
IMPACT OF THE COVID-19 PANDEMIC ON URBAN DEVELOPMENT: A SYSTEMATIC REVIEW

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ABSTRACT

The COVID-19 pandemic gradually became prevalent globally in early 2020, affecting multiple aspects of lifestyle, transportation, and politics, and hitting the world economy hard. Due to the large population and economic activity densities, urbans are more vulnerable to more dangers. The influence of COVID-19 on urban areas is therefore widespread. The authors reviewed the literature after the first confirmed cases in Wuhan, China, to present a comprehensive evaluation of studies on the impact of the COVID-19 pandemic on urban development. The results show that studies on the impact of COVID-19 on cities are mainly related to five main topics, namely (1) environmental quality, (2) social impact, (3) economic impact, (4) urban residents, and (5) urban planning and management. While this shows the diversity of the research agenda, the first theme dominates, whereas the others remain relatively under-researched with little systematic research. This paper also has five more suggestions that can be used in planning and designing cities after COVID to help them grow in a way that is sustainable. Overall, the available research indicates that the COVID-19 crisis offers governments and planners a powerful chance to better respond to future emergencies and disasters and to promote sustainable and healthy urban development.

Keywords: COVID19 Pandemic, Systematic Review, Urban Development.

1. INTRODUCTION

The phrases *pan* (which means "all") and *demos* (which means "people") in the Greek language are where we get our word "pandemic" (Qiu et al., 2017). The word often refers to the quick spread of a disease that affects a significant proportion of the population and a large geographical area, and that can cross provincial, national, or even continental boundaries in a short amount of time to build a worldwide epidemic (Honigsbaum, 2009). The severe acute respiratory syndrome coronavirus, also known as SARS-CoV-2, is the virus that is responsible for the global outbreak of coronavirus disease 2019 (COVID-19) (Ciotti et al., 2020). It was declared a pandemic on March 11, 2020, and a public health emergency of worldwide concern on January 30, 2020, by the World Health Organization (WHO) (Li et al., 2021). There have been many very serious pandemics throughout human history. In addition to the debilitating and sometimes fatal effects on those directly affected, the disease can also have far-reaching consequences. As an example, "The impact of the 2009 pandemic influenza (i.e., H1N1) went beyond mortality to include the health care system, agriculture, industry, education, transportation, tourism, and finance. In essence, a pandemic event poses a threat to the entire economic and social fabric." (Drake et al., 2012). The global pandemic diseases from the beginning of the 20th century to the present, there are five times, respectively, 1918 Spanish flu, the 1957 Asian flu, the 1968 Hong Kong flu, 2009 Mexico and the United States of America the H1N1 new influenza epidemic, and now the global occurrence of COVID-19. COVID-19 and the previous occurrence of pandemic influenza, SARS compared to have three major characteristics, first, the Infectious, much stronger than influenza and SARS; China had successfully prevented and controlled the 2002 SARS (coronavirus) epidemic with low morbidity and high mortality (nearly 11%), with 919 deaths globally, and was not included in the global pandemic. Secondly, from the point of view of pathogenicity, it is heavier than influenza, and lighter than SARS (SARS mortality rate of 11%, the new crown 4.6%); thirdly, the new coronavirus infection after the virus exists for a longer period of time. 1918 to 1919 influenza pandemic, commonly known as the "Spanish flu", is the most serious health disaster in recent history. In contrast to the "Spanish flu", COVID-19 was a "pandemic" that spread more rapidly, infected a wider range of people, lasted longer, and was more globalized in its prevention and control. There have been at least 20 clearly documented plagues or pandemics in human history. COVID-19 is the latest in a series of pandemics that have had a wider impact, have affected more areas, and have lasted longer. These pandemics have changed the course of history and provide lessons for today. It is therefore essential to study the impact of the COVID-19 pandemic.

