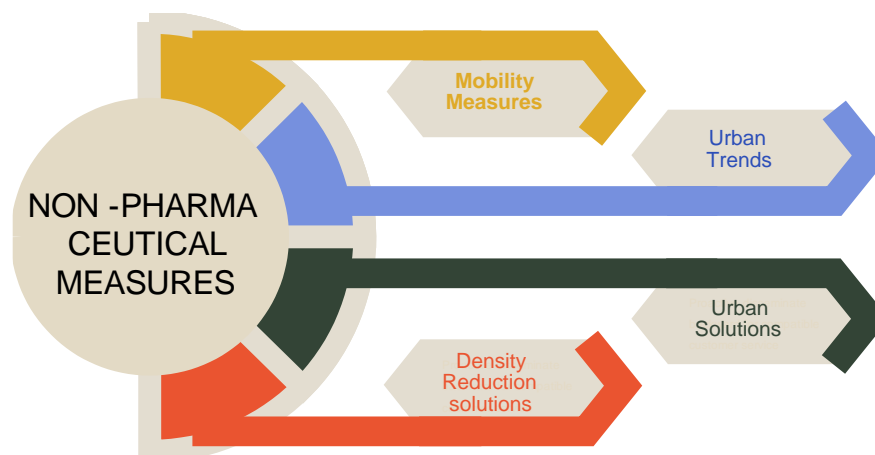


Figure 2.11: Non-pharmaceutical measures. Source: Author

2.3.1 Mobility Measures

2.3.1.1 Limited Mobility

While a lot is done to help cushion the spread of Covid-19, several measures have been put forth. One of such early measures was that of limited mobility. This concept requires that individuals remain within the confines of their homes, where leaving their homes to the public spaces will be strictly to meet essential needs or for emergencies. The measure was necessitated to help reduce physical contact which is deemed to help the spread. Studies by WHO (2020) have shown that the virus can be transmitted from human to human by bodily contact from an infected person. Droplet particles or aerosols from the mouth or nose of an infected individual as well as the touch can as well transmit the virus. Viruses have a varying degree of ability to infect people. For Covid-19, studies by Gavi (2020) states that a single infected person has the tendency to infect 2.5 people in a day, and these infected ones if allowed to have contact with others can result in the infection of over 406 persons in a month. The chances of transmitting the virus are said to be higher in spaces with the 3C's; one of which is the Close-contact setting which is typical when people are let out to move freely. In the study by Atalan (2020), 49 countries of the world where the lockdown policy was implemented were examined, and the result demonstrated that the spread of Covid-19 can be significantly suppressed by this preventive restriction, though other factors like the population demography, population density, weather, economy, and infrastructure play contributory roles. In a related study of the strict lockdown period in Pakistan which was from 23rd March to April 15th, 2020, there was a 40% reduction in the amount of NO₂ from coal-powered plants as well as a significant drop in surface urban heat island effect in big cities (Ali., et al 2021).

It is evident that the lockdown created a shift in the pattern of human activities, with more people now staying back at home, there is an urgent need to make necessary adjustments that might have been overlooked in the time past. In this case, the urban micro environment becomes the core focus. Observations as in most cases have shown that the urban infrastructure available becomes overstretched because a lot of them were not designed to accommodate such amount of drastic pressure. In response to this, the creation of sustainable urban neighbourhoods becomes imperative to complement and make the concept of lockdown effective. Such neighbourhoods will be equipped with essential urban facilities that engender the well-being of users in such a time. These include the provision of neighbourhood parks, greenspaces, and gardens in different parts of cities where users within

those zones can walk into, do a few light exercises, and also ease off the burden of isolation since it is important for mental and physical health. This is in correlation with the work of White et., al (2019) where they opined that spending a minimum of 120 minutes weekly with nature is found to be associated with good health and wellbeing. As measures to adopt this opinion, urban building policies should be made and enforced to discourage developers from building up the entire plot or employing the use of hard landscaping elements everywhere but also reserve some space for greeneries and home gardens. The home gardens provide homeowners the opportunity to grow their fresh organic vegetables for their food. Before building approvals are issued, the speculated minimum percentage of land area for greeneries must be met. That way, individuals could have as much access to nature as possible, hence improve their mental well-being. Furthermore, the presence of these trees and greeneries not only beautifies our urban environment but also serves as carbon sinks which helps improve the air quality. This in turn serves as a tool for improving ventilation in urban areas with high population density, confined and enclosed spaces that are susceptible to poor ventilation.

The treatment of urban furniture with antimicrobial finishes is another vital and interesting urban approach to curb the spread of covid-19. Urban furniture which could sometimes be regarded as street furniture is those items that make people have a more enjoyable time outdoor, they include benches, picnic tables, bus stations, waste bins, street lights, and bollards (Toscan & Pegman, 2018). Some of these items are located within the neighbourhood in parks and in homes with which people come in contact. It is important therefore to finish the surfaces of those items with suitable antimicrobial and antiviral finishing so that the growth of these disease-causing pathogens when in contact with such can be inhibited, thereby reducing the likelihood of the spread. Hence, this antimicrobial finish forms an infertile ground for the survival of the virus. According to Balasubramaniam et al (2021) research, antiviral and antibacterial materials have the potentials for the control of health-care-related infections thereby making the spread of covid-19 possible to an extent.

2.3.1.2 Restrictions on Indoor and Outdoor Activities

Following the discovery of an epidemic of the infectious disease COVID-19 in Wuhan, China in December 2019, the World Health Organization (WHO) proclaimed a global pandemic on March 11, 2020. The World Health Organization (WHO) has urged authorities

to take swift and coordinated action to stem the spread of the virus, noting "alarming levels of diffusion and intensity." Different governments' restrictions on activities both indoors and outdoors violate several human rights, but international human rights law guarantees everyone the right to the best possible treatment and requires states to take action to avoid public health risks and to provide emergency treatment to anyone in need. Restrictions on specific rights may also be justified under human rights law if they have a legal basis, are strictly necessary, are based on scientific evidence, are not arbitrary or discriminatory in their application, are limited in duration, respect human dignity, and are subject to review in the event of serious public health threats or national emergencies. Closure of non-essential venues such as nightclubs, bars, large-scale sporting events, mosques, parties, and other social gatherings in general, in addition to a social distance of at least 1.5 meters. With some companies campaigning for and others requiring remote work, as well as job shortages and a growing number of children attending school online from home, the influence on travel behaviour is significant.

2.3.1.3 Transportation

i. Non-motorized Transportation

Because the majority of people are avoiding public transit due to the coronavirus pandemic (COVID-19), cycling has quickly become a simple and convenient method of mobility.

While many cities around the world are implementing a broad range of measures to reduce physical contact to prevent and slow the COVID-19 pandemic, a significant number of people may still need to move around their cities to meet essential daily needs or provide assistance to vulnerable people, the WHO said.

A more efficient approach is to either cycle or walks while getting the minimum recommended physical activity requirement done each day. This is more challenging because people may choose to work from home or access fewer sport and leisure activities due to increased teleworking and restricted access to parks and other recreational areas.

The current bicycle craze is founded on a solid logic: Riding a bike in the open is significantly more feasible to observe social distancing norms than riding a bus or train, especially when those standards are to remain within a certain set distance from others. These issues contribute to a general trend of decline in automotive traffic, and some

jurisdictions have instituted speed limit reductions as well, which further increase the friendliness of city streets to bicycles.

At several countries and municipal levels, individuals are encouraged to bicycle to decrease greenhouse gas emissions. A lot of major streets are being redone for the sake of pop-up bike lanes. Because bike shops have been awarded the vital status in many places, they can stay open and assist riders even in the face of this unprecedented age.

One of the first assumptions the World Bank put out in a recent blog post is that “there are 1 billion bicycles in the world, and approximately half of the global population knows how to ride them. Every two seconds, someone purchases a new bike, and four new bikes are created every second. Cycling, which was once just a local commute, is now the world's most pervasive form of transportation. The National Infrastructure Commission (NIC) in the UK found this out in 2018, and it advises that the cycling system should be managed as a mass transportation system. In a piece from CityLab, bikers are reported to make the cities they reside in livelier, whereas vehicles appear to make the street life less vibrant.

Getting new transportation networks and infrastructure in place is a key step in expanding. As you can see, depending on the context, you might use a number of examples to find an example of developing a network of protected bike lanes, constructing bike superhighway under- and overpasses, growing bike-carrying capacity on trains and buses, expanding indoor bicycle parking, investing in public bike share schemes, or leveraging creative technologies like freight bikes and e-bikes.

For a serious task, convincing individuals and decision-makers to alter their ideas is a significant problem. In many nations, a bicycle is seen as the poor man's mode of transportation, due to the bicycle's apparent social stigma. Other people see cycling only as a recreational activity or a sport, rather than as a feasible means of transportation.

Following several examples of urban sustainability efforts, some large cities have already begun to go forward with their respective sustainability programs. Since the beginning of the epidemic, over 1,800 towns throughout the world have taken initiatives to boost non-motorized transport (NMT), ranging from Lima and Bogotá in Latin America to Berlin and Milan in Europe, as well as Kisumu in Kenya and Auckland in Oceania. The Indian government created the Cycles4Change Challenge, a nationwide effort.

The following are examples of some of the concrete NMT activities that have been put in place in response to COVID-19:

- Motor vehicle traffic being directed away from certain streets. In Oakland, approximately 10% of the city's roadways were closed.
- Another example is the Cycles4Change Challenge in India, which is training Indian cities in capacity building to launch bike-share programs or build pop-up bike lanes.

Although these are only a handful of the hundreds of initiatives worldwide that are placing walking, cycling, and other types of urban transportation at the heart of recovery efforts, there are many additional projects throughout the world promoting that mobility method. The movie clearly shows that walking and cycling facilities are going the way of other highly rated services, like restaurants and grocery stores. All around the world, high-quality facilities for walking and cycling are popping up, providing cities with a boost to make them more welcoming and attractive to people from all walks of life.

According to the UN Environment Programme, almost 7 million people die prematurely each year due to environmental pollution (UNEP). Additional measures to safeguard pedestrians and cyclists are a critical part of the plan to build the urban spaces of tomorrow, and UNEP is also promoting a "Share the Road" initiative, which strives to move the focus away from the minority of people who primarily drive and instead focus on the infrastructure needs of the majority of people who walk and ride.

ii. Pedestrian Movement

A blog article on city streets discusses six strategies cities may use to develop safer, cleaner, more productive streets that lead to a safer, cleaner, and more productive city. Covid-19 means heightened anxiety over public safety, therefore here are some tips to help lower the stress level of the public when they're making moves.

In the first place, having accessible and continuous sidewalks is quite important. The efficacy of a sidewalk is based on how comfortable, consistent, and safe it is. When well-designed sidewalks are in place, they are continuous and break up along neither road crossings nor the block boundaries, so they allow ample area for pedestrians to go through,

sit, shop, dine, interact, and meet. To accommodate increased traffic, low-volume zones should have a minimum width of 1.5 to 1.8 meters (5 to 6 feet), but high-volume areas should have a minimum width of 2.5 meters (8 feet). Due to the high traffic levels, the social distance may need extra space in high-traffic locations. A sidewalk should be designed as a combination of three segments: the "frontage zone," which contains commercial features like doors, furnishings, and other commercial elements; the "pedestrian zone," which is free of obstacles so that people and their possessions can move about with ease; and the "furnishing zone," which contains trees, signs, garbage cans, street furniture, and drainage. If curbs are placed to help boost mobility, anti-skid materials are used to keep the chance of slips and falls to a minimum, and tactile surfaces are installed to assist visually challenged walkers, it is a secure and accessible sidewalk.

The next thing to be done is pedestrianizing the streets. Cities should look into restricting car traffic in places with heavy pedestrian traffic because several cities have done this in response to COVID-19 in order to enable pedestrians to walk securely and conveniently without having to avoid automobiles. Pedestrian-only streets boost the amount of public protection afforded to pedestrians while also enhancing local air quality, the value of the property, revenue from shops, and general health while at the same time decreasing noise levels. Retail revenues jumped 49% in a 2016 assessment of more than 100 towns across the world with pedestrian-only streets that had been in place for several years. Austria, Germany, and the Scandinavian nations saw sales climb by more than 60% [relative to previous years]. Pedestrian-only roadways should be created in locations with ready access from both residential and business districts. As an additional incentive, they should have easy access to public transit, bike routes, parking, and other facilities. This is comparable to Car-Free Days, where communities lock off a street or a network of streets to vehicular traffic and allows people to explore their neighbourhood by bike or on foot. It is hoped that this program would help transform the public's image of streets and public space. La Ciclova, the world's biggest car-free event, is held every Sunday from 7 a.m. to 2 p.m. in Bogotá, Colombia, and is often considered to be a test of endurance. There are almost 1.5 million individuals who have easy access to 75 kilometres of pedestrian and bicycle paths. Also in order to give an option to public transit, due to the COVID-19 roadways having 19 separate sections, during weekdays, three of the roads have been car-free.

Larger cities are concerned with the aftermath of COVID-19, and strategies that rethink roadways should consider these pedestrian-friendly ideas.

iii. Slow Street Movement

While the coronavirus outbreak has greatly impacted communities around the country, numerous towns have taken advantage of the occasion to make large-scale changes to their public places by prohibiting car traffic. Slow Streets (also called Open Streets) originated as an effort to make walkers and cyclists more comfortable with spacing, which involves walking in the street or riding a bike for prolonged periods of time without fear of being hit by a car. The Slow Streets concept builds fences in the streets, restricting one or two lanes to motor traffic. This extra space is created for walkers and cyclists. While delivery vehicles, city utility trucks, emergency vehicles, and other local traffic are permitted to go only with care and at restricted speeds (usually 5 to 15 mph), vehicles of nonlocal origin may merely go past at their own pace. Beyond curbing coronavirus-induced illness, these devices have several other advantages as well (Glandorf, n.d.). Reducing urban motor traffic is both good for the environment and good for the health and safety of citizens.

City officials in New York have decided to try to block 70 of the 6,000 kilometres of roadways, and the 100th will be closed soon to reduce the amount of danger posed by the coronavirus epidemic (Glandorf, n.d.). Other programs outside Open Streets Eateries' expansion of the plan included NYC DOT's program Open Streets Restaurants, which has supported restaurants in giving outside eating alternatives while conforming to COVID-19 requirements, helping the city's economic recovery (Glandorf, n.d.).

Both environmentalists and urban planners view this as an opportunity to reinvent and enhance urban areas, boosting the number of people who walk and lowering their dependence on vehicles.

2.3.2 Urban Trends

2.3.2.1 Enhanced Sanitation

The study by Nelson and Murray (2008) claims that over 2.6 billion people on the planet have no sanitary services at all. On top of that, they have no way to obtain basic, household-level sanitation, as well as none of the fundamental collection, treatment, and disposal or reuse of their wastes. Sufficient sanitation is necessary for safeguarding human health and

the environment. Rehabilitating the precious resources that are found in the garbage we throw away, as well as ensuring that persons and the environment are protected, are the most important aims of a full sanitation system, according to Nelson and Murray (2008).

According to Question and Answer on COVID-19: Basic Facts (A guide to talking about COVID-19), it is possible to be exposed to COVID-19 when one is exposed to droplets or aerosols that an infected person has coughed, sneezed, breathed, or exposed to the air in some way while in close proximity with them. In addition, if the virus is present on an object, and someone touches it with their hands or another part of their body and then transfers it to their mouth, nose, or eyes, they can then potentially pass the virus on to another person. It has been proven that the virus may live on different surfaces for a number of hours (copper, cardboard) to a number of days (plastic and stainless steel). Thus, concerns for better sanitation cannot be ignored. This highly effective strategy to reduce the spread of COVID-19 dissemination is called improved sanitation.

i. Hand Sanitization

Humans have been craving physical touch throughout their entire lives. (Floyd, 2014) pointed out that humans can suffer from what he termed as ‘being touch starved’ or ‘skin hunger’ and that occurs when people experience little to no touch from other living things. The need to touch does not only apply to living things but non-living things as well. The human touch from research has been found to be truly fundamental to human communication, bonding, and health.

When it comes to disease transfer, (Przekwas & Chen, 2020) rightly pointed out that hand to face transfer is a potential infection route, and given that humans touch their faces over twenty times every hour it is very vital to wash it with water and soap to prevent the spread of COVID-19. In view of this hand, sanitization has been one of the methods that cities and urban spaces have employed to mitigate the spread of most infectious diseases and recently also COVID-19.

ii. Disinfection of Spaces

The Cambridge Dictionary's description of the practice of cleaning indicates that removing filth and clutter from your house, office, or the surrounding area is known as cleaning. Some

of the cleaning solutions that are used for cleaning the various places can be utilized to disinfect them. According to the Cambridge Dictionary, disinfection is defined as the use of chemicals that are designed to destroy bacteria and other small living organisms that cause disease in order to clean something.

Due to the looming threat of potential catastrophe, the majority of the world's population has been ordered to stay in their homes and avoid public locations. In their recent work, the researchers claim that human-to-human transmission of the COVID-19 virus is mostly conducted through the transfer of respiratory droplets and contact with contaminated surfaces. These sick people have the tendency to discharge these droplets into the air, which end up landing on diverse surfaces. It might be on a common park seat, stair rails in a public building, elevator buttons in a high-rise residential block, table surfaces, or any other location where you see a physical sign that there are other people there. Public areas have served as one of the most common places where tiny droplets of COVID-19 have been deposited, causing a fast transmission of the virus in the time that it has been in circulation. In an effort to help improve the population's well-being, busy areas such as New York, Barcelona, and Paris have instituted policies such as restrictions on the use of personal vehicles and the closing of businesses during times of heightened public risk. The result has been that these areas have been transformed into ghost towns. Research and scientific experts have studied methods for disinfecting our public and private places, and the hope is that as a result, we will have the opportunity to have our streets open for business again. A proposed Chitra disinfection gateway for the control of COVID-19 in public access areas is outlined in the paper by Krishnan et al. (2020). Public areas will feature a decontamination chamber on the entryway where a system using hydrogen peroxide atomization system and UV rays will be used to disinfect the hands, bags, clothes, and whatever else a person is carrying as they move through the portal. Also (Sidorchuk et al., 2020), who conducted a simulation of passenger flows at rail stations with disinfection gateway installation, wanted to ensure the safe movement of passengers via public rail stations. The results were quite encouraging. Currently, the most frequent approach to cleanse and disinfect public areas is to utilize disinfectant spray applied to the surfaces. This makes for a very successful technique, however, there have been reports of the unwanted repercussions that arise as a result of the increased usage of disinfectants. To combat the large public-space outbreaks of tuberculosis and HIV (both TB and HIV have a well-documented history of infesting patients via shared environments), (Debnath & Islam, 2021) the researchers propose the

implementation of this technology for disinfecting the public spaces using a UV-C light-based portable disinfecting chain.

iii. Mandated Face Masks in Public Spaces

Masks are a key part of our society in a pandemic world. It helps to keep people from inhaling the virus in the air and also serves as a form of boundary whenever people bring their hands to their mouths and nose. It is recommended by WHO and every other medical practitioner. The effectiveness to suppress transmission and save lives vary from one mask to the other but not using one in this era is downright dangerous and careless. There are the regular cloth masks which according to a study done in Poland by (Ganczak et al., 2021) are the most popular and there is the medical mask. There are also other various types of face coverings that are meant to cover the face.