In late 2019, the first cases of the coronavirus disease known as COVID-19 were discovered in Wuhan, which is located in the province of Hubei in China. By the year 2020, it has evolved into a full-fledged pandemic that has swiftly swept through numerous nations (Lu et al., 2020). Until now, the COVID-19 pandemic has continued to affect all parts of the globe. As a result of the ongoing pandemic caused by COVID-19, many areas of the world continue to struggle, researchers have continued to investigate the origins, transmission mechanisms, and preventative measures of the pandemic and cast additional illumination on its unresolved issues. In fact, as of May 20, 2023, a search on Scopus for the term "COVID-19" yielded 469,252 articles. As COVID-19 continues to spread around the world, research on the pandemic is expected to increase.

Generally speaking, a "city" can be defined as a settlement that has reached a certain size and population density and has gathered various non-agricultural workers (Sjoberg, 1965). As a direct consequence of this, cities now house the vast majority of the world's population and serve as the epicentres of a diverse range of economic activities. The high population and economic activity concentration in cities makes them more susceptible to a variety of factors, such as natural and man-made disasters. Numerous studies on the causes of various hazards and their effects on cities, as well as the planning, recovery, and adaptation measures required to deal with these hazards and promote sustainable urban development, have been published over the past few decades. Despite the fact that this is not the first instance that a pandemic has affected a city in human history, there is a dearth of literature on cities and pandemics (Ayyoob Sharifi & Amir Reza Khavarian-Garmsir, 2020).

As was to be expected, a significant portion of the research that has been conducted on pandemics has focused on medical concerns relating to the identification and management of the disease (Harapan et al., 2020). But since the beginning of pandemics, people have also been interested in how they affect cities and how cities respond to them. And once again, the COVID-19 pandemic has brought the debate about the potential vulnerability of cities to the forefront of academic research. Moreover, urban development encompasses a wide range of components, such as the natural environment, economic development, urban life, and urban management. Therefore, the impact of the COVID-19 pandemic on urban development is not limited to one aspect; its impact on urban development is multifaceted. In the past few years, a large number of studies on various issues related to COVID-19 and urban development have been published. However, most of the studies only analyze the impact of pandemics on a single

aspect of urban development. To date, few studies have systematically analyzed the impact of pandemics on urban development. A systematic analysis of the impact of pandemics on urban development is conducive to a more comprehensive understanding of the impact of pandemics on urban development, which in turn analyzes the deficiencies in disaster prevention in urban development and thus promotes further urban development. In this context, the primary objective of this study is to comprehend the impact of the pandemic on urban development and to identify the most important lessons that can be drawn from COVID-19 for urban development. For this purpose, the authors systematically reviewed and analyzed articles related to the impact of the pandemic on urban development. Some problems are also identified and suggestions are made to address them, in the hope of providing some degree of experience for future cities to cope with disasters and thus promote sustainable and healthy urban development.

2. MATERIALS AND METHODS

The authors of this systematic review compiled 79 publications from the Web of Science and Scopus databases. These 79 studies were discovered to be frequently cited in other studies. The following describes how to search for and organize the data:

2.1 Sources of Data

The Web of Science and Scopus databases were mined for information for this systematic review. Since it was founded by Clarivate Analytics in 1900, Web of Science has been a continuous effort. It encompasses nearly 256 disciplines, including the sciences, social sciences, arts, and humanities, and is interdisciplinary (Reuters, 2021). Scopus, the second data source for this review, is an abstract and citation database introduced in 2004 by Elsevier that covers nearly 27 major disciplines and over 300 minor disciplines, such as physical, health, life, and social sciences (Burnham, 2006; Mongeon & Paul-Hus, 2016). Both databases include powerful search features to identify relevant results.

2.2 Searching Strategy

This systematic review describes the impact of the COVID-19 pandemic on urban development (environmental quality, social impact, economic impact, urban residents, and urban planning). To search for relevant literature, a search query was developed. The first step was to find and gather pertinent material using the keywords listed in Table 1:

Table 1: Data-Search Queries

Databases	Keywords
Scopus	TITLE-ABS-KEY ((“covid*” OR “covid-19” OR “coronavirus” OR “pandemic” OR “covid-19 pandemic”) AND (“urban” OR “cities” OR “city”) AND (“urban development” OR “city development”) AND (“urban planning” OR “urban design” OR “urban studies”) AND (“environmental quality” OR “Air quality” OR “Environmental factors”) AND (“social impact”) AND (“economic impact”) AND (“urban residents”))
Web of science	’TS = ((“covid*” OR “covid-19” OR “coronavirus” OR “pandemic” OR “covid-19 pandemic”) and (“urban” OR “cities” OR “city”) and (“urban development” OR “city development”) and (“urban planning” OR “urban design” OR “urban studies”) and (“environmental quality” OR “Air quality” OR “Environmental factors”) and (“social impact”) and (“economic impact”) and (“urban residents”))

An initial search and exclusion was performed on Web of Science and Scopus on March 1, 2023, and 1025 articles were obtained. Of these articles, 375 were duplicates and were given first exclusion. Of the remaining 650 articles, some had abstracts that included mainly the term "urban" referring to work done in cities related to other disciplines, such as medical experiments, nursing, etc. Therefore, the authors used the filters of Scopus and Web of Science to exclude papers that were not related to urban development. Thus, nursing, medical sciences, and medicine-focused papers were excluded. At the conclusion of this phase, the database contained 136 articles. After

verifying the relevance of these articles' abstracts, 37 additional articles were excluded. Subsequently, twenty additional similar articles were omitted (from both Web of Science and Scopus). While reviewing the abstracts, the authors also categorised each paper according to its focus on a particular theme. At the conclusion of this phase, the classification was refined by integrating similar themes (e.g., urban taxation, residential unemployment, and industrial development were combined into the "economic impact" category). Seventy-nine additional articles were eventually systematically reviewed, and their think-thematic classification is shown in Table 2.

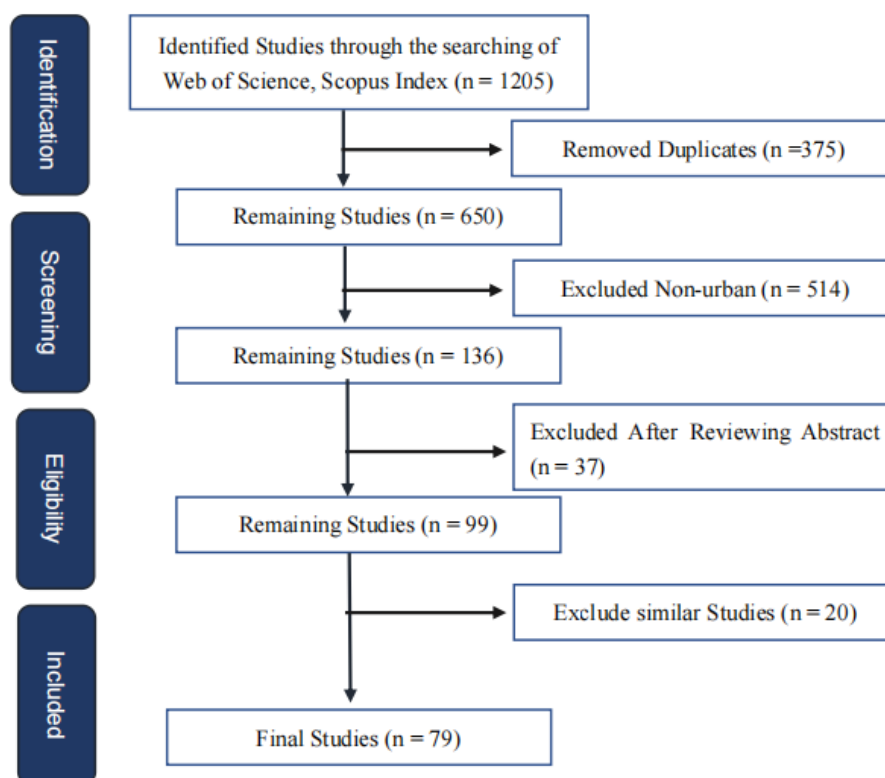


Figure 1: The Process of Selecting Studies for Review

Table 2: Detail of Reviewed Studies (main contributed papers)