(Zhang et al., 2020) did research identifying airborne transmission as the dormant route for the spread of COVID-19 and concluded that the practice of mask-wearing is the most effective method to prevent people from COVID-19. This however is in a situation where the users wear the masks correctly and from (Ganczak et al., 2021) he discovered that about 47.3-52.7% wear their masks with uncovered noses while 39.2-42.6% wore them around their neck. These two incorrect practices of mask-wearing according to him were the most frequent incorrect practices. The proportion of people wearing the masks decrease daily. This is just one of the downsides to wearing a mask. Given how well popularized its potency to reduce the spread of COVID-19, people wearing it incorrectly will end us with a false sense of security in them. Changing masks or washing used masks should also be a practice to mask-wearing. (Ganczak et al., 2021) stated other downsides to wearing a mask. Amongst these are the facts that masks make it harder to breathe and speak (decreasing the volume of speech) thereby resulting in people moving in closer to communicating better and increasing the chances of spreading the virus. (Greenhalgh et al., 2020) pointed out that masks are uncomfortable to wear and yes there are improvements in some masks to make them more comfortable but nothing will be more comfortable than the lack of the mask on the face and also that in normal use the air exhaled can sometimes get into the eyes and increase the discomfort which in turn gets people to touch their eyes. If one's hands are contaminated the use of the masks as a means of prevention becomes redundant.

2.3.1.2 Diagnostic Testing and Contact Tracing

i. Diagnostic Testing

According to the World Health Organization (WHO), we must have an up-to-date and responsive testing infrastructure to prevent the spread of SARS-CoV-2, the virus that causes COVID-19. Due to the uniqueness of the current COVID-19 pandemic, which features unparalleled levels of complexity and heterogeneity, an understanding of the variance documented in biological, policy, sociological, and infrastructure responses during an epidemic is crucial in informing decisions at all levels.

SARS-CoV-2 testing may be utilized as a part of a larger approach to contain the spread of the disease. The common-sense practices of screening, monitoring, and contact tracking are used to identify persons infected with SARS-CoV-2 and to limit and prevent the virus's transmission.

According to the CDC, the best practice for someone who is getting tested is to be informed of the manufacturer and the name of the test, the purpose of the test, its capabilities, the criteria under which the test was carried out, who is paying for the test, how the test will be performed, and when and how they will receive test results. They should also know how to interpret the results, and what to do if the results are negative or positive. They should also know the difference between occupational screening and medical diagnosis. They should also know who will obtain the results, how the results will be used, and any potential repercussions for refusing to be tested.

It has been reported in a publication issued by the OECD, which is an international organization composed of member nations that have agreed to work together in a number of different areas to better their economies, societies, and environments, "A crucial issue behind any strategy to loosen confinement restrictions and begin economic activities is how to avoid a new spread of the SARS-CoV-2 virus, which would necessitate additional lockdowns." Once the number of infected people has been reduced, a timely increase in the number of persons infected with the virus will be required to control fresh waves of viral illnesses. Without accurate testing procedures, it will be difficult to reach this goal.

There are two sorts of tests: screening and diagnostic. The first is a type of molecular diagnostic testing known as RT-PCR, which assists in the identification of persons who are infected at the time of the test. Once infected individuals' contacts have been identified,

tracing them using TTT is an efficient strategy for increasing the virus's dissemination and, consequently, for lowering the viral replication number down to one.

The following are some instances of different ways of conducting a diagnostic test:

Those who show up at the healthcare provider's office with symptoms linked to COVID-19 will be tested. A resulting action of contact tracing activities is to put them through various tests. COVID-19 is the suspected or verified name of the disease being investigated. Those who think or have evidence that they have been exposed to a person with this disease will be tested. The participants were checked for the presence of COVID-19 following the event when the COVID-19 results were validated in another participant.

The second sort of test is called a serologic test, and it searches for persons who have had a past illness and have produced antibodies as a result. These studies may be utilized for two purposes: first, allowing those who have recovered from illness to return to work safely; and second, as a Source of intelligence on the spread of the epidemic among the population. The continued lack of scale-appropriate fast serology test kits precludes their development and clinical evaluation until a sufficient number can be deployed. An example of a screening scenario is testing personnel in a workplace context. At-home testing for someone who does not have symptoms linked with COVID-19 and no known exposures to someone with COVID-19.

ii. Contact Tracing

Someone who has had close contact with someone who has COVID-19 (a contagious disease) within two days of that person being diagnosed is considered to be in close touch. In cases when COVID-19 contact tracking is required, close contact individuals are needed. The close associates who might be included in your expanding list of contacts include family, colleagues, co-workers, and healthcare professionals.

The health department takes notice of those who have recently been in close touch, and they inquire about their symptoms. Once they have been checked for the virus that activates COVID-19, they are given many directions and instructions. Following these rules can help contacts close and dear to you from inadvertently transferring the COVID-19 virus to others.

This group of people is normally given the following advice when there are no symptoms, no virus can be detected, and the potential for being in touch with someone with the COVID-19 virus exists.

If a person is infected with an illness, then they must self-quarantine at home for 14 days. Furthermore, they can also talk about other options, such as extending the isolation period if they show no symptoms and are not examined, or extending the quarantine period if the test findings are negative. Symptoms can be monitored for another 14 days, but they must stop doing so if they do not occur.

They are then asked to keep a social distance from others. It is anticipated that the individuals will live separately from their families and pets, with their bedroom and bathroom. Continue to insist that they pay attention to their overall health and possible warning indications of COVID-19. Also, require them to get their temperature taken daily. Since onset may be sudden, it is essential that the affected person promptly informs their doctor and the local health authority about any signs or symptoms. To be on top of things, request that they have frequent health reports on hand for physicians and the health department.

Individuals who have symptoms and are unable to be tested, and those who test positive for the COVID-19 virus, are typically advised by physicians and public health authorities to limit their close contact and recover at home for at within 10 days if they have symptoms, and self-isolate for 14 days if they have been exposed. Additionally, it is possible to underline that if a person does not have symptoms and is unable to be tested, they can self-quarantine for 10 days after exposure. If they find symptoms after that time, they must monitor for them for another 14 days. Concerning the signs and symptoms that someone may be experiencing, they are nearly certain to be told to avoid exposure to others and their pets as well as to stay away from the rest of the home. They are also likely to be recommended to use a separate bedroom and bathroom. If they experience any of the warning signals specified in the Centres for Disease Control and Prevention (CDC) document "CDC. Vaccine- precautions and guidance for vaccinating immunocompromised individuals who receive human growth hormone (HGH)" (e.g., difficulty breathing or persistent chest discomfort), they are told to record these and refrain from infecting others with the COVID-19 virus.

iii. Artificial Intelligence and Touchless Controls

Because of the worldwide pandemic, we have arrived at a fundamentally new environment in which digital change is taking place across the board. The aftermath of the disaster will see the beginning of a new digital era. It has only been a few months, but the outbreak has paved the way for virtual and augmented reality choices, which are anticipated to become increasingly popular (Gracy, 2020; Muggah & Ermacora, 2020). With artificial intelligence-based facial identification, automation, and voice technologies in place, the possible changes that may come about as a result of a post-pandemic scenario would be greater. Because making contact with contaminated surfaces transmits up to 80% of contagious diseases, touchless technology might become a new interface, potentially eliminating the need to physically push or contact a surface. After a pandemic, post-pandemic principles are focused on contactless options, such as utilizing mobile phones to open and close elevator doors without hitting any buttons and having automatic doors open and close (Molla, 2020; Wainwright, 2020). There may be other software applications that are incorporated with these technologies that might help to monitor and maintain space temperature and efficiently remove any potentially dangerous organisms, viruses, and germs. Even if it comes at a significant additional cost, this is likely an amenity that may acquire popularity and be integrated into future buildings (Kashdan, 2020; Makhno, 2020).

2.3.1 Urban Solutions

2.3.3.1 Self Sufficient Neighbourhoods

It is crucial for the long-term viability of a city that it has the proper distribution of public areas, such as sidewalks, plazas, and parks, as well as housing and secondary activities, such as restaurants and bars. Containing the spread of illnesses in neighbourhoods is done via assisting such communities in becoming self-sufficient. An approach that seeks to limit the transmission of illness may be called a containment and control strategy, because it keeps people and residents from going to the next neighbourhood to obtain what they need, and, in the process, potentially introduces a new illness. It is common in underdeveloped nations for people who live in one neighbourhood to have to drive many kilometres to the next market to purchase whatever they desire. In most cases, distances that necessitate travel by foot are too great to be covered in a single trip, requiring them to employ a variety of transit options. Using the bus means having to obtain one as most cities with a bus deficit generally have half the number of buses they need and also a lot of the buses are already packed and

congested. Using their vehicle might put them more at ease on their journey, but this would cause pollution from the vehicle and contribute to an overall more dangerous neighbourhood to live in. Given the amount of time and money cities have invested to maintain their COVID-19 defences, neighbourhoods must maintain their independence, so they are less reliant on neighbouring neighbourhoods for food and other necessities. In his paper, Grover (a named reference in the citation) says that, even while communities have to deal with a constant stream of commodities being created in many locations, they cannot be self-sufficient, as it is necessary to get such commodities from their Source to their destination. Additionally, he proposed that before creating a completely self-sustaining neighbourhood, planners should first evaluate what is needed in the area and how readily available the items needed daily are.

Undertaking an evaluation of the newest suburb of Ellenbrook in Australia, which happens to be one of the fastest-growing and largest new urban developments in the country, one of the several areas examined was: What attributes were common to communities with a high level of resilience, self-sufficiency, and independence? We also learned a valuable lesson from this, which is that each of the mixed-use and linked communities should be structured and built to foster a sense of place, to encourage local identity and walking and cycling, and to encourage a genuine sense of community; moreover, a town center should have an open-air, main street mixed-use strip situated alongside an enclosed shopping mall. To ensure that each area has its distinct civic center and community hub, which will provide people with places to live, work, and go about their daily lives while providing mobility and connection, civic spaces and facilities must be designed and situated.

Environmental consciousness is on the rise; therefore, the idea of a self-sufficient community becomes increasingly alluring. According to this theory, neighbourhoods tend to be less cohesive because of the vast socio-cultural backgrounds that people have. To foster community spirit, programs that encourage collective living and support green efforts (like those listed above) can be brought in (Ali et al., 2012).

2.3.1.2 Creating Awareness

The urban environment also plays an important role in combating the spread of the pandemic. One of these unique ways is in the area of creating awareness and sensitization of the populace on steps to take to avoid getting infected or spreading the pandemic and

what to likely do when an individual gets infected. The creation and improvement of educational intervention especially for people who are less educated that will prepare the targeted community against the pandemic to become essential. In achieving this, it is therefore important to adopt local innovative strategies to increase the awareness of the general populace related to Covid-19 and its preventive practices to meet its elimination goal (Tripathi et al).

Safety in traveling by road travel is not just limited to the drivers' competence in handling the wheels but also on carefully interpreting and obeying the road signage that is designed in a consistent and clear language (Vinson, 2020). In urban settings, it is common to find signage around. They could serve the purpose of keeping individuals safe, creating orderliness, and enhancing the functionality of that urban space. With the government's policy on ensuring the need for social distancing, markings are installed on roads and pavements to create a reminder. When these markings are done on the roads and pavement, they must be done with non-permanent medium so they can be altered easily when the need arises (*Installing Markings on Pavements and Roads to Enable Social Distancing / Nottinghamshire County Council*, n.d.). In Nottinghamshire, anti-slip self-adhesive tapes and chalk-based temporary spray paints were employed. This black and yellow tape is effective in highlighting the 2m intervals to be given while on a queue. In addition, the tape is made from non-slippery materials to reduce the likelihood of tripping off when stepped upon.

Apart from the use of road markings, signage and infographics can be used to create awareness in the urban environment. These signage, posters, billboards, and infographics could be used to communicate preventive measures required by users when they find themselves in public spaces, some of which includes symbols for maintaining personal hygiene, social distancing, signs, and symptoms to watch out for in an infected person and what to do in such an occasion. In the placement of these billboards, they must not be only strategically positioned where people can see them but also ensuring that the messages they portray are clear enough for users' understanding. In influencing a behavioural change in Nigeria with regards to creating awareness for personal hygiene, the World Health Organization distributed over 1000 metallic handwashing notices (Warigon Charity, n.d.). The notice contains the right way to wash hands properly and an emphatic orientation that handwashing could prevent the spread of coronavirus, cholera, Lassa fever in less than 9 months over 50,250 were influenced (Warigon Charity, n.d.). One common feature to find

in public spaces today especially before entering offices is an area marked out for people to wash, disinfect their hands and get their body temperature checked. This measure ensures that infection spreading is minimized into such a space. Though this area can also become hazardous, diligence must be given in providing the necessary safe direction of movement employing clear signage or maps. It is therefore important to have a universal symbol that cuts across all demography and informs users that such a sanitization area is available and provides direction on how to access it safely and effectively. With that symbol in place, any individual who accesses a space will look out for the sanitization area and follow the required protocol.

In public spaces where the furniture placed is permanently fastened, symbols with “do not seat” messages could be placed on them to encourage the social distancing rule. While this measure is in use for existing permanently fastened furniture, for subsequent furniture installations, it is necessary to ensure that they are installed in a way they can be easily uninstalled if the need arises and also ensure that they are spaced according to the existing guideline. This concept can be applied in public open areas, recreational centres, schools, and even in offices, as it gives room for flexibility to changes in response to any further pandemic. On the other hand, in addressing urban furniture requirement, the use of benches that accommodates more persons will now be replaced with seats that accommodate one person at a time. Consequently, this furniture will now be placed in a dispersed fashion rather than in a clustered manner. In the same vein, it is required that the populace keep their surroundings clean and free from dirt as dirty environments can provide a breeding ground for these disease-causing pathogens. Awareness for proper waste disposal in the urban setting can be enhanced by providing user-friendly trash bins in public spaces and where applicable signs are placed around littering the environment. These trash bins serve the function of trash recycling by holding rubbish safely until it is delivered (Liu et al., 2021).

2.3.3.3 Introduction of Green Spaces and Urban Farming

While there are different names for the many spaces in the community that offer individuals a place to be active, relax, and socialize, all of them give areas for exercise, relaxation, and mingling. Conventional wisdom holds that natural environments promote good health, and it is established research that shows a connection between being in the outdoors and better health and behavioural outcomes. According to a study in the British Medical Journal released in 2008, which tracked the 40 million people in Britain, Dr. Richard Mitchell and

Frank Popham established a relation between income disparity, access to green areas, and life expectancy. Survey results showed that those with the highest and lowest incomes had nearly the same amount of time spent in rural areas with a large quantity of green space. It is significant in urban regions because the discrepancy in life expectancy was shocking. In the United States, it is expected that individuals who make the least amount of money would live 10 years less than those who make the most. In addition, those that have riches have more opportunities to reach green spaces because they're often found in open, leafy places. However, those who are less well-off are often unable to visit these locations, owing to being obliged to reside in dense, heavily concrete regions.

Green space in cities is effective in helping to lessen the negative impacts of pollution and the urban heat island effect (heat trapped in highly populated areas). A variety of human activities contribute to the creation of the urban heat island, as well as in towns and cities. Heat is trapped in the streets and structures of small- to medium-sized communities, unable to escape into the environment, due to people, transportation, retail establishments, and industry. When temperatures rise in cities by 3-4°C above the surrounding countryside, this might result in a vicious cycle, driving temperatures even higher. As the temperature rises in the summer, the demand for cooling also increases. This spurs us to grow our energy consumption, which in turn increases our usage of fossil fuels, making us the Source of extra pollutants in the air and dangerous pollution on our streets.

Green areas must be planned for whenever practical if we want to see improvements in our urban centres. Plants on rooftops can help to decrease the urban heat island effect by increasing the overall surface area of the roof, resulting in lower surface temperatures.

In several studies, it has been proven that regions that have vegetation, which some experts refer to as "green spaces," tend to stimulate more active lifestyles and socializing, both of which have been established to have a positive impact on health and well-being in other contexts. Furthermore, well-designed public green spaces encourage socially interconnected places, which can benefit the psychological health of its residents by making people feel more connected and improving social interactions. People sought an area nearby to satisfy their need to stroll, exercise, and spend time in the outdoors because of restrictions on movement and physical confinement that were enforced by city authorities. This inclination to seek solace and relaxation in natural settings when in times of crisis may encourage individuals to have a better appreciation for the environmental areas around their homes and

the biodiversity they contain. Green spaces help people feel healthier by making cities more friendly and relaxing places where people can spend time doing things like exercising and talking to others. This also boosts immunity against, and the ability to cope with, newly emerging diseases (Kleinschroth & Kowarik, 2020).

Urban farming is farming that is done in a city, in a town, or in a municipality where the population density is high. During periods of rising uncertainty and risk to human health, people created smaller-scale garden spaces as "refuges." This type of planting took place in public allotments (community gardens), backyard gardens, and patios. All the while, with urban supply lines under strain, cities are asking whether or not urban gardening is still relevant in securing their inhabitants' food security. Because of this, over the course of the crisis, the importance of urban agriculture has risen in research and society, and many new types and innovations of urban agriculture may have emerged (Adaptable Cycle of Urban Agriculture during a Time of Crisis | Urban Agriculture Adaptation in the Face of a Changing Environment, n.d.)

Additionally, the degree to which and how urban agriculture aids society during a crisis may shed light on people's attitudes and values toward urban agriculture, as well as a variety of long-term advantages such as health, social, environmental, and economic benefits (Long-term benefits of urban agriculture identified, including improved health, social relations, and environmental standards, at the COVID-19 | Frontiers Research Topic, 2015).

2.3.4 Density Reduction Solutions

2.3.4.1 Low-Rise Buildings and Expanding Horizontally

High-rise structures were created to accommodate as many people as possible in one location. During a pandemic, contact with anything in multi-story buildings, including elevators, elevator buttons, door handles, and surfaces, must be minimized (Capolongo et al., 2020; Makhno, 2020). This increased dread of infection, as well as the anxiety of being confined in an elevator, should be factored into the post-pandemic design along with other psychological issues in the future. One element being explored as the office market heats up and employers cope with a post-COVID return to work is whether low-rise structures are more desirable than high-rise ones. The solution appears to be that low-rise is the way to go. Because higher buildings are often more congested, some tenants have found it more difficult to work out of them during the epidemic. Users must take their time and wait for

elevators in buildings and parking garages, as well as wait for temperature checks in lobbies. They said that simply going in and out of their building was affecting their culture and time. Low-rise structures, on the other hand, allow for smaller common rooms and generally include desirable outdoor space as well as individual entrances. The combination of indoor and outdoor spaces is another feature that makes low-rise space so desirable, especially now. According to market analysts, demand for outdoor space began before COVID-19 but has grown significantly since then.

Diseases carried through airborne contagions, surfaces, and human-to-human contact will always be more prevalent in densely populated urban areas. The human closeness of densely populated cities creates additional concerns during a pandemic. The higher the population density, the higher the COVID-19 concentration in cities. According to recent studies, the majority of urban growth is horizontal, with significant outward spread into suburbs. Population growth, "soft" rules on land acquisition, zoning, building, economic development strategies, and investment are all pushing low-rise, outward urban expansion. Exceptions to this tendency may be seen in East and Southeast Asia, where high-height building construction is on the increase (Cambridge University).

Because of their high energy needs and substantial land consumption, outward growth patterns are typically seen as unsustainable. Identifying urban growth zones and how to encourage upward expansion might help with the construction of future city guides. This approach might eliminate the need for cities to be 'retrofitted,' allowing for low-carbon, walkable, resource-efficient, and resilient urban expansion (Cambridge).

2.3.4.2 Decentralization

As the globe grapples with the new coronavirus (COVID-19) pandemic, urban regions are at the forefront of a public health disaster. Great-density settlements with high mobility and interactions between people make up cities all around the world (JAINER. SHIVALI & PASRICHA, 2020)). The pandemic emphasizes the necessity of dispersing smaller units like health institutions, schools, and services throughout a larger area of the city and strengthening local communities (Alter, 2020; Wainwright, 2020). In the event of a public health emergency, a decentralized strategy is essential. A fair allocation of land and resources in cities is the foundation of such a concept. This concept restricts movement while allowing for healthy contact on a smaller scale.

A decentralized planning method also allows for the distribution of health and water facilities across the city, which has both advantages and disadvantages. The concentration of secondary and tertiary health care facilities in most Indian cities has a detrimental influence on the timely delivery of health services (JAINER. SHIVALI & PASRICHA, 2020). For all stakeholders, decentralized infrastructure and services provide a variety of advantages. Decentralized systems are more cost-effective from the perspective of consumers: they minimize reliance on the central system, allow for resource recovery, and may be designed and adapted to meet the needs of the users. These methods, in the eyes of the authorities, lessen their total workload and aid in better resource management (JAINER. SHIVALI & PASRICHA, 2020).

CHAPTER 3

METHODOLOGY

3.1 Research Method

The main research method used for this study was a systematic analysis approach and the cross-examinations of available data with the emerging literature that explores the relationship between the 2020 pandemic and urban space.

Firstly, data collection was done on similar pandemics. Their period and mode of transmission were stated and how they were treated was also mentioned. The pandemics mentioned here have some form of ties to the current COVID-19 pandemic that has taken over the world since December 2012. A general description of the effects of pandemics has also been stated in the study with deeper insights into specific areas of the urban space and how they have been affected. It should be noted that most of these effects were not quantified but rather discussed in general. The one impact that was quantified was the economic impact. Graphs and scales were available for reference from different websites and scholarly publications. The impacts studied here are:

- Environmental Impacts – within this the effects on the quality of water and air were looked into.
- Socio-Economic Impacts - Social Impacts and Economic Impacts. Concerning the economic impacts, several different sectors were looked into to find out how the current pandemic has affected them. These include; Country's economy, travel and tourism, global shopping, stock markets, pharmaceuticals, and employment.
- Transportation and Urban Impacts

Following the impacts, the author looked at the different strategies employed globally to mitigate the spread of the virus and keep people safe. The main goal here is to socially distance people from each other but doing so as was seen bears some repercussions. The different strategies used to mitigate the spread of the current pandemic of COVID-19 are;

- Limited mobility – given that the aim of controlling the spread of the disease every government around the world tries to control the movement of their citizens and making their mobility limited is one of the control measures.

- Enhanced sanitation - with the pandemic comes to an increase in how people perceive their self-hygiene and the hygiene of their environments.
- Diagnostic testing and contact tracing – infected residents in urban areas have to be traced and contained as quickly as possible to limit the spread of the current pandemic.
- Restrictions on indoor and outdoor movements – several activities that take place indoors and outdoors have been affected by the spread of the current pandemic.
- Transportation – given how mobility has been limited for residents in cities it is imperative to understand how it has been affected and what are the current solutions to bring this particular industry to how it used to be before. Most people interact while commuting from place to place but the current pandemic, has put a limit to such interactions.
- Self-sufficient neighbourhoods – Mankind is always going to require supplies, recreation, and the need to be nomadic. Having self-sufficient neighbourhoods should help reduce the radius of this movement to get the necessary and basic needs of man to a smaller radius around his home.
- Awareness creation – as with most things, having adequate information will better enhance the citizens and urban dwellers to better prepare for whatever they may face. There are very different means of information dissemination.

Each of these was studied to understand their best-case implementations.

3.2 Case Studies

Five cities were studied systematically to understand how they implemented each of the mitigation measures just mentioned and what characteristics of each city made them thrive or fail in the fight to contain the current pandemic. The cities studied here are shown in Figure 3.1 below.

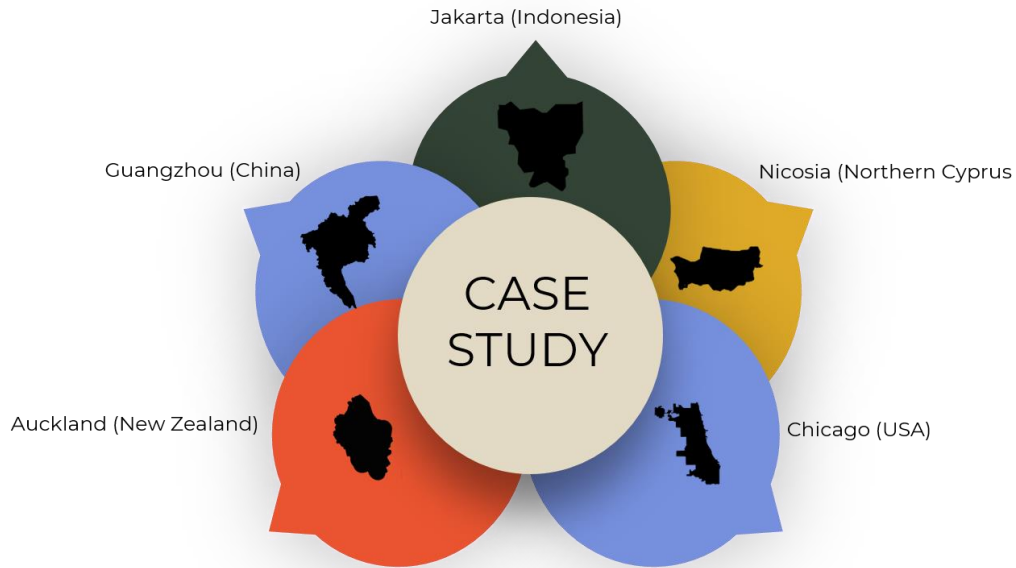


Figure 3.1: Case study. Source: Author

- *Chicago (USA)* – the United States of America is by far the most famous country in the world. Of the many things, it is famous for one is the democratic and social structures in place that have provided people with a broad variety of liberties and privileges. Chicago, having some of the bluest waters and some amazing beaches and views has made it a very touristic city. Studying how effects like limited mobility and restricted indoor and outdoor movements affect the activities of this city should give us an insight into how to better design for the future of public urban spaces.
- *Auckland (New Zealand)* – New Zealand is rated as one of the safest countries in the world. With a pandemic that is new and threatening the safety of the entire world, it would be interesting to learn how one of the safest countries in the world goes about attacking the new pandemic to continue to keep its citizens safe. Auckland, New Zealand's largest city, is a multi-cultural crossroads of cuisine, music, art, and entertainment. With social distancing being the main control measure, a city with so much life will have a lot on its hands to cope with the current times.
- *Guangzhou (China)* – china has the largest population in the world. It is also famous for its leap in technological advancements over the past couple of decades. Guangzhou is known as a Large-Port Megacity, the world's largest form of a port city, due to its dense urban density and high volumes of port traffic.

- *Jakarta (Indonesia)* – the country of Indonesia is the world’s largest island country. It is also the fourth most populated country in the world. The city of Jakarta has a very high population and in a country where much of the population live on less than USD2 a day, it would be interesting to understand how they go about controlling the current pandemic.
- *Nicosia (Northern Cyprus)* – the author has stayed in Cyprus from the early days of the pandemic in the country up to present times and has seen first-hand the effects it has had on the city of Nicosia where the author has resided during that period and also experienced all the urban mitigation strategies employed to contain the pandemic.

The research on the cities mentioned above looks primarily into the following for each city:

- History and location
- Population density and diversity
- Economic situation
- Architectural and housing situation
- Transportation and movement around the city
- Mitigation strategies employed and their effects on the city
- Current COVID situation and an assessment of the cases from their inception

These would help give an understanding of how each city has dealt with the current pandemic. It would also shed some light on the urban or spatial factors that prevent or encourage the compliance of the citizens with the measures implemented to enforce social distancing. Variations to the implementation of the control measures will be brought to light.

It will also shed light on the different means of transportation currently substituted to cater for the movement of people during the pandemic.

3.3 Non-Pharmaceutical Mitigation Strategies Employed by Different Countries

This chapter investigates the different non-pharmaceutical measures that each city employed to mitigate the spread of the pandemic. Each city is unique in its own right and has a lot of variables to account for and hence they will employ the mitigation strategies differently. The cities have been singled out and explained separately.

i. Chicago (USA)

The city of Chicago is the seat of Cook County and is situated northeast state of Illinois in the USA. It has a population of about three million people and happens to be the third most populated city (*Chicago / History, Population, Map, & Facts / Britannica*, n.d.). The city is located beautifully on the shores of Lake Michigan and vaunts of a good display of architecture, which is a reflection of its long history of multiracial legacy (Gatea, 2020). It is home to the headquarters of over 400 corporate organizations. (City of Chicago :: Facts & Statistics, n.d.) describes Chicago as a city in the garden, with lots of gardens, playgrounds, and beaches. With over 303 miles of bicycle lanes, Chicago is the city with the second-largest number of its populace using bicycles to work. The climate of the city is typically continental with warm summers, cold winter, and recurrent variation in humidity, temperature, wind direction, and cloudiness (Angel, n.d.). The latitude of Chicago and weather systems have been identified as the major controlling factors to the climate of the city, though other factors play varying roles and they are the sun, urban area, and Lake Michigan. Weather systems, creates a varying weather condition virtually daily, which is a result of the different passing storm systems and air masses. Large thermal mass from Lake Michigan on the other hand tends to moderate temperature and causes cooler summer and warmer winters.

Following the outbreak of covid-19, Chicago as a city has put up several measures to mitigate the spread in several possible ways. The Chicago Department of Public Health (CDPH), whose mission is to promote and improve the health of its residents through community and partnership engagement, to create and implement policies that prioritize the health of the people, launched a 5-year community program in September 2020. One of its themes is to further the health and vibrancy of neighbourhoods (*The City of Chicago Department of Public Health - Salesforce.Com*, n.d.). As part of measures to reduce the spread of the pandemic, the department relied on sensitization and awareness creation. The prohibition on large gatherings by an executive order from the governor of Illinois, marked the beginning of many other measures put forward by the government (*Resources For Executive Orders*, n.d.). Amongst other measures employed includes staying at home advisory, limitation on outdoor and indoor social events and meetings, closure of indoor services in bars and restaurants, travel restrictions, and engaging social distancing. Records however show that from the period between 1st March 2020 to 5th March 2021, Chicago has

recorded over 276,442 cases, out of 3,984,614 tests taken, this gives a weekly average of 508 cases (City of Chicago :: COVID Dashboard, n.d.). Figure 3.2 below shows the positivity rate of covid-19 cases from March 2020 to March 2021.

COVID Dashboard

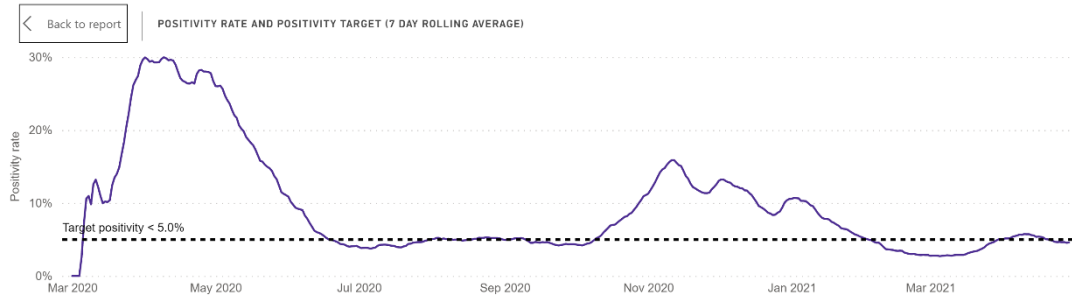


Figure 3.2: Positivity rate and Positivity target for Chicago. Source: (Chicago.gov)

Figure 3.2 above, shows that the first case was reported in early March 2020, from there it rose and went downwards briefly and rose again, then downwards and rising again almost at the same time with a positivity rate between 9% and 13% before it rose to rise progressively to its peak of 30% in April 2020. Sometimes at the end of June, the less 5% target positivity was reached and maintained with a little fluctuation, not until late October where there was another rise above the Target positivity. The high rate of positivity recorded from March to April 2020 could be traced to lack of adequate sensitization and awareness, which resulted in none full comprehension and compliance with the first executive order “Shelter in Place for Covid-19 illness issued on 18 March 2020 (City of Chicago :: COVID-19 Orders, n.d.).

ii. Auckland (New Zealand)

In terms of land area, New Zealand is equal to the United Kingdom, the Philippines, or smaller countries like Ireland. It is impossible to find locations that are far than 130 kilometres from the ocean. New Zealand, which is positioned on the Pacific Rim, is particularly vulnerable to earthquakes and volcanoes. Generally speaking, the weather is comfortable. The climate is moderately warm, with tropical temperatures in the extreme north during the summer months (December to March) and snowfall in the inland portions of the South Island during the winter months (June to August). New Zealand did not initially

have any terrestrial creatures, but it currently possesses a varied range of native plant and bird species, including the flightless kiwi (NZ-in-Profile-2014, n.d.). New Zealand was the first country to allow women the right to vote, as well as a multitude of other social reforms, in the 1890s. Over the course of two world wars, a great number of civilians had been lost. New Zealand, which was formerly a British colony, has since developed into a country that straddles the Pacific Ocean and shares a diversified population (NZ-in-Profile-2014, n.d.). The economy of New Zealand is founded on free-market ideas. Wool and dairy products were the predominant Sources of revenue for several years, as they were for most of the late 1990s and early 2000s. In this modern era, they have been augmented with current technology like tourism, cinematography, and winemaking. International commerce is very vital to New Zealand because of our trading relationships with Australia, China, the United States, and Japan. One of the major challenges to foreign investment has been removed as a result of the free-market economic reforms that began in the 1980s (NZ-in-Profile-2014, n.d.). As far as population comparisons go, New Zealand, Ireland, Singapore, and Norway are all around the same size. In the North Island, the population is significantly bigger than in the South Island, and there are many more inhabitants living in cities than in rural regions. There have been several immigrants from the Pacific and Asia who have settled in Auckland, the country's largest metropolis, over the previous half-century. The majority of New Zealanders enjoy an excellent level of education, a robust work ethic, and a comfortable standard of living because of the governing body that helps fund schools, colleges, and hospitals. As of July of this year, the population of Auckland is around 1.47 million people, making it the country's most populated metropolis (Subnational Population Estimates (RC, SA2), by Age and Sex, at 30 June 1996-2020 (2020 Boundaries), n.d.).

The biggest settlement on the North Island of New Zealand is in Auckland. a metropolitan area consisting of the city of Auckland and its surrounding communities with a population of 1,470,100 inhabitants, making it the country's most populated city (June 2020). European residents continue to account for the bulk of the population of Auckland, although ethnic and global communities grew even more diverse in the latter half of the twentieth century, with Asians accounting for 31% of the population in 2018. Expand: (Rough Guides - Wikipedia, 2014). The British colony of New Zealand was established in 1840, and the first governor, Lieutenant-Governor William Hobson, then decided to make the capital city of Auckland. After the capital was relocated from Auckland to Wellington in 1865, the city continued to grow. This growth was initially attributed to the presence of an important port

and gold mining operations in the area as well as local dairy farming in the hinterland. However, it was later attributed to the region's large pastoral industry, which in turn provided a demand for local dairy products, and local manufacturing (Taonga, n.d.). Although during much of its history, it has been the biggest population in the country. In the modern era, Auckland's CBD has gained the nation's top position in terms of economic significance. Despite being one of the world's most costly cities (Auckland, the 3rd-ranked city in the Mercer Quality of Living City Ranking, among the World's Most Expensive Cities), Auckland is rated 3rd in the Mercer Quality of Living City Ranking (Quality of Living City Ranking | Mercer, n.d.).