Sr.#	Author (Year)	Study area	Citations	Findings
1	Chen et al (2020a)	Shanghai (China)	83	The lockdown has led to a sustained and substantial improvement in air quality, but severe haze still occurs in winter.
2	Wang et al (2023)	Linfen (China)	1	The lockdown has improved air quality, but not all air pollutant concentrations have decreased significantly.
3	Lian et al (2020)	Wuhan (China)	235	Six air pollutants such as PM _{2.5} decreased and the concentration of O ₃ increased.
4	Ren et al (2023)	Beijing-Tianjin-Hebei region (China)	1	O ₃ concentrations climbed with a maximum rise of 75.69%, whereas NO ₂ concentrations declined dramatically with a maximum decrease of 65.28%. On the other hand, NO ₂ concentrations decreased significantly.
5	Zhang et al (2023)	290 cities (China)	1	PM _{2.5} , PM ₁₀ , SO ₂ , NO ₂ , and CO concentrations decreased by approximately 18.8%, 13.1%, 13.5%, 11.1%, and 6.9%, while O ₃ concentrations did not change significantly.
6	Zoran et al (2023)	Tokyo (Japan)	1	Percentage changes in air quality variables are not as high as in other metropolitan areas of the world due to unfavorable meteorological conditions.
7	Karim & Rappenglück (2023)	Lahore (Pakistan)	1	During the semi- lockdown period, NO ₂ and SO ₂ levels in the troposphere decreased by approximately 20% and 50%.
8	Biswas et al (2022)	10 cities (India)	44	Pollutants like CO and NO ₂ have reduced to about –30% and –57% respectively during the full-fledged lockdown period.
9	Menut et al (2020)	Western Europe	271	The drop in PM concentrations was insignificant
10	Fu et al (2023)	Northeast China	2	Unfavorable meteorological factors and winter heating have contributed to the lack of improvement in air quality in Northeast China.
11	Rugani & Caro (2020)	Italy	101	Italy's carbon footprint (CF) from energy consumption during the COVID-19-related embargo has increased significantly compared to the same period in recent years.
12	Helm (2020)	NA	143	The shutdown and downsizing of industrial production has significantly limited GHG emissions.
13	Tewari & Srivastava (2023)	Bokaro, Dhanbad, and Ranchi (India)	5	Based on the findings of the study, it appears that the lockout had a beneficial effect on the heating and UHI impacts.
14	Yang et al (2022)	China	26	Sudden reductions in emissions during the pandemic enhanced summer atmospheric convection in eastern China.
15	Rupani et al (2020)	NA	197	This paper provides general knowledge of the factors affecting environmental sustainability during a pandemic.
16	Chand (2021)	NA	4	New findings suggest that the fast proliferation of personal protective equipment (PPE) during the COVID-19 epidemic has contributed to an increase in the amount of microplastics that are found in the water.