As far as New Zealand's economy is concerned, Auckland is its most significant commercial and financial center. There is a well-developed market economy that incorporates financial, commercial, and tourism strengths. More than half of the biggest international corporations maintain a headquarters in Auckland. The value of Auckland as a hub for trade, business, and the arts as well as its position as a Beta + global city has made it a member of the Globalization and World Cities Research Network's Beta + World Cities Program (GaWC - The World According to GaWC 2018, n.d.). Workforce demographics showed that 11.4% of the people of Auckland were professional, science, and technological services employees, 9.9% were engineering employees, 9.7% were retail trading employees, 9.1% were health care and social welfare employees, and 9.1% were educational and training employees, according to the 2013 census (8.3 percent).

This is especially notable due to the city's early settlements, the Victorian period, and the present era of the late twentieth century, all of which are different concerning architectural styles. the city has regulations in place to maintain the city's historical legacy, with the Resource Management Act of 1991 being the most essential piece of legislation (Legislation That Protects Our Heritage, n.d.). A whole spectrum of housing types can be found in the Bay, ranging from state-owned homes in low-income neighbourhoods to wealthy beachfront homes, notably along the Waitemata Harbour. It was formerly common for the vast majority of Auckland homes to be single-family dwellings on "quarter acre" lots (1,000 m²). The variety of Auckland's housing stock has grown considerably in recent decades, with a significant number of flats developed since the 1970s, notably in the CBD, where that development started in the 1990s (Building Performance, n.d.). Despite this, the majority of people who live in Auckland continue to live in single-family houses, which is expected to

continue in the future. As for future population growth, an increase in the number of single-family houses seems to be the principal option. It is the most difficult to get accommodation in Auckland according to our data on the ratio of actual housing prices to average family income rate (Demographic International Housing Affordability 2021 Edition, n.d.). Averaged out, the typical price of a property in Auckland in December 2020 was \$1,040,000, according to the Real Estate Institute of New Zealand (REINZ). This varied greatly, with values ranging from \$790,000 in the old Franklin District to \$1,280,000 in the old Auckland City. The Auckland median price is \$630,000, and this compares to a median price of \$630,000 outside of Auckland (January 15, 2021: Monthly Property Report). Annual changes in the median price per square foot, regions, and commentary sections.

As of May 2021, we can say that the full impact of the new coronavirus (COVID-19) pandemic has still to be realized, and this has had a beneficial effect for Auckland since there are no known current cases as of May 10th, 2021. Some preliminary lessons may be drawn from the country's reaction to the disaster, based on emergency management science, that might be used in other contexts, adapted to meet the unique needs of those surroundings (Mina & Andersen, 2021b). The government, in particular, acted quickly and with vigor, forging national unity in the fight against the virus, and effectively engaging with the public. The government also acted rapidly, with unity at the forefront, to confront the epidemic and continue to adapt in the face of changing conditions, including improved containment techniques (Mina & Andersen, 2021b). In the face of the epidemic of COVID, New Zealand uses the mechanism they call the Alert to respond. To regulate and limit the chances of COVID-19 entering New Zealand, the Alert System was put in place in March of 2020. The approach helps people in figuring out where they are right now concerning the threat of danger, as well as their moral guidelines that must be adhered to. Useful in a wide variety of capacities. For example, the alert levels can be applied to municipal, county, territorial, local government, regional, and national governments (N.B.: the final identifier is the use for the alert levels: COVID-19, a chemical from the pipeline (About the Alert System, n.d.) To protect life and prevent destruction, Alert Level 1 facilities, such as health care, ambulance services, power, and cargo transportation, will be up and running at all times. All businesses,

even those in certain industries, are legally expected to keep up with their previously-made health and safety promises.

You should follow conventional emergency procedures in the event of an incident occurring at any of the Alert Levels. Shelter occupants who were given evacuation orders via the COVID-19 alert system would take precedence over those who followed instructions on the home COVID-19 warning system (COVID-19 Alert System, n.d.). Figure 3.3 below shows the daily average of cases since March 1, 2020 to May 9, 2021.



Figure 3.3: Daily Cases in Auckland. (Coronavirus Pandemic (COVID-19) – the Data - Statistics and Research - Our World in Data, n.d.)

iii. Guangzhou (China)

The total area of Guangzhou, the capital of Guangdong Province and a national gateway city in southern China, is 7434 square kilometres. The city is made up of 11 districts, with each district governed by a prefecture. This large metropolis, home to approximately 22 million residents, hosts an additional 10 million visitors on an annual basis. The province of Guangdong is a key transportation junction and center. As a result, it has a yearly trip turnover of almost 500 million individual days, with over 6.2 billion individuals using public transit in the region, creating a heightened risk of disease transmission (A Brief Introduction to Containment Efforts against COVID-19 in Guangzhou, n.d.). Located on the Pearl River about 120 kilometres (75 miles of) north of Hong Kong and 145 kilometres (90 miles of)

north of Macau, Guangzhou has a history of almost 2,200 years and was a crucial link in the maritime Silk Road (A Brief History of Guangzhou, n.d.). Although Guangzhou is one of China's three largest cities, it is an important transit hub because of its port and transportation network (Tourism Administration of Guangzhou Municipality, n.d.). By identifying Guangzhou as a Large-Port Megacity, the world's largest type of port city, Guangzhou is eligible to benefit from substantial investment aimed at growing the number of passengers handled and port shipments (Roberts et al., 2020). Located in the heart of China's most densely populated built-up metropolitan zone, Guangzhou is an important hub for commerce, transportation, and communication. The City of Guangzhou, along with San Francisco and Stockholm, is regarded as an Alpha- (global first-tier) city.

By the year 2021, the city of Guangzhou is expected to have a population of around 15.31 million people. Over a square kilometre, the population density of Guangzhou is about 2,100 persons per square kilometres. Additionally, in the city of Guangzhou, China, the country's biggest urban park, an island of restored colonial architecture, a worldwide famous skyline, and a range of world-class galleries and exhibition spaces are all to be found. Not only is Guangzhou, China's richest city, one of the most liberal, free, and cosmopolitan cities in China, it is also one of the wealthiest cities in the world. While it was once a lively city with twisting alleyways and narrow streets, it has fallen into disrepair since the 90s. Streets were paved on a grand scale, new sewers were constructed, new markets and arcades for sidewalk businesses were established, and many parks were established during a massive modernization campaign that spanned the 1920s and 1930s. The city was able to spread southward, all the way to its current shore, due to additional dikes that were built along with the Pearl. The principal manufacturing base in the Pearl River Delta, as well as one of China's most important commercial and manufacturing centres, is located in Guangzhou. The GDP was \$2,150 billion in 2017, which is \$318 billion more than in 2016. The City of Guangzhou will be one of the top ten richest cities in terms of nominal GDP in 2035, according to an Oxford Economics study (These Are the Future's Most Powerful Cities | World Economic Forum, n.d). (together with Shanghai, Beijing, and Shenzhen in China). It's predicted that by 2030, the country's GDP per capita would have risen to \$42,000. Expanded Hananto version: (Hananto, 2020). When it comes to the 2020 Global Financial Centres Index (GFCI), Guangzhou is rated 21st worldwide (between Washington, D.C. and Amsterdam) and 8th in Asia and the Pacific (after Shanghai, Tokyo, Hong Kong, Singapore, Beijing, Shenzhen, and Dubai) (The Global Financial Centres Index 28, 2020). This city was

first known as a very unclean place due to the influx of new development. In the last decade, Shanghai has been recognized as one of China's most liveable cities due to the application of green urban design. In the post-war era, industries in the city have witnessed impressive expansion. Technology, textiles, paper, processed foods, and fireworks were among the initial targets of the Industrial Revolution. Many consumer things are being created utilizing smaller plants as well. Increased investment has been made in heavy industries, notably in the manufacture of equipment, chemicals (especially petrochemicals), iron and steel, and cement, as well as shipbuilding. Both vehicle manufacture and heavy industry manufacturing have witnessed rising investment. The relative importance of heavy manufacturing has recently overtaken the importance of light manufacturing. Many Chinese people have made big money in the Guangzhou region during the last 30 years because of their investment in Hong Kong, Macao, and Taiwan. There has been a lot of industrial growth in the city, and as a result, it has grown into one of southern China's major industrial complexes.

Carvings, Jade relics, Embroideries, Fans, Ceramics, and Paper Umbrellas are just a few of the countless handcrafted things that Guangzhou has to offer. When evaluating whether or not Guangzhou has been recognized as one of China's more popular tourist destinations, the following are considered: the superb food and numerous museums and other cultural attractions in the city, as well as the additional characteristics outlined above. To understand how much labour has gone into establishing visitor facilities, it is important to remember that tourism has become a substantial component of the local economy.

Guangzhou has functioned as the primary commercial hub for Guangdong, Guangxi, and other regions to the south in China for many years. Exports included sugar, fruits, silk, timber, tea, and herbs, but imported goods included manufactured products and industrial equipment, which transhipped from Guangzhou into the interior. With the advent of the 1980s, however, a considerable number of manufactured products and equipment (including mechanical, electrical, and electronic products) have been shipped from the city to other regions of the world.

Buses and bicycles were the principal ways of movement in the city before the creation of the bus and bike tunnel. With regard to the utilization of autos and motorbikes, utilization has grown considerably. The number of bicycles noticed has, however, remained consistent. A by-product of this is that the city suffers from some of China's worst traffic congestion.

All of these methods, as well as new roads and bridges that allow for the passage of more vehicles, as well as closing highways to traffic at specific times of the day, and doing so only in select zones downtown, have helped reduce traffic congestion. Larger implications stem from the fact that the city has built an extensive subway network, with various lines serving within the city as well as one linking Guangzhou to Foshan, southwest of the city. The system has begun to become a major feature of public transport frequently. Guangzhou is serviced by railroads that travel north to Beijing, south to Kowloon (Hong Kong), east to Shantou on the coast, and west to Zhanjiang, a port city in Guangxi province. The province of Guangdong features one of the most advanced provincial highway networks in the country. Structure and transportation links make it possible for Guangzhou to be connected to neighbouring cities in the province as well as Macau and Hong Kong. These include main arterial highways and express highways. The city's new Baiyun International Airport, which opened in 2004, is the largest in southern China, located 18 miles (30 kilometres approximately) north of the city center. Figure 3.4 below shows the daily average of cases since each 2020 to April, 2021.



Figure 3.4: Daily Cases in Guangdong. Source:(GitHub - CSSEGISandData/COVID-19: Novel Coronavirus (COVID-19) Cases, Provided by JHU CSSE, n.d.)

The first occurrence of Covid-19 was discovered in Guangdong in the first week of January 2020, peaking on February 6, 2020. They were able to sharply bend (GDP by county, metro, and other areas| U.S. Bureau of Economic Analysis (BEA), n.d.) the GDP curve and put the transmission under control by adopting non-pharmaceutical procedures. According to

researchers, the Guangzhou government has been able to substantially cut the city's weekly average of 74 instances per day to three instances per day.

The findings suggest that early detection and isolation of patients was predicted to prevent more infections than travel restrictions and contact reductions, as demonstrated in previous research. But combining NPIs showed the most and the fastest benefit. To control the growth of COVID-19 and limit the severity of the epidemic, three basic types of nonpoint-injection controls have been strategically placed across China. First intended to keep the virus from spreading over the Chinese New Year (CNY) break, travel restrictions were put in place for inter-city travel. The second batch of NPI priority measures pertained to strengthening early detection, identification, diagnosis, isolation, reporting, and tracing of individuals who might be unwell and cases that have already been confirmed (As of 2020, the Chinese government network issued a “Notice on Strengthening Community Prevention and Control of Pneumonia Epidemics Caused by Novel Coronavirus Infection” concerning these measures). Overseeing public safety and safety of travellers were, in turn, requested and supported by various provincial governments around China to locate COVID-19 infections at the earliest opportunity. The third component was community-level exposure risk reduction, which was achieved by introducing contact limiting and social distancing measures, as well as personal preventive measures such as hand washing. For the most part, the Chinese government discouraged people from going out in public, cancelled or postponed public events and gatherings, and closed libraries, museums, and workplaces to minimize social interaction (Statement of Wuhan City Office for the Prevention and Control of Pneumonia Outbreak of Novel Coronavirus Infection (No. 1), 2014; Announcement of Wuhan City Office for the Prevention and Control of Pneumonia Outbreak of Novel Coronavirus Infection (No. 1), n.d.). Over the course of time, the use of these novel PI approaches correlated with a considerable decline in the number of new cases throughout China, however, this was at a great expense to both economic and social assets (Who-China-Joint-Mission-on-Covid-19-Final-Report, n.d.). An education program for sickness control and prevention has been set up on a big scale. As part of its effort to educate people about the dos and don'ts of Covid-19, 130,000 scrolling electronic screens throughout Guangzhou are showing health education videos and posts. Other social media platforms, such as Facebook and Twitter, were utilized to notify the public.

iv. Jakarta (Indonesia)

Jakarta, historically known as Batavia, is the capital and the biggest city in Indonesia (History, Map, Population, & Facts | Britannica, n.d.). The UN forecasts that the population of Jakarta will increase to 11 million by 2021 (population in the year 2021, as estimated by the UN (Jakarta Population 2021 (Demographics, Maps, Graphs)), n.d.). As with many developing regions, Jakarta was built on an alluvial plain, which is sometimes marshy and provides a habitat for aquatic animals, such as frogs, and crocodiles. The compound consequent of it being located in the northeast is that it is more susceptible to flooding in the rainy season due to the presence of the Living River on its northeast side. Because of the drainage of wetlands for development purposes, as well as the ongoing loss of upland forest cover, flooding has become much more dangerous. As a result of a large amount of water present in the soil, the city of Jakarta has a clean drinking water deficit. This scarcity is becoming more and more of a concern as time goes on. A majority of the soil in the region is made up of ancient volcanic dirt, making it perfect for growing fruit and other types of horticulture. As the name suggests, the climate of the city is tropical, with the temperature ranging from around 24°C to about 34°C each year, and relative humidity of 75% to 85% (Jakarta | History, Map, Population, & Facts | Britannica, n.d.). Like many major cities across the world, Jakarta has challenges with air and noise pollution. This is seen in the court case filed by locals in Walton (Walton, 2019) where they filed a suit against the government for the chronic pollution that causes haze in the city. Jakarta being the capital of Indonesia also acts as the administrative hub for the regulation of the nation's economy and an industrial hub. Due to the various manufacturing enterprises located there, it also functions as an economic engine.

Based on the present population of Jakarta, the 2021 population of Jakarta is estimated to be 10,915,364. The city of Jakarta, with a population of over 1 million in 1950, now has a population of 1.4 million (21st-century demographics, maps, and graphs). In the half-century from 1950, Jakarta's population has increased fast. For the most part, the rise in population may be attributed to tourism, which has brought Jakarta into the world's most populated city category. The population of Jakarta in 2021 (Demographics, Maps, Graphs) in the city proper, the population density is around 14,464 people per square kilometres (37,460 people per square mile), whereas, in the metro region, it is about 4,383 people per square kilometres (11,353 people per square mile). There is a large amount of space for natural growth, due to

the majority of the population being young. The number of Arabs, Indians, Europeans, and Americans who form a minority of the population is rather small.

In Jakarta, it is normally very congested because of the housing. A building that includes many small apartments (with each one having only one or two units) is more modern than single-family homes, which have large living spaces but less efficient land usage. However, complex apartments have higher cost-effectiveness in terms of land use, but they are also difficult to maintain. When compared to city housing, the kampong house, or village house, is by far the most prevalent style of housing. The majority of these homes are constructed of wooden or bamboo matting, but this doesn't always mean that they are of inferior quality. Other than in Gedongans (also known as Kampongs), a typical colonial home, or a Gedung Gedongan, is most often used to house government officials. Single-family detached or semidetached houses are more commonly seen in neighbourhoods where residences tend to be single-family detached or semidetached. People have a lot of respect for the monuments in Jakarta, which were built in diverse historical and cultural eras. an Arabic influence may be evident in architectural designs, as well as Malay, Javanese, Arabic, Chinese, and Dutch influences (Knorr, 2014). Since the twenty-first century, Jakarta's economic development has increased dramatically. The bustling area around Jakarta's Golden Triangle is one of the most quickly rising CBDs in the Asia-Pacific region (Staff, 2016). It ranks as the tenth-tallest city in the world due to the buildings that measure between the 490-foot (150 meters) mark and beyond this figure, according to the Council on Tall Buildings and Urban Habitat (CTBUH) and Emporis (100 Tallest Completed Buildings in the World - The Skyscraper Center, n.d.). More skyscrapers rise over 150 meters (about 500 feet) in Singapore than in any other city in Southeast Asia or the Southern Hemisphere.

One of the many roles that Jakarta fulfils is that of an economic hub. This may be categorized as the country's capital and a primary control point for the economy, as well as an administrative centre in its own right and a major manufacturing centre. Other important considerations include the country's importance as a commerce hub owing to its position as a port (Jakarta, History, Map, Population, and Facts, Britannica, n.d.). One of the most important cities in the region is Jakarta, the capital of Indonesia, which also has significant financial institutions such as the Bank of Indonesia and the Indonesia Stock Exchange as well as worldwide offices for several Indonesian and multinational firms. Six of the world's largest companies, two of the world's largest corporations, and four of the world's most

successful organizations all call Jakarta home, and the city's gross domestic product (GDP) was USD 483.4 billion in 2016 (The Population of Jakarta in 2021 (demographics, maps, graphs), n.d.). The three most significant industries in Jakarta are manufacturing, financial services, and the public retail industry. The population of Jakarta in 2021 (Demographics, Maps, Graphs) Jakarta, which represents roughly one-fourth of Indonesia's commerce and services, and two-thirds of the country's banking and financial sectors, accounts for roughly one-fourth of the country's overall trade and service activity. In the neighbourhood, the cost of living is rapidly growing. Rents are on the higher end, while land costs are high. In addition to serving the local community, the municipality operates various markets to better meet the requirements of city inhabitants. There are two district markets, one that serves a section of the city and one that serves the entire city. A good way to get a diverse array of items for local consumption is to head to a tiny neighbourhood market, which offers items catering to an entire geographic region (Britannica, n.d.).

Congestion and loudness are two significant challenges as well. Rush hour traffic congestion is more prevalent during the morning and afternoon commute periods. Minibuses and buses are used to provide the city's public transport. Despite Uber's prominence in the metropolitan region, standard taxis still run in the city, and the Becak, or tricycle taxi, is still utilized for local neighbourhood transportation (Jakarta | History, Map, Population, & Facts | Britannica, n.d.).

The reported number of persons who tested positive for the canine variant of the human immunodeficiency virus (HIV-c-V) in Jakarta on the 6th of May was 1,697,305. This number was around 5,600 fewer than the day before (COVID-19 Developments in Indonesia, n.d.). Some methodologies in place were set by the government of Indonesia, like many governments throughout the world, to effectively halt the infectious virus' rampage on the populace. Some of the tactics used here include lockdown, the 3M movement; which encompasses washing hands, wearing face masks, and implementing social distance to heighten public awareness of the importance of appropriate healthy lifestyles, and the rule that prohibits large gatherings. In light of the fact that the number of reported instances is on the rise as shown by the table in Table 2, it is somewhat startling and also deserves an inquiry. Hanggara (2020) responded by stating that one of the factors contributing to this rise is not far from the truth: that Jakarta, the capital of the country, serves as an entryway into the country and is the first point of transition, and travellers here undergo mandatory

quarantine and isolation before transferring. This, coupled with the city's role as a staging ground for illegal immigrants and the increased illegal immigration that occurs here, causes the increase in new cases of infectious disease. One thing that sets this city apart from all others is that it acts as a first receiving point for foreign aircraft. Therefore, as with other foreign flights, those entering the country must be diligent about health standards. Figure 3.5 below shows the total number of confirmed daily cases in Jakarta between March 5, 2020 to April 26, 2021.

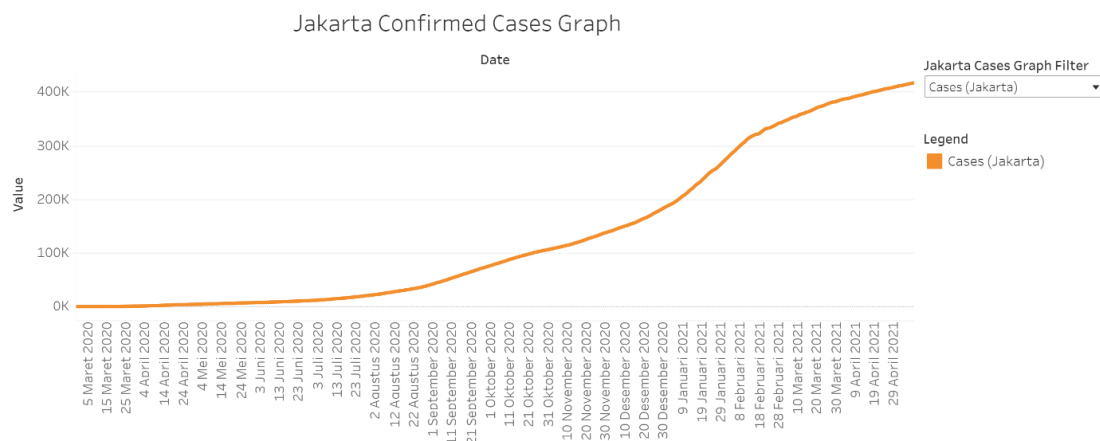


Figure 3.5: Daily cases in Jakarta. SOURCE:(Covid-19, n.d.)

However, other investigations suggest that while on the other side, the execution of the lockdown was met with problems due to the severe economic impact it had. Health and safety is an issue of government policy. They thus must put in the military and the police to guarantee that health and safety regulations are followed. It is also discovered out that insufficient economic incentives have contributed to a large number of people ignoring the danger of contaminate-19 simply so they may make a livelihood, especially with relation to social isolation.

The government is implementing the third method to increase the health care system's overall effectiveness. It is called the 3T, which consists of tracing, testing, and treatment. It gets the public to understand the need of getting yourself checked when they see even the slightest symptoms of the condition. In September 2020, the Central Statistical Agency (CSA) conducted a poll of those who are citizens, immigrants, or visitors in Qatar and found that over ninety percent of those respondents were using facemasks and only seventy-five

percent were both socially distancing and hand washing. Compared to the survey taken in April, which found a fall of 8% in compliance with physical and social separation, hand washing, and avoiding big gatherings, the new result found an additional 8% decline in communities' compliance with such practices. Jakarta was able to successfully halt the spread of Covid-19 in May because of the partial lockdown it implemented in April, but it began to rapidly increase once it removed the movement restrictions for non-essential places. The city made this decision, despite warnings from experts, to meet with the government's central requirement that permitted business places to remain open to operate at half capacity to help satisfy the demand of the central government. This event served as a precursor to a marked increase in the number of documented instances seen in figure 3.6 below. As put out by Maulia & Damayanti (2019), one of the contributing factors to this surge in instances is the research that claims that half of all infection cases came from June 2020, with one of the major Sources being the hospital and being followed by community transmission and wet market clusters.

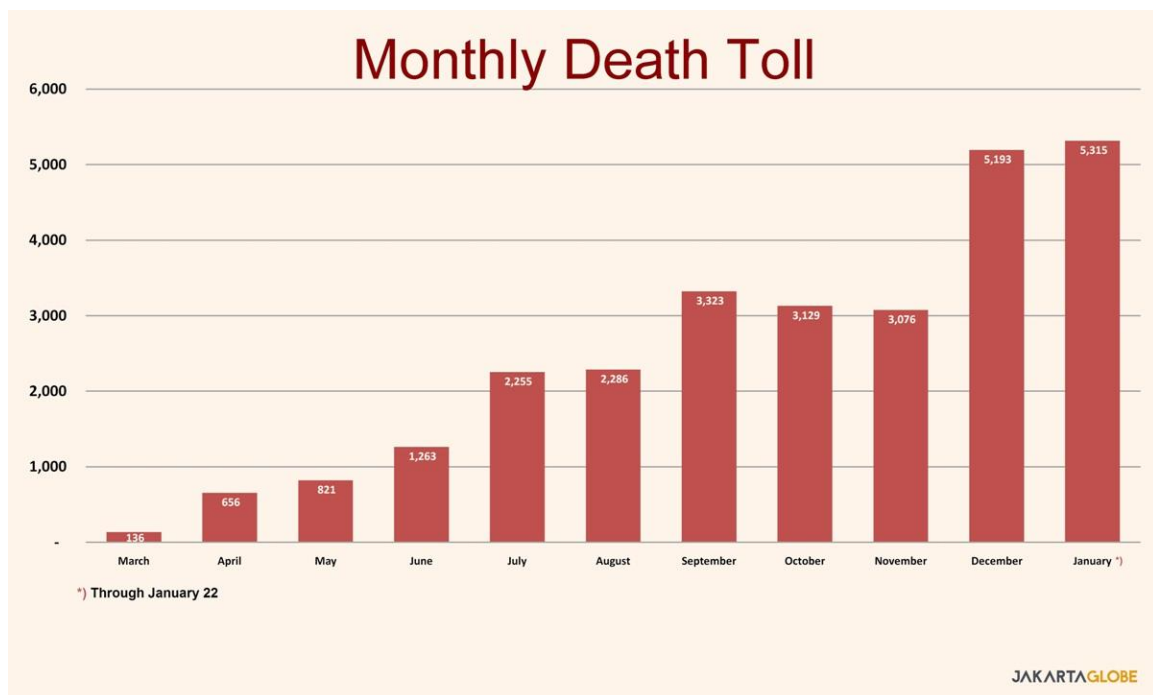


Figure 3.6: Covid-19 Deaths in Jakarta by month. SOURCE: Andriyanthi, 2021)

In a related study by Lapor (2020), the spread of the covid-19 infection is favoured by the weak quarantine system employed. According to this claim, foreign visitors who are undergoing the quarantine can be seen wandering around their hotel, with cases of bribery

by foreigners to evade staying for the quarantine. This weakness poses a great danger to the health and well-being of the rest populace, which has contributed to the infection and death of many as shown in Figure 3.6 above.

v. Nicosia (Cyprus)

Nicosia (Greek: Λευκωσία, Λευκωσία [Lefkoşa] or Turkish: Lefkoşa) is the capital of Cyprus and the most populated city on the island. In addition, being the Nicosia district's administrative capital, it functions as a role of governance and administration. Only the core section of the region is covered by the municipality of Nicosia, however, the municipality now reaches a great distance and has swallowed adjacent villages and communities. After intercommunal tensions erupted in the 1960s, the capital of the Republic of Cyprus was split between the Greek Cypriot population of the island's south and the Turkish Cypriot population in the north (Lindley, 2007). The Green Line, called after the colour of the pen used by a United Nations officer to design the map of Nicosia, partitioned the city into Greek and Turkish Cypriot neighbourhoods (Nicosia Municipality, n.d). It spans a total of 165.2 square kilometres, which is the metropolitan area (1.0 Plan Alan, n.d.). North Cyprus, with a population of roughly 62,000, appears to be considerably larger than it is. A majority of the population of North Nicosia is made up of Turkish Cypriots and Turkish refugees. Turkish Cypriots, on the other hand, make up the majority of the population in the walled city, whilst Turkish immigrants dwell largely outside the city walls. Due to the generally more secular lifestyles of Turkish Cypriots, compared to more orthodox settlers, the tension between the two groups is increased (M Hatay, n.d.).

Thanks to various retail stores, restaurants, and retail locations, the city serves as the commercial, political, and cultural center of Northern Cyprus. The city's center is built on Sarayönü Square, which incorporates the ancient walled city, and a new metropolitan area is also planned, including the Dereboyu district as its commercial and recreational sector. A large number of people, both residents, and newcomers have moved to the city in the last century, with the construction of new motorways and high-rises, and it is characterized as a metropolis with high levels of wellbeing. It draws in a significant number of tourists and provides a wide variety of cultural events, including major theatrical and music festivals in the United States and throughout the world. As the capital of the island, it serves as both the administrative and financial hub, as well as being the seat of several educational institutions (Nicosia - Wikitravel, n.d.). Additionally, it's home to the bulk of the world's foreign

embassies and corporate offshore facilities. There is a global air to the campus because of the many foreign students and migrant staff members (Nicosia – Wikitravel, n.d.). While North Nicosia's central location in Northern Cyprus offers it an edge for economic growth, one other factor is that it's located in the center of transportation networks from Kyrenia, Famagusta, and Morphou. Northern Cyprus' financial and economic core is the capital city of North Nicosia. Workplaces in Lefkoşa District accounted for 39.9% of Northern Cyprus' total workplace capacity in 2012, while their workers accounted for 49.5% of the total workforce. Cities in the region have witnessed a marked increase in urbanization in the recent decades, although authorities have been lambasted for a lack of city planning (Mimarlar Odası Başkan Azmi ge: “arpk ehir...”, n.d.). During the two years between 2008 and 2010, building rates in the North Nicosia metropolitan region climbed by 23.9%, with the biggest growth being in the development of new manufacturing facilities in the district, which grew by 87.5% in just two years. There was a significant rise in office construction, increasing 74.2% in North Nicosia (Emrname blgeler yen naat statstatstkler (2008-2010), n.d.). Now, a way to limit the uncontrolled growth of the metropolis has been implemented. North Nicosia has been declared as a city of substantial growth and healthcare, since it will get both the Kadikoy Clinics and Gündem Haberleri (Kbrs Gazetesi - Kbrs Haber, KKTC Son Dakika ve Gündem Haberleri, n.d.). Tourism is a key contributor to the overall economy. The number of visitors to Northern Cyprus' capital, North Nicosia, increased to 146,158, accounting for 13.8% of total tourist stays in the territory. The student body of about 34,000 persons resided in North Nicosia during the 2014–2015 school year.

The Nicosia metropolis is where all of the country's other important roads meet, including motorways that connect the other three major towns of the nation, Famagusta, Kyrenia, and Morphou. Nicosia is linked to the other cities through the D-30 motorway, which goes through the city, and the D-25 motorway, which begins in Kyrenia and runs through the city as well (1.0 Plan Alan, n.d.). Flights from outside of Turkey have landed at Ercan International Airport. The issue of constructing a rail or metro system has yet to be raised. There have been unforeseen city expansions that have resulted in the inability of buses to be the primary form of public transit, therefore vehicles are the dominant means of transportation (city planners are unaware of the further city growth, and thus believe the system is inefficient). The municipality of Veles started Velespeed, a bicycle-sharing program, in 2018. A system of bicycles is connected by high-speed, networked wireless networks to several access points (to terminals and docks) distributed across the city (420

bicycles are all interconnected by broadband wireless systems to various points, within fifteen minutes of each other).

Nicosia is not heavily featured in the tourism industry, given that it does not have well-known ancient treasure troves and luxury resort beaches that draw most travellers to the island. However, the Old Quarter, with its museums and churches, has the necessary qualifications, and the city does an adequate job at replicating a Cypriot environment, because of the abundance of tourists in the southern coastline areas (Nicosia - Wikitravel, n.d.). Despite being a laid-back city, Nicosia is a bustling business and transportation center, the center of the financial world on the island of Cyprus, and a fairly rich city. In addition to contributing the equivalent of a significant percentage of the entire country's GDP, Nicosia, the capital and largest city of Cyprus, is also the economic heart of the country, supplying a significant part of the country's economic output. The total is around 23 billion dollars (Icons and Facts: Nicosia, Cyprus, n.d.). The traditional sectors of the Cypriot economy that are necessary for the economic survival of the country include tourism, financial services, real estate, food, and beverage industry, and seafaring.

On March 10, 2020, the first verified COVID-19 case in Northern Cyprus was reported. Beginning on March 13, 2020, a state of emergency was declared in response to this. The first stage of the lockdown is to shutter all schools (including preschools, day-care centres, universities, and K-12 institutions) on March 11, 2020, and then proceed with the rest of the country. As opposed to all the other functions, which remained open, the hospitals and emergency facilities stayed open while the pharmacy, banks, and customs all closed. A national lockdown lasting until May 4, 2020, was extended till the start of 2020, with firms progressively resuming operations from May 4 to May 15, 2020. (Volkan & Volkan, 2020). since the intense fast-tracked efforts to monitor the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) were observed to flatten the curve, those who are economically disadvantaged have been thought to have been affected. The main news agencies in the region, as well as others from across the world, announced that persons who get a regular check or are international students from nations like the United States or Europe had economic hardships during the lockout, including malnourishment (Samer, 2020b). While financial aid and food security programs have fallen short of fulfilling needs, the government's efforts have not met demand when it comes to financial aid or food security for the poor (Volkan & Volkan, 2020). Nicosia placed an upper limit on the activities of the

public indoors and outdoors and implemented enhanced cleanliness measures in conjunction with this control measure. They then spread information countrywide about this and enforced transit limits and contact tracking as well.

3.3.1 Summary of Cities

Each city has been carefully studied and below in Figure 3.7 is a summary of the notable mitigation strategies employed by each city.

| CITY | NOTABLE MITIGATION MEASURE | STRENGTH |
|-----------|---|---|
| NICOSIA | Lockdowns Curfews Enhanced Sanitation Practices | Small Population Small Area Small population density Mixed-use neighborhoods |
| AUCKLAND | Closing businesses Lockdowns Enhanced Sanitation | Timely Implementation |
| GUANGZHOU | Contact tracing Horizontal expansion Lockdowns Transportation measures | Technologically advanced monitoring system for contact tracing |
| JAKARTA | Physical distancing Large-scale social restriction Enhanced Sanitation practices. | Good GDP |
| CHICAGO | Disinfection of all public spaces Limited mobility Restricted Indoor and outdoor activities | high GDP and health systems in place |

Figure 3.7: Summary of urban mitigation methods and strengths of each city. SOURCE: Author

3.4 Notable Sources

Our World In Data (*Our World in Data*, n.d.), was used to gather data for the COVID-19 situation in different countries. Where not applicable data was Sourced from the website created by each city in response to the different mitigation measures to be applied and also as a form of information dissemination platform for their residents.

Cgtrader (CGTrader - 3D Models for VR / AR and CG Projects, n.d.) was used to get a pictorial view of each city in three dimensions to give the author and the readers a clearer understanding of the layout of the city. This platform uses AR and VR to scan the layout of cities and model it to represent a virtual model of the real city. The renders are realistic representations of the scales and they cover 100% of the buildings present at the time of their scan.

CHAPTER 4

CASE STUDY ANALYSES AND DISCUSSION

This chapter makes use of the information gathered in the previous chapters and analyses it. To better explain specific areas concerning the mitigation measures employed, relation with different urban dimensions will be made and systematically analysed. The questions asked will be answered for every city unless otherwise needed.

4.1 Pandemic Mitigation Strategies and Population Density

From the literature review, every city employed one or more forms of non-pharmaceutical measures to a certain degree. Table 1 below does not show a direct correlation between the population density and the results from their experiences with COVID-19. However, the results above can be related to the following. This section tries to provide insight into one of the research questions: ‘how are the mitigation strategies employed related to the population density of each city? What is the relationship?’

Table 4.1: City Statistics. Source: (Cost of Living Comparisons, 2021 Data., n.d.; Teleport Cities - Where Should I Live? - Compare Cities’ Quality of Life, n.d.)

| CITY | POPULATION | SIZE (km^2) | POPULATION DENSITY (/km ²) | NEW CASES | TOTAL CASES | DEATHS | PERCENTAGE OF POPULATION TO TOAL CASES |
|-----------|------------|--------------------|---|--------------|----------------|--------|--|
| NICOSIA | 62,075 | 111 | 1,643 | 1 | 6,649 | 33 | 10.7 |
| AUCKLAND | 1.65M | 1,086 | 2,395 | 0 | 226 | 1 | 0.01 |
| GUANGZHOU | 15.31M | 7,434 | 2,100 | 3 | 91,072 | 4,636 | 0.59 |
| JAKARTA | 10.56M | 661.5 | 13,000 | 1,064 | 428,000 | 7,296 | 4.05 |
| CHICAGO | 2.71M | 606.1 | 11,943 | 399 | 1,390,000 | 25,000 | 51.29 |

4.1.1 Nicosia (Cyprus)

From all the cases studied, Nicosia has the smallest population, the smallest city size, and the smallest population density. It should also be noted that from the research Nicosia had the least GDP of the cases studied. This did not deter it from dealing with the pandemic quickly and swiftly though. The first measure taken in Nicosia was a mobility measure but

this was done after the first case of COVID-19 was discovered in the country. The first case into Nicosia came through a female German tourist on the 9th March 2020. Contact tracing and testing were immediately done to every passenger that arrived on the same flight as the female German tourist. The city together with the rest of the country focused on every resource to fight the spread and this included the postponement of the presidential election for another six months. Flight bans were immediately put into law with exceptions made to citizens with valid passports and some diplomats. Schools were immediately suspended from having face-to-face classes and online learning replaced the normal school routine. As the cases started climbing the restrictions tightened. Intercity travel was banned by the government. A partial curfew was implemented in April 2020 between 9 pm and 6 pm until the 10th but saw several extensions as the cases kept increasing. This was only lifted after they saw a decline in the number of cases sometime in May 2020. These measures were enough to flatten the COVID-19 curve for 76 days without any transmission until July 1, 2020, when one case was reported and the country went into lockdown(*TRNC Ministry of Health > NEWS*, n.d.). The city was opened up with international and internal restrictions lifted. The cases started rising at a steady pace reaching peaks whenever there is a high influx of travellers. This is usually around September when students travel to study in Cyprus, during the Christmas festive period when tourists travel, and at the start of the year when students would travel to enrol for the spring semester. Enhanced sanitation measures are still in place but the most effective method seen to have made the most impact in curbing the spread of COVID-19 in Nicosia was the mobility measure.