Sr.#	Author (Year)	Study area	Citations	Findings
17	Zhao & Zhang, (2023)	NA	1	The COVID-19 pandemic resulted in a significant 5-10% increase in global plastic production, which could potentially impact soil quality through increased levels of microplastics.
18	Prata et al (2020)	NA	541	For the duration of the pandemic, poor management of personal protective equipment (PPE) led to a rise in the levels of plastic pollution in metropolitan areas.
19	Rojas Quezada et al (2022)	Talca and Chillán (Chile)	3	It has been demonstrated that green spaces in urban areas are effective in improving both the physical and mental health of the general population.
20	Chen et al (2020b)	Hubei (China)	22	The most alarming aspect of a pandemic may be the high number of people battling the health-care system, resulting in a severe scarcity of health resources.
21	de Carvalho et al (2023)	Brazil	6	The lack of cohesion between the various levels of government disrupts the basic functions of pandemic management.
22	Noceda et al (2023)	Philippine	2	The capacity of basic health services was negatively affected by the COVID-19 pandemic, and that telemedicine alternatives, which can meet the needs of patients and health systems.
23	Maimaitiming et al (2023)	China	6	Telemedicine enables patients to successfully connect with clinicians.
24	Seifert et al (2023)	Valencia (Spain)	11	Transportation use patterns of Valencia Bike Share System (BSS) users changed.
25	Beck & Hensher (2020)	Australia	293	The second phase of the embargo imposed by the Government of Australia has led to changes in the pattern of travel activities of the Australian population.
26	Pawar et al (2020)	India	156	Safety Perceptions of Public and Private Transportation Modes during the Transition to the Lockdown in India.
27	Zhang et al (2022)	China	9	In this study, a mesoscale examination is conducted to investigate the structural and geographical changes that occurred in China's intercity transportation networks before to, during, and after the shutdown of Wuhan due to the outbreak of COVID-19 viruses.
28	Niu & Zhang (2023)	Shenzhen (China)	4	When the greatest degree of response was implemented in response to a public health emergency, there was an immediate decrease of 4,567 trips per day.
29	Essa et al (2020)	NA	11	Online instruction benefited students during the pandemic.
30	Choudhary (2021)	India	4	The scenario altered because they were having difficulty understanding the practical parts of veterinary anatomy in virtual environment.
31	Gerber et al (2023)	United States of America	3	Changes in American dietary and nutritional habits two years after the pandemic.
32	Nickanor et al (2023)	Windhoek (Namibia)	6	Households in informal settlements are disproportionately affected by food insecurity, and public health compliance should come before providing monetary or food assistance to disadvantaged households.
33	Wade (2020)	NA	122	Pandemic has not weakened structural racism.
34	Cheah et al (2023)	United States of America	3	Vicarious and collective racism may have a more severe negative impact on mental health and well-being.

Sr.#	Author (Year)	Study area	Citations	Findings
35	Bahi (2021)	United States of America	23	The pandemic has a geopolitical dimension.
36	McDonald & Larson (2020)	United States of America	41	COVID-19 Impact on Local Government Sales and Use Tax Revenues
37	Kakaulina (2021)	Russia	10	The epidemic caused by COVID-19 has exerted a significant amount of strain on the Russian economy and the income of the state. Tax revenues from individuals will experience a decline.
38	Naik & Haldankar (2021)	India	36	Governments all throughout the world are seeing a decline in income collection.
39	Pan et al (2021)	Hunan (China)	3	The Chinese government reduced or waived corporate taxes to encourage industry recovery, which temporarily imposed financial strain on local governments.
40	Li et al (2023)	Guangdong (China)	11	Unemployment has risen, especially in cities that are more dependent on exports or have a higher share of the hotel industry.
41	Serpil Aday & Mehmet Seckin Aday (2020)	NA	805	Pandemic affects food supply chain.
42	Bayar et al (2023)	Turkey	10	The short-term working allowance policy appears to have been critical in improving income distribution, which may have deteriorated.
43	Vu et al (2022)	Vietnam	14	The tourism sector in Vietnam has been severely impacted by the epidemic, as seen by the decrease in not only the number of tourists but also the volume, commercial activity, income, and employment throughout the country.
44	Qiang (2022)	China	4	The loss of Chinese tourism revenue due to COVID-19 was severe.
45	Al-Qadi et al (2023)	Jordan	1	COVID-19 affects and increases unemployment in the Jordanian tourism industry, as more than 46 per cent of tourism workers are unemployed.
46	Napierała et al (2020)	Poland	90	The negative impact of national COVID-19 cases was more obvious in urban locations that were less internationalized (or population-wise) than other urban destinations.
47	Koo et al (2020)	Korea	2	Import-dependent firms are more affected than export-dependent firms.
48	Zhu et al (2021)	China	10	The pandemic has had a serious impact on Chinese production and supply in the short term, increasing the risk of accelerated outward migration of the domestic industrial chain.
49	De