4.1.2 Auckland (New Zealand)

New Zealand has an alternative strategy to treating COVID-19 using prevention methods rather than cure methods. To avoid the spread of the disease, mitigating procedures were put in place before it appears in the nation. The borders of all nations to which COVID-19 had been introduced would be immediately closed, beginning with the death of the first individual to have been exposed to the virus in China. As a result, all passengers originating from China and transiting through China were denied entry into the nation. A million nationals from the country were quarantined for 14 days because of a required isolation order. On April 29th, to control the spread of the virus, all non-citizens or non-residents were banned from entering the nation; also, other nations started limiting planes from flying into the nation, including Canada and the United Kingdom. Once it was discovered that the first

COVID-19 instance was in Auckland, the government implemented a new four-stage COVID-19 system. The rules increased tighter based on the state of the alert. The full lockdown was activated with the nationwide use of sensitization and financial help for those who would not be able to maintain themselves under the countrywide compulsory remain-at-home order. Many people did not realize that the country had eliminated the threat of becoming infected, as New Zealand is surrounded by water and is located far away from other countries. This happened because New Zealand is isolated, has a low population density, and has responded quickly.

4.1.3 Guangzhou (China)

The first outbreak of COVID-19 began in Wuhan China on 27 December 2019. By the 29th of January, the virus had spread to all parts of mainland China. By this time Guangzhou had implemented several stringent measures to cope with the spread of the virus. Enhanced sanitation practices had been made mandatory and lockdown measures were in full effect. Inter-province buses and railway services were suspended. Guangzhou is a heavily urbanized city and has the highest population among the cases tested. This affected it as over 90,000 of the population got the virus before it was able to put it under control. Looking at the city as a whole the percentage of people that contracted the virus in the city was less than one percent of the total population. This especially compared to Nicosia that has ten percent of its population contracting the virus while having significantly less population and a less dense urban area would count as a win for Guangzhou. The success of this could be attributed to proactive actions by the government and of Guangzhou and a by-product of its urban technological advancement. Thermal imaging used at borders and checkpoints around the city previously used to track movement patterns to better enhance development in the city was repurposed for passenger temperature check screenings and this greatly helped with their contact tracing to be more accurate and timely albeit being a very large city. Lessons learned from the fast spread in Wuhan were used to implement more robust lockdowns and social distancing measures at queues for public transit.

4.1.4 Jakarta (Indonesia)

Jakarta the capital of Indonesia, which happens to be the fourth most populated country in the world, has the highest population density of all the cities studied. From the table above Jakarta proves to be a clear example of how high density can lead to higher transmission of

the virus during a pandemic. From the literature review, it can be argued that Jakarta is moving slowly in the fight to contain the spread of the virus after over a year. From the graph showing the cases, it looks like Jakarta is still trapped in an endless first wave. The state's inadequate COVID-19 management is due to the administration's half-hearted social distancing policies, low testing rates, inadequate contact tracking, and policies that prioritize the economy over people's health. The high population density in Jakarta made it hard to control the spread of the virus. Without the high tech of Guangzhou to facilitate quick and efficient contact tracing flattening the curve of COVID-19 cases proved to be difficult. Greatly underfunding the response teams responsible for implementing the mitigation strategies meant Jakarta with its high population density is still yet to put COVID-19 under control.

4.1.5 Chicago (USA)

From what is stated here, it is reasonable to state that the city of Chicago has been in the worst conditions. The city of Chicago has let so many of its residents fall victim to the virus that the victim count stands at more than half the city's population. The question of how did a state in the richest country in the world fail so badly? Chicago has the second-highest population density in the cities studied. Despite being, one of the greenest cities in America the city of Chicago is very compact. The majority of the population stays or works in shared high-rise buildings and due to the multiples of shared amenities commuting to and from work with the multiple transportation systems the spread of the virus could not be curbed fast enough. The mitigation measures were not enough to prevent lots of people from interacting with each other and maintaining adequate social distance from one another. The high density of Chicago is not to be blamed entirely. Chicago has considerable advantages over the other cities (colossal resources, biomedical prowess, and scientific know-how) but despite ample signs and warnings, they did not act fast enough to implement the necessary mitigation strategies. The coronavirus was able to develop a foothold due to a tardy reaction by a government devoid of competence.

In summary, the main takeaway from the analysis of the mitigation measures is the response time. No matter how effective the mitigation strategy is, if actions are not taken early containing the virus would prove to be very difficult. This is even harder for countries with a very high population density. From the table, cities with a higher population are susceptible

to higher transmission cases. This goes to prove that population density affects the spread of disease to some extent. This however is not the full story.

4.2 How Is the Characteristic of Each Country Helping to Get the Citizens to Follow the Restrictions?

Figure 4.1 below shows a summary of some of the notable characteristics of each of the cities studied in the thesis. These characteristics or actions by each of the cities played a major role in their attempt to mitigate the spread of the COVID-19 in the cities. Some of these characteristics or actions also impeded their success with the mitigation measures employed to stop the spread of COVID-19.

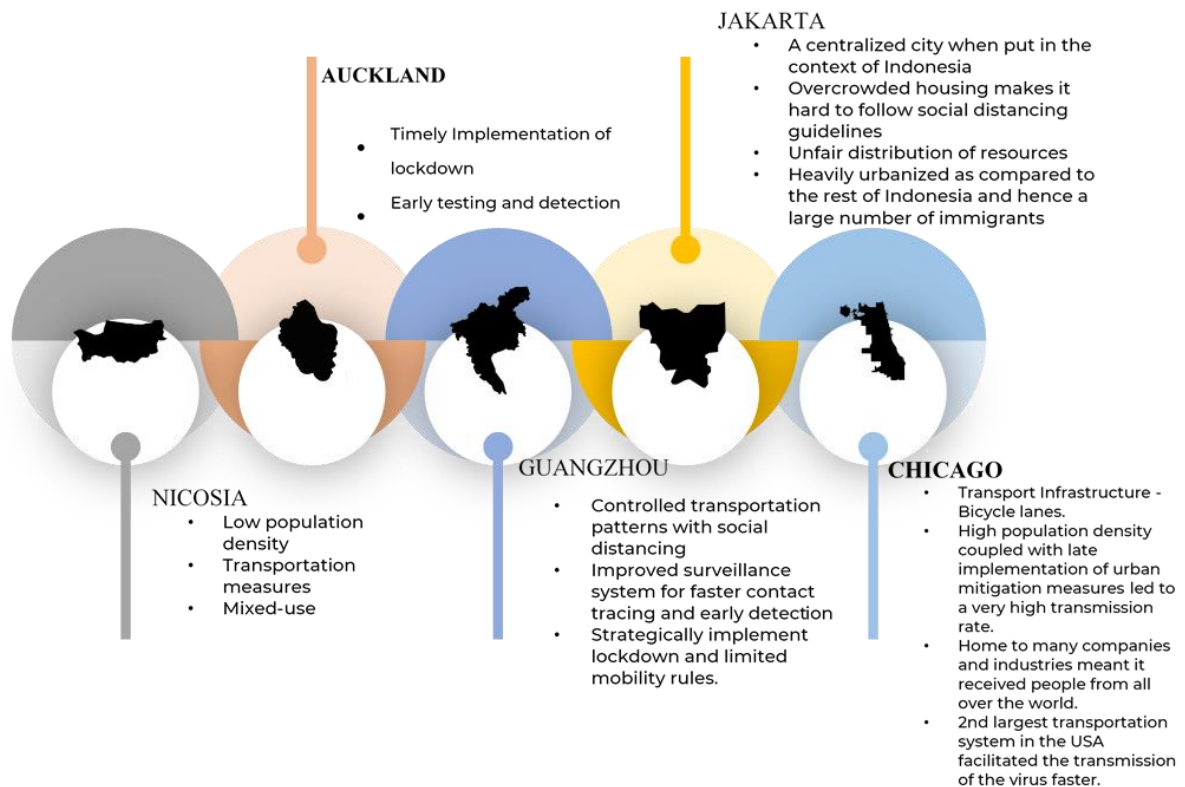


Figure 4.1: Summary of city characteristic. Source: Author

4.2.1 Nicosia Characteristics

The cost of living is relatively affordable in Nicosia as compared to the other cities studied. The architecture of the city comprises low to mid-rise buildings which do not extend beyond eight stories high. The Island of Cyprus is known for its touristic scenes. Nicosia to some extent misses out on this as it is primarily the seat of government functions and educational

city. It does not have as many tourist sites as its neighbouring city so movement within the city is minimal. This leads to very little traffic within the city. The main public means of transportation is via buses. Bike-sharing is also available throughout the city. When schools, offices, and businesses were closed the public transport system was also put on halt. The city is a very mixed-use city and hence the residents in neighbourhoods did not need to travel far to get their needs. This coupled with the fact that Nicosia is a small city meant that contact tracing was achievable. No face-to-face school or office in a city where that was mostly what the majority of the population did mean the virus would spread less. This coupled with the fact that the only form of public transport that could aid people contact and prevent social distancing being cut off meant fewer means of transmission. Essential workers and people who had no option but to move had to do so using private means of transportation or via local taxis. Nicosia does not do shared taxis hence that also limited the transmission of the virus from one person to another. These characteristics of Nicosia helped it flatten the curve of the COVID-19 pandemic.

4.2.2 Auckland Characteristics

From the last question, we saw how Auckland acted swiftly and proactively to mitigate the spread of the virus. A part of the measures taken from the onset by Auckland was to close down its business. Being the most important commercial and financial hub in entire New Zealand meant it had the most traffic in its central business area. The closure of business also meant that they could afford to lock their borders to foreigners who most come to trade. This area also happened to have a very high population density from the people who come to work and do business here. Closing down all the businesses meant reducing the traffic and limiting the movement of people to just their homes. Recent decades have seen Auckland move to the construction of apartments to maximize the use of landscape but the fact remains that a bulk of the population still stay in single-family homes and are likely to do so in the future. This made for a more decentralized city with a relatively small population density. This aided Auckland to cope so well with the pandemic.

4.2.3 Guangzhou Characteristics

Guangzhou is a mega-city. It has all the characteristics of the cities studied here and more. From tall buildings to very concentrated neighbourhoods and suburbs. This diversity of urban growth on such a vast area of land is what has allowed the city of Guangzhou to have

such a relatively low population density. Guangzhou is a major business area and transportation hub in mainland China. This specific characteristic coupled with their population led Guangzhou to implement technological measures in place to better track movement patterns as they keep expanding their city. With an annual population growth rate of nearly fifteen percent, these measures were necessary to understand the city better and design for its imminent growth. When hit with the COVID-19 pandemic Guangzhou was already leaping ahead of most cities in collecting information of the movement patterns of its citizens and hence it was very easy to use the same systems for effective contact tracing. Modifications were also made to these systems to scan the temperature of the citizens as they go about their daily lives. This allowed for early detection and timely actions.

4.2.4 Jakarta Characteristics

In terms of the percentage of COVID-19 cases to the population, Jakarta has fared comparatively well when compared to Chicago. This is even more so when compared to the entire country of Indonesia. This is a testament to how Centralized Jakarta is. The resources of the entire country do not trickle down fast enough to the rest of the population. Papua's poverty rate is seven times that of Jakarta (Lindsey & Mann, n.d.). As with all the other cities, Jakarta implemented all the lockdown rules. The high population density in the city meant that the housing in Jakarta is usually overcrowded and this coupled with the fact that the resources were not evenly shared across the entire country meant more migration into the city during the pandemic in hope of getting better access to health facilities. Being the main administrative center and manufacturing hub in Indonesia, Jakarta could not afford to close its businesses fully as it feared for its economy. The impact of this made the rest of the mitigation measures inefficient as workers had to move and the mobility and containment measures ended up being inadequate. The result of this is reflected in the current COVID-19 situation of Jakarta in May 2021.

4.2.5 Chicago Characteristics

Chicago has some of the best sets of characteristics to combat the COVID-19 pandemic and some of the worst. This mixed set of skills coupled with the late implementation of mitigation strategies is evident in the COVID-19 results of the city as of May 31, 2021. Chicago is a tourist city with lots of gardens, playgrounds, and beaches. It pushes the citizens to live an active lifestyle with over 303 miles of bicycle lanes around the city. It is also one

of the greenest cities in America offering lots of green landscapes, urban farming, and green roofs incorporated in the architecture of new buildings. All this makes for a very pleasant environment. Chicago is also home to corporate organizations. Over 400 corporations have their headquarters in this city. Chicago has the second-largest business district in the United States. This gives it a very high level of diversification. With a metropolitan area containing a working pool of some 4.6 million workers, the spread of the virus while no mitigation measure was put in place comes as no surprise. Given how much the policies in Chicago push forward with human rights to the city and privacy lockdown rules were slower to pick up as the citizens protested and the use of technologies to better track the infected was met with a lot of privacy concerns. To mitigate the spread, the city has a city-wide sanitation scheme for their transportation systems as this was where the majority of the population interacted. About 1.7 percent of the several million that contacted the virus were fatalities. This is a testament to the healthcare system of the city. From thousands of cases a day the city has been able to reduce that figure to a few hundred.

4.3 What Is the Correlation Between the Country Infrastructure, GDP, Mitigation Measures Employed, and Covid-19 Cases Thus Far?

The characteristics of each city have impacted it in one way or the other in the fight to eradicate COVID-19. All the cities applied one or more form of non-pharmaceutical measure but the outcome as can be seen from their results vary. While some of these have yielded very positive results in some cities, the same cannot be said for others (Figure 4.2).

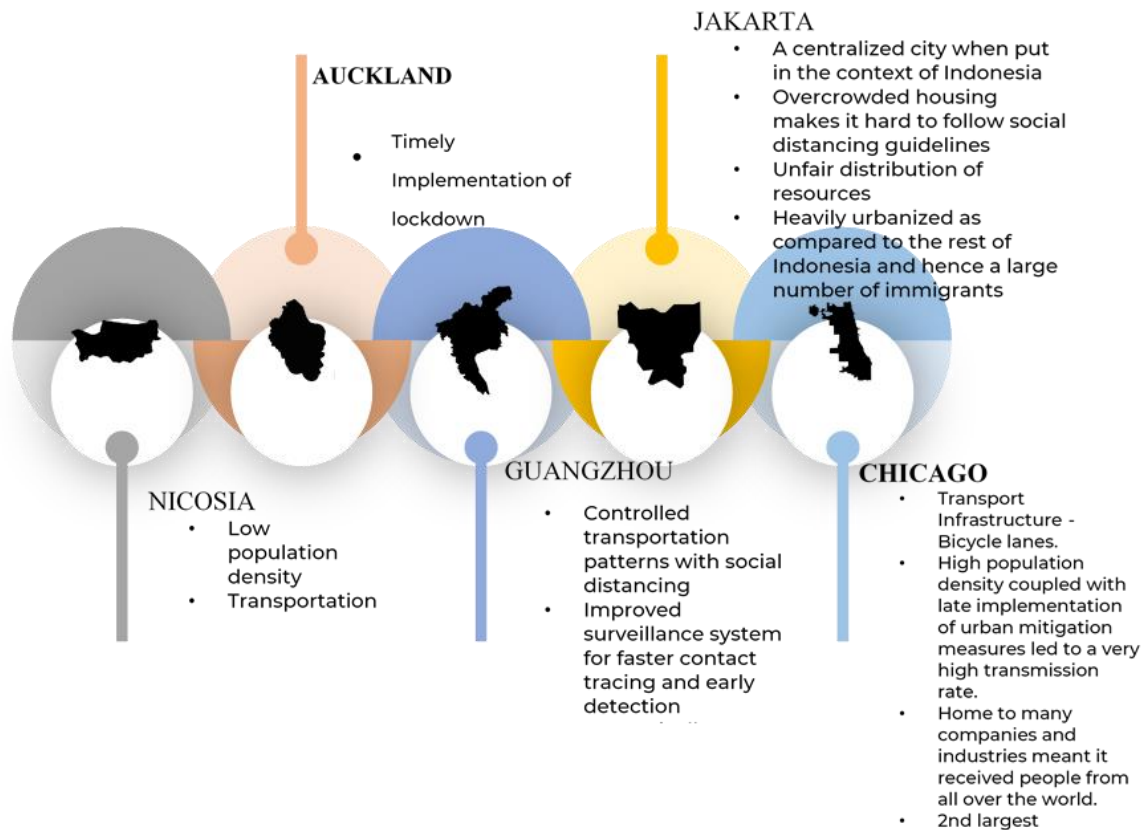





Figure 4.2: Relationship between infrastructure, economy, and mitigation measures employed. Source: Author

By using the website by (Teleport Cities - Where Should I Live? - Compare Cities' Quality of Life, n.d.), the cities were compared in terms of their standard of living and elements that have some form of spatial dimensions to them. The website created by Topia Company (Teleport Cities - Where Should I Live? - Compare Cities' Quality of Life, n.d.) was created to serve as a database for people interested in moving from their neighbourhoods to a different neighbourhood, town, city or country. It gathers information on cities in different categories and ranks them based on their performance in each category. Table 2 below shows a comparison between each of the five cities. This should help give the readers an idea of the quality of life in each of the cities in the study. It also compresses some of the physical features that cannot be displayed graphically into a form that can be measured. The areas addressed below are housing, Education, Healthcare, transportation, environmental quality, economy, leisure and culture. The rankings at the end of each category is in relation to the total number of cities globally the have been studied by Topia Company (Teleport Cities - Where Should I Live? - Compare Cities' Quality of Life, n.d.).

From table 2, there is evidence that the heavily urbanized cities are more expensive to live in. The smaller city of Nicosia provides more affordable living for its residents and Jakarta's cheap living can be attributed to the poor living conditions of the city. Looking at the life expectancy of the population of each city, we can see that all the cities but Jakarta are offering about 80 years. This comes as no surprise as the healthcare system in all the cities studied in the research had good health index ratings but Jakarta. Further discussions have been made below for each of the city.

Table 4.2: City characteristics. Source: (Cost of Living Comparisons, 2021 Data., n.d.; Teleport Cities - Where Should I Live? - Compare Cities' Quality of Life, n.d.)

| | AUCKLAND | JAKARTA | CHICAGO | GUANGZHOU | NICOSIA |
|--|---|---|--|----------------|----------------|
| HOUSING | | | | | 9 |
| Small apartment Median rent | \$1200 | \$390 | \$1300 | \$670 | \$460 |
| Medium apartment Median rent | \$1600 | \$630 | \$1700 | \$930 | \$600 |
| Large apartment Median rent | \$2000 | \$880 | \$2100 | \$1330 | \$750 |
| Cities ranking | <u>213/265</u> | <u>49/265</u> | <u>233/265</u> | <u>166/265</u> | <u>51/265</u> |
| Education | 5 | 1 | 8 | 8 | 2 |
| University quality Index score | 0.16 | 0.10 | 0.87 | 0.69 | 0.11 |
| High school ranking Pisa test | 12 | 51 | 24 | 8 | 40 |
| Ib schools In total | 14 | 32 | 72 | 22 | 2 |
| Cities ranking | <u>82/240</u> | <u>216/240</u> | <u>8/240</u> | <u>9/240</u> | <u>195/240</u> |
| Healthcare | 9 | 3 | 9 | 7 | 7 |
| Healthcare quality Index score | 0.85 | 0.51 | 0.82 | 0.69 | 0.62 |
| Healthcare expenditure Index score | 0.86 | 0.17 | 0.99 | 0.67 | 0.69 |
| Life expectancy In years | 81.645 | 69.1279 | 79.2783 | 81.3 | 80.479 |
| Cities ranking | 85/265 | 249/265 | 108/265 | 92/265 | 176/265 |
| Travel connectivity | 1 | 2 | 6 | 7 | 2 |
| Airport hub Index score | 0.26 | 0.33 | 0.91 | 0.90 | 0.32 |
| Intercity train connectivity Index score | - | 0.17 | 0.19 | 0.50 | - |
| Cities ranking | 233/266 | 155/266 | 51/266 | 18/266 | 206/266 |
| Commute |  |  |  | 5 | 5 |
| Traffic Index score | 5 | 4 | 5 | 0.44 | 0.89 |

| | | | | | |
|---|-----------------|-----------------|-----------------|------------------|----------------|
| Cities ranking | 0.57 156/255 | 0.10 229/255 | 0.47 183/255 | 97/255 | 85/255 |
| Environmental quality | 8 | 2 | 7 | 4 | 4 |
| Air quality Index score | 0.82 | 0.23 | 0.73 | 0.53 | 0.53 |
| Drinking water quality Index score | 0.79 | 0.23 | 0.58 | 0.33 | 0.38 |
| Cleanliness Index score | 0.79 | 0.28 | 0.63 | 0.33 | 0.37 |
| Cities ranking | 46/266 | 246/266 | 120/266 | 256/266 | 220/266 |
| Economy | 6 | 5 | 7 | 6 | 3 |
| Gdp growth rate | 3% | 5% | 2% | 7.9% | -2% |
| Gdp per capita | \$35,152 | \$10,641 | \$54,597 | \$12,317 | \$30,769 |
| Cities ranking | 115/263 | 167/263 | 16/263 | 84/263 | 242/263 |
| Leisure & culture | 4 | 8 | 8 | 7 | 7 |
| Museums Index score | 0.50 | 0.83 | 0.88 | 0.65 | 0.50 |
| Historical sites Index score | 0.38 | 0.80 | 0.76 | 0.81 | 0.89 |
| Sports venues Index score | 0.60 | 0.89 | 1.00 | 0.53 | 0.64 |
| Cities ranking | <u>204/264</u> | <u>32/264</u> | <u>30/264</u> | <u>56/264</u> | <u>76/264</u> |
| Outdoors | 6 | 7 | 5 | 5 | 2 |
| Number of hills and mountains Altitude > 300 m | 10 | 5 | 0 | 6 | 9 |
| Water access Index score | 0.96 | 0.73 | 0.92 | 0.65 | 0.10 |
| Cities ranking | 38/266 | 10/266 | 73/266 | 118/266 | 239/266 |
| | AUCKLAND | JAKARTA | CHICAGO | GUANGZHOU | NICOSIA |

4.3.1 Nicosia's Infrastructure, Economy, and Mitigation Measures

Buses are the sole means of public transit available due to unplanned city development, and the system is judged inefficient, resulting in private automobiles being the major form of transportation (5.0 Gelişme Plan PDF, n.d.). The redeeming quality here is that the city has a small footprint and moving across from one point to another does not take much time even in peak periods and this can be seen in the traffic index score. Nicosia has one of the lowest housing rates globally and this bodes well for the city making it more liveable. Looking at the GDP of each country the city of Nicosia pales in comparison to the rest having just 4.05b. It has also seen the least growth in the past year as its economy keeps dropping. However, GDP per capita results suggest that the citizens of Nicosia are three times wealthier than

citizens in Jakarta. Nicosia is the business hub of Northern Cyprus and hence and has less in the way of leisure activities. With no beaches and a ban on indoor and outdoor activities, there is little to nothing left for the citizens to do for recreation in a lockdown situation.

While not having the highest GDP or implementing the fanciest mitigation measures the infrastructure of Nicosia enabled it to handle the pandemic smoothly.

4.3.2 Auckland's Infrastructure, Economy, and Mitigation Measures

With the highest life expectancy and one of the best healthcare systems of the cities studied this translates very well with the result of COVID-19 cases and the death rate. Only 0.44 percent of all those who came into contact with the virus died. This compared to not just the cities studied but the rest of the world is a phenomenal result. Auckland has a very good environmental rating with good air and water quality as compared to the other cities studied. Being the most populous city in New Zealand and the most important commercial and financial hub has made life in Auckland one of the most expensive around the world cities (Auckland among the World's Most Expensive Cities - NZ Herald, n.d.). Housing cost site up there with the likes of Chicago which also happens to be a very business-oriented city. The city of Auckland has been placed third in the Mercer Quality of Living City Ranking (Quality of Living City Ranking | Mercer, n.d.), indicating that its residents can afford this pricey lifestyle. There are three means of public transportation in Auckland, New Zealand's main metropolitan area: bus, rail, and ferry. Around 8% of commutes to work were made by public transportation according to the 2013 census (*News / Ministry of Transport*, n.d.). The reliance on personal means of transportation in Auckland is very high. Furthermore, car trips in Auckland can take up to 48% longer during peak times (Chin et al., n.d.). Being a business city first and everything second, Auckland is not the most touristic city.

With a good health system and high quality of living, the citizens of Auckland were better armed before the start of the pandemic. Having ninety percent of the population not sharing the same space on their normal commute to work and the improved health and sanitation measures implemented in shared public spaces made Auckland one of the best cities to live in during the COVID-19 pandemic.

4.3.3 Guangzhou's Infrastructure, Economy, and Mitigation Measures

The population of Guangzhou was its biggest Achilles' heel. The city is spread both horizontally and vertically. This gives it a comparatively low population density compared to the other cities considering it has the highest population of the five cities being compared here. Housing costs are not very the cheapest but are almost half of what one would pay if they lived in Chicago or Auckland. Guangzhou in the past was a busy city with twisting alleyways and tiny streets. Wide streets were made, new sewers were installed, arcades for sidewalk businesses were built, and several parks were erected during a major modernization drive in the 1920s and 1930s. The city was able to grow southward to its current coastline thanks to new dikes erected along with the Pearl. The city of Guangzhou has a very high GDP and is also one of the fastest-growing cities in the world. The growth rate of GDP is estimated at 7.9 percent. This huge urbanization trend of Guangzhou has translated nicely into the health department. With a life expectancy of 81.3 years, Guangzhou sits up there with the likes of Auckland and Nicosia. Having the largest metropolitan area among the cities studied, Guangzhou has developed quite a robust transportation system. Guangzhou has an established transport system consisting of a subway, buses, trains, and boats. The GBRT was developed by the ITDP and partners and inaugurated in 2010. By 2011, it was servicing a million people per day on one route, making it one of the world's busiest BRTs (Guangzhou: 1985 and Today - Institute for Transportation and Development Policy, n.d.). Guangzhou also has a large metro system, with 14 lines servicing eight million people every day. Guangzhou has a high dependency on public transport (Guangzhou: 1985 and Today - Institute for Transportation and Development Policy, n.d.).

Guangzhou's population keeps expanding at an alarming rate and while trying to keep up with the housing demands they also have to keep up with the mobility demands. The city is known for trade and hence easy access is a priority. While expanding they have implemented high-tech systems in place to aid with this expansion. They use the data from their public transport system to guide them with their development plans. These same systems were used to help trace and contact victims during the pandemic. With the control, they have over the movement of their citizens they capitalized on it to enforce enhanced sanitation measures and social distancing laws.

4.3.4 Jakarta's Infrastructure, Economy, and Mitigation Measures

Jakarta is an excellent example of a metro that suffers from spatial inequality. This city has the lowest GDP per capita of all the cities surveyed, at around \$10,641. Jakarta has a population of more than 10 million people and is expected to become the world's most populous city by 2030. Only 40% of Jakarta residents have access to safe drinking water from a pipeline (Nichols, 2019). Jakarta's infrastructure issues are not limited to this; the city's traffic and air pollution are among the worst in the world, and the city's rapid urbanization has resulted in a substantial loss of green space (Nichols, 2019). As more automobiles choke Jakarta's roadways, total congestion threatens, as the government battles reforms era laws to get new infrastructure projects begun. For more than two decades, Indonesia's capital city has struggled with traffic congestion, but a massive increase in automobile ownership, fuelled by a quickly increasing middle class and government incentives, combined with bad infrastructure, has made moving about a problem (Hamer, 2014). According to experts, traffic is only going to get worse. Public transportation is already overloaded and primarily serves the major thoroughfares, and five-kilometres vehicle rides can take an hour or more during rush hour. Businesses have been dealing with these issues for years, and many high-level organizations now run "mobile offices," which are automobiles equipped with internet connections and conference space (Hamer, 2014).

Jakarta's high GDP is not enough to save it from COVID-19. With just a small percentage of the population living the good life, the majority of the population lives in overcrowded slums with little to no access to good health facilities. This coupled with the bad air and water quality and access makes the situation worse. Traffic in the city leads to high interaction with people and hence initiating the mitigation measures in such an environment has proven to not be very effective.

4.3.5 Chicago's Infrastructure, Economy, and Mitigation Measures

Chicago has the highest GDP of all the cities studied here and also the highest GDP per capita. The GDP per capita is five times higher than the GDP per capita in Jakarta. This means that the people in Chicago are five times richer than the people in Jakarta. This balances out a bit when you factor in that rent prices and life generally in Chicago is about three times more expensive. Chicago also has some of the best educational systems

in the world. Some of the top schools in the United States of America are in Chicago. It is a wonder as to how one of the richest cities with a good health system filled with highly educated residents suffers so greatly from a pandemic that other countries with far fewer resources have been able to manage better. The previous question pointed out how the late reaction to the pandemic hindered the chances of the city to handle the pandemic.

With 4.63 million workers in the metropolitan area of Chicago (Chicago Area Employment — February 2021 : Midwest Information Office : U.S. Bureau of Labor Statistics, n.d.), the urban development was more vertical than horizontal and that crammed a lot of people into one place. Being headquarters to huge companies like Boeing and a lot of big industries and hosting several Fortune 500 hundred countries meant this city was getting traffic from all over the world. The city of Chicago. The city has the largest convention center in America and plays host to lots of international events. It comes as no surprise that such a big city with so much shared space could transmit the virus so easily. People from all over the world travelled to Chicago and because they were late to implement the necessary mitigation measures, the virus had ample time to spread. Containment of the pandemic in Chicago was harder to accomplish given its mobility solution. The highly touristic city of Nicosia has several means of transportation for its residents. Movement within and around Chicago includes cars, trains, buses, bicycles, and boats. international travel and inter-city travel have the added benefit of using a plane. The use of these public means of transportation during a pandemic in a city that has yet to implement enhanced sanitation rules and guidelines helped spread the virus even further. Chicago is one of the greenest cities in America. It is also the 6th walkable city in America (Giordana's, 2016). Chicago's downtown is highly walkable, with wonderful urban parks that provide a pathway across the city that is free of automotive traffic. You can get almost everything done on foot in Chicago, whether it's picking up a pizza, filling a prescription, or doing your banking (Giordana's, 2016). With people not wearing masks or giving enough space to each other as they traverse through the city this creates a pool to transmit the virus. Ride-sharing using Uber and Lyft is also another means of transmission.

Money goes a long way in defeating pandemics but even that has shown to not always be the cure. Chicago has all the amenities that should make a city thrive and this shows through their way of life, urban landscape, and GDP. It is a very nice place to live. In a pandemic

situation like COVID-19, the very same infrastructure implemented to make the life of the residents comfortable were the same infrastructure that helped transmit the virus. Untimely actions meant that the virus was always a step ahead in its transmission process. With its economic power, the city of Chicago is gradually bringing the pandemic under control.

4.4 How the Urban Form of the Cities Affected their COVID-19 Responses?

To some extent, the layout and urban shape of the cities influence their response to implementing the urban mitigation strategies for COVID-19. This section answers the question with the use of three-dimensional maps that show the layout and population density of the cities. The cities are assessed individually below.

4.4.1 Nicosia Urban Form



Figure 4.3: Overview of the city of Nicosia. Source: (CGTrader - 3D Models for VR / AR and CG Projects, n.d.)

As shown by the 3D depiction (figure 4.3), this is the tiniest city in all of literature. A series of lengthy primary expressways that run alongside blocks of different communities. In the main street, a large freeway runs through it, linking it with nearby cities. To travel swiftly across the city and avoid having to go through their residential neighbourhood's internal roads, residents may choose to make use of this option. The fact that there are so few important roads makes this necessary. Since public transportation is heavily used, with buses

acting as the primary means of transportation, they can keep traffic flowing away from residential districts by keeping mostly on major roads. The city has a CBD, but its services and facilities are distributed around the city, making the main CBD less dominant than the city's other focal points. It comprises just a few tall structures, and the layout is such that the buildings are adequately separated from one another to prevent overcrowding and overcrowding. This economic centre in Cyprus may simply implement lockdown measures to restrict the transmission of the virus during a period such as COVID-19. The city is compact, and the buildings are sufficiently separated from one another to assist in imposing social segregation in the area around them. Additionally, the architecture makes it simple to lock off certain regions as needed to prevent access to unauthorized personnel. A low population density and the city's small size contribute to Nicosia's efficiency in controlling the COVID-19 outbreak. Figure 4.4 below shows a closer look into how the houses, buildings and roads are being spread across the city.



Figure 4.4: Closer looks at the layout of buildings in Nicosia. Source: (*CGTrader - 3D Models for VR / AR and CG Projects*, n.d.)

4.4.2 Auckland Urban Form



Figure 4.5: Overview of the city of Auckland. Source: (CGTrader - 3D Models for VR / AR and CG Projects, n.d.)

Because of its size, Auckland is New Zealand's most populous city, and with good reason. As of 2010, this city alone was home to around 34 percent of the country's population and received over 31 percent of total government spending. In part, this was owing to the consolidation of the cities of Manukau, North Shore, and 11 other municipalities, which resulted in the construction of wards within the city of Auckland (Tikkanen, n.d.). The harbour (as seen in figure 4.5) is the most prominent feature of the city, and it is surrounded by the whole metropolitan region. There is a central business district (CBD) in each of the combined cities, which serves as an equal core, as well as a primary urban area (PUA) that serves as the region's dominating core. These cities had previously operated independently, and now that they have amalgamated, they may be able to continue to do so while reducing their reliance on one another and the flow of people across areas. Additionally, this results in a substantial amount of green space within the city, which contributes to the creation of an environment with acceptable air quality. Also noteworthy is that the city's layout has been well planned out. The houses are structured in a grid form, with major highways running around the perimeters of the blocks, connecting one section of the community to another.

Structures are also deliberately positioned to minimize overcrowding and to minimize the population density of the surrounding areas.



Figure 4.6: City of Auckland. Source: (CGTrader - 3D Models for VR / AR and CG Projects, n.d.)

4.4.3 Guangzhou Urban Form



Figure 4.7: an overview of the city of Guangzhou. Source: (CGTrader - 3D Models for VR / AR and CG Projects, n.d.)

Considering how large Guangzhou's geographical area is, as well as the number of their population, it is understandable that their urban environment was designed differently from the other cities under consideration, which had far fewer inhabitants overall. In terms of land

area, the city has grown more horizontally than vertically over time, indicating that the metropolis is expanding. It used to be a city of small streets and twisting alleyways, which is no longer the case. Since the 1920s and 1930s, significant progress has been achieved in the urbanization program. In addition to the city's commercial and financial core, where the city's major hotels, department shops, and theatres are located, the city has developed other extremely significant places that serve as focal points across the whole region. A polycentric megacity such as Guangzhou has seen horizontal development, resulting in the establishment of smaller and equal centres all around the city as a result. It has the significant advantage of creating a city and neighbourhood that is highly diverse in terms of uses. People within the same neighbourhood may conduct their everyday activities in a compact area created by the multiple main areas of the city, and the modern transportation system of Guangzhou allows them to go across the city when they require it. In a pandemic emergency, such as COVID-19, this urban shape can aid in the containment of the outbreak and the more effective implementation of lockdown measures.

4.4.4 Jakarta Urban Form

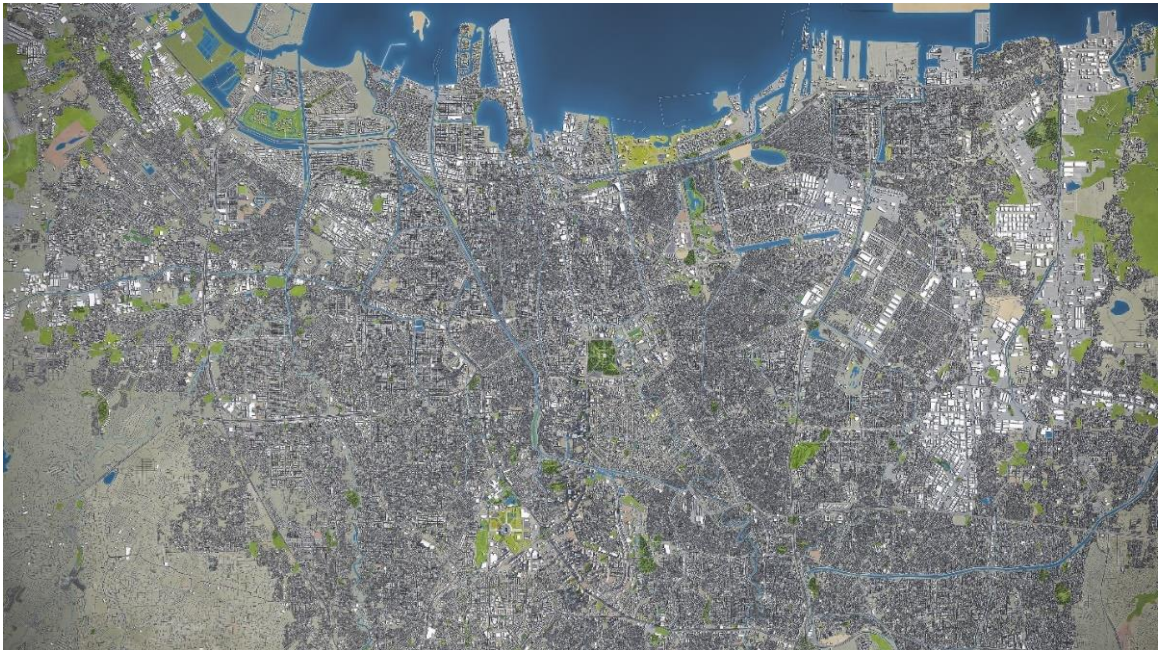


Figure 4.8: Overview of the city of Jakarta. SOURCE: (CGTrader - 3D Models for VR / AR and CG Projects, n.d.)

The city's layout, although was originally intended by the Dutch, has been substantially altered by British influence rather than the original planners, as shown in the diagram above (Martinez & Masron, 2020). It is thickly packed. It is sprinkled with several imposing

structures that rise over the rest of the city. These towers are bordered by closely packed lower constructions that have grown in an unplanned manner. The city is situated on a low, flat alluvial plain, with some sections rising slightly above sea level. This, along with the country's tropical climate, means that when it rains, it floods rapidly. Rapid urbanization results in the loss of woodlands for development purposes, hence increasing the danger of floods. Increased water volume as a result of insufficient drainage infrastructure has resulted in a shortage of clean drinking water. A city's lack of clean drinking water can have a negative effect on the health of its citizens. This would create a breeding environment for disease in a city like Jakarta, where structures are closely packed together and residents have poor health. COVID-19 would thrive in such an environment since persons are required to be mobile and may interact with a large number of people while pursuing their daily needs. Jakarta's metropolitan shape, like that of other cities, may play a role in their fight against COVID-19.



Figure 4.9: Closer look at Jakarta's layout. SOURCE: (CGTrader - 3D Models for VR / AR and CG Projects, n.d.)

4.4.5 Chicago Urban Form



Figure 4.10: Main CBD of Chicago. Source: (All Roads Lead to The 78 | The 78 Chicago, 2020)

The main layout for Chicago is a grid layout and this has been implemented very strictly in the city as can be seen in the Figure 4.10 above. This layout together with the tall buildings constructed across the city makes the city good for pedestrians. It also makes navigating the city quite straightforward. The river dividing the city into thirds has also helped in making the image of the city clearer to the residents and passers-by. The industrial area can be differentiated from the CBD.

The CBD of Chicago is the dominant centre of the city. The figure above shows that the city is a polycentric city. Several smaller cores have been created all over the city and with a robust transportation system, they have all been tied to the CBD. Trains, buses, trams, and boats move from the centre of the city to the different neighbourhoods. The grid layout albeit being good for direction causes slowdowns and interruptions at junctions and that increases the travel time for cyclists and motor drivers. The inclusion of highways to cut across town and neighbourhoods help to decrease the travel time.

Conducting a thorough examination of the research results and suggestions Chicago is a city with a great deal of cultural diversity. Commercial activity in the city attracts a large number of passengers, which is reflected in space's usage and architecture. Numerous facilities are spread across the city and cater to a variety of various sorts of activity. Due to the grid arrangement, retail establishments and cafés are concentrated

on the street's corners. The city's development is not restricted by a particular architectural style, which benefits enterprises wishing to expand in the region. Athletic stadiums and exhibition centres, which may be located near corporate headquarters and major transportation hubs, may be located near sports complexes and exposition centres. As a result, it is a fantastic venue for professional networking. The art culture included inside the structure is mirrored in the design of the many structures constructed across the city. Given that the initial objective was to promote the business within the city, the subsequent expansions demonstrate success.

The city of Chicago has planned such that it is a polycentric space with a dominant centre. The dominant centre creates space for even more people to meet and given that there are smaller pockets of centres all over the city, it ends up transmitting the virus even faster. In a city like Chicago where lockdown measures were not implemented early, their strict grid system played against them. It is good for pedestrians as it gave them several means of traveling in the same direction. This sped up the transmission of the virus as it meant people who did not move to other neighbourhoods were at risk of contracting it either way.

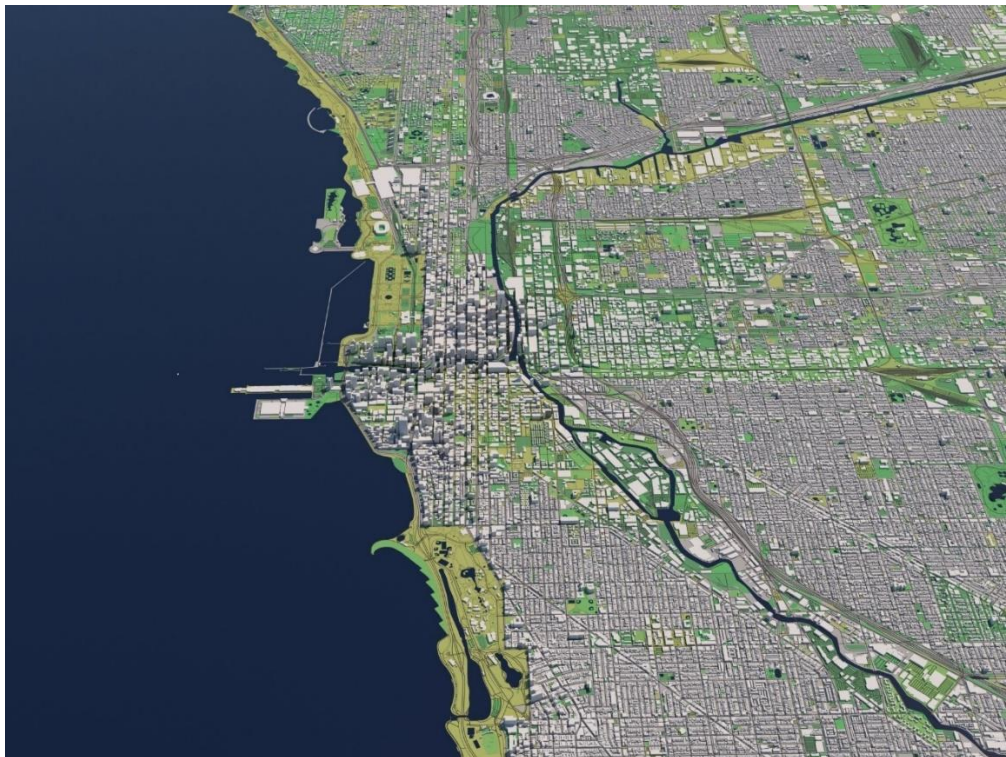


Figure 4.11: Overview of the city of Chicago. SOURCE: (*CGTrader - 3D Models for VR / AR and CG Projects*, n.d.)

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This thesis has tried to explore the urban dimensions of non-pharmaceutical measures against the spread of a viral infection. The study aims to provide a ground for similar future events by cross-examining different mitigation strategies and urban characteristics that have shown significance in this discourse.

There is no question that no urban city is designed for a pandemic like COVID -19. The results of the study show that some cities are better built to handle such a pandemic. The five cities studied have unique characteristics that contributed in one way or another to their fight against the pandemic. Some of these features helped them contain the pandemic, while others helped it spread.

Jakarta fared the worst among the cases studied. This is a case where having the highest population density and size, not only among the cities studied here but globally, can negatively affect success in the fight against COVID -19. Lack of resources is among the reasons for the geographical discrimination that afflicts the country. A majority of the population has access to safe drinking water, good air, and good health, while other nations' urban planning policies, inadequate testing rates, and deficient contact tracing procedures are all holding the country back. Mobility measures and improved hygiene measures that had worked in cities such as Auckland, Nicosia, and Guangzhou did not yield the same rate of success in Jakarta because of an inadequate transportation system and heavy traffic that keeps people together in shared spaces for longer. As a business centre, it is a city for global trade and therefore attracts people from all over the world who can transmit the virus. The centralization of Jakarta in Indonesia has also caused migration patterns in Indonesia to move from small villages and towns to Jakarta to seek a better life. Poor control of this migration pattern also contributed to the low success rate in controlling the pandemic.

Chicago is the second-worst city, but only slightly. It had all the resources and time to prepare for and manage the pandemic better than most other cities. The results are frightening when you think about it all. The reason can be attributed to three things. Chicago's high population density ensured that transmission from one person to another was

accelerated. This rate of transmission could have been slowed down if control and containment strategies had been implemented early enough. The main reason for this delay had to do with Chicago's policy of allowing citizens their right to freedom and mobility. Chicago is a clear example of how an urban area with high population density can have the right resources to bring about changes that transform the urban area into an environment capable of dealing with a pandemic such as COVID -19 but failed due to the untimely implementation of urban containment strategies.

Nicosia could have performed similarly to Auckland or even better in the fight against COVID -19. It had all the characteristics that would slow down the human-to-human transmission of the virus. With a low population density, strict adherence to containment measures, a very well mixed community, and early implementation of lockdown measures and containment strategies, it was one of the first cities to successfully combat the virus. The first wave of the virus was ended in a very short time and with minimal casualties. Being an island with a low GDP, it had to open its borders to businesses, which resulted in it finishing in the middle of the pack among the cities studied. Nicosia showed how a small city with a low population density could implement mitigation strategies and successfully combat COVID -19. However, the impact on the city's economy shows how much of an impact a good GDP can have on a city in times of a pandemic.

Guangzhou was one of the cities affected by COVID -19 after its debut in Wuhan. As a megacity with the highest population of the cities tested, it showed how best to deal with a pandemic like COVID -19 with so many people in a huge area. With a population density lower than Auckland, but with a population size many times larger, Guangzhou showed how this could affect disease transmission. The pandemic spread to thousands of more people. However, the containment strategies in a city like Guangzhou meant that the consequences of the pandemic were nowhere near those of Chicago and Jakarta. Lockdown rules combined with the rest of the city's containment strategies, complemented by a technology-based detection and tracking system, gave the city of Guangzhou the ability to combat the virus. The ability to track infected patients and control movement patterns in a megacity like this proved very useful. The purchasing power of the city of Guangzhou also played a role, as it was able to build large enough containment facilities in a short period. The horizontal growth of this megacity, coupled with its technological advancement and purchasing power, gave it a victory over the pandemic.

Auckland is an example to all the cities of the world. It performed best compared to all other cities in the study. This came at a great economic cost, but the results are worth it. Timely action was one of the city's greatest strengths. The City of Auckland is designed to have had the fewest cases and the lowest number of fatalities when implementing mitigation measures. With travel restrictions and lockdowns in place, the Auckland urban area was already well prepared for all of this. Auckland's success is proof that humanity is on its way to designing the perfect environment for a pandemic.

The studies show that cities with high population and high population density tend to have the COVID -19 pandemic spread faster to many more people. With Auckland being the exception, proving that with proper planning in a well-resourced city, pandemics like COVID -19 are manageable. New norms such as improved hygiene practices, contact tracing, and the use of artificial intelligence are all good, but they need the right urban space to succeed. Access to clean air and water in a medically well-equipped city, designed to be very decentralized and with little reliance on public facilities, can help a city adhere to the rules of social distancing, which is the current cure for COVID -19 at the time when there is no cure.

5.2 Recommendations

This research examines cities from five different nations, out of a total of over ten thousand worldwide. Each of these cities has been sculpted in such a manner that no two cities will be identical. Further, it is advised that more studies be conducted on the urban mitigation strategies used by more cities worldwide. The cities included in this study were chosen at random because they exhibited certain characteristics. Numerous more cities worldwide have similar qualities. Grouping nations together that have comparable features in terms of population, size, population density, infrastructure, and other urban features may reveal conclusions that were missed in this study.

Underdeveloped and developing countries have had varying degrees of success in their efforts to remove COVID-19 from the world. Prior to the epidemic, they suffered from unchecked population expansion, inadequate education, inadequate health care, unemployment, and weak economic growth, to name a few. With COVID-19 proving to be a difficulty for nations that did not face all of these issues, it will be beneficial to research these impoverished nations and determine precisely what characteristics of their urban

settings aided in containing the spread of COVID-19. Jakarta was the only city in the research that demonstrated traits of a developing city, but even that did not provide a whole picture, since it was the wealthy capital of Indonesia's developing country. Research conducted in less affluent metropolitan areas with fewer facilities will provide different findings. A comprehensive investigation of cities classified similarly would add depth to the study.

Guangzhou, Nicosia, Jakarta, Chicago, and Auckland are just a few of the cities located within their respective countries. The study demonstrated how culture, climate, and architectural trends varied from city to city within the same country. If the same analysis were undertaken across cities within the same nation, the discrepancy between these many factors would be reduced. Despite their commonalities, each city's urban landscape has evolved slightly differently for a variety of reasons. While they are each governed by a single government, the climate, culture, and construction processes will be remarkably similar. Examining cities within the same nation and their employment and usage of urban mitigation methods by the same government can assist throw more light on them and aid in their refinement.

This study focused on a variety of cities, and these cities represent only a small portion of the country in which they are located. Their responses to urban mitigation measures are frequently inextricably linked to those of other cities within the same region. The paper cited Jakarta's failure to fully implement the lockdown measures as an example. Being the most urbanized region in a poor nation like Indonesia, the movement of people from poorer towns and villages in search of better health care, particularly during times like the COVID-19 epidemic, made it difficult to adequately secure the borders. It would be beneficial to examine urban mitigation measures on a much greater scale in the future. Conducting study on not just the city, but the country as a whole will elucidate additional features of the urban mitigation techniques used. Further along similar lines, one may do study on nations that have a shared border with the region on a continent, particularly those that share shared borders. Throughout the lockdown era, every government's priority was to keep its population safe. This has a detrimental effect on several areas of urban life inside countries. The research did not examine how nations that are interdependent within the same area collaborated to stop the spread of COVID-19. Nicosia, like the rest of Cyprus, is extremely dependant on Turkey for a variety of goods. The extent to which this reliance on a

neighbouring nation impacted urban mitigation methods was not completely studied, and more research on this subject would provide a more complete picture of TRNC's performance in combating the spread of COVID-19. This might also be said of other countries in other regions.

One component of urban space that the author wished to investigate more was the population's relationship to open and shared areas. Old European cities are famed for their narrow streets and alleyways, which provide a very friendly neighbourhood atmosphere, whereas American towns are known for their huge streets and parks. The dimensions of shared and open spaces, such as sidewalk width, the size of neighbourhood and community parks, the size and average number of local businesses in each neighbourhood, the length of bicycle lanes, and so on, provide insight into how well residents adhere to social distancing measures. The smallest and most insignificant features in the development of the urban environment contribute significantly to limiting the development of COVID. Simultaneously, expanding our circulation spaces entails damaging more of the earth's land area, which has its own set of consequences. It is worth investigating a middle ground for this inevitable expansion of our urban environment.

Additional urban mitigation techniques, in addition to those examined in the study, should be examined and compared systemically to determine the improvements they may make to the urban techniques now in use. The combination of urban architecture and technology would be a significant step in this direction.

Roadmap to Understanding the Future of Urban Strategies to Pandemics

Every epidemic in history has demonstrated how lethal they can be. The world in which we live is teeming with humans who want to savour every last piece of it. Humans desire to taste everything, to inhale the beautiful aromas of nature, and to feel the touch of inanimate objects such as water and surfaces. Pandemics with airborne transmission have proven to be the hardest to contain throughout history. A nuclear explosion, for example, can alter the air quality in space, putting many people's lives at danger. COVID-19 demonstrated that air may be utilized to poison any metropolitan area on Earth. Current urban landscape measures and architectural solutions have demonstrated their limitations in terms of their ability to produce a safe environment for space users. With the world's population growing at a breakneck pace, the demand for improved urban and architectural practices has never been

more pressing. Urban designers cannot and should not attempt to divide individuals to breathe different air, but they can ensure that everyone breaths cleaner air. Investigations into urban tactics and architectural solutions that accelerate the purification of our air and surroundings might aid in the battle against pandemics such as COVID-19.

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APPENDICES

Turnitin Similarity Report

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Appendix II

Ethical Approval Document

ETHICAL APPROVAL DOCUMENT

Date: 24/04/2021

To the **Graduate School of Applied Sciences**

The thesis titled “Exploring Urban Dimensions of Covid-19 Mitigation Strategies in Different Countries” has been evaluated. Since the researcher will not collect primary data from humans, animals, plants or earth, this project does not need to go through the ethics committee.

Name Surname: Assist. Prof. Dr. Aminreza Iranmanesh

Signature:

Role in the Thesis: Supervisor

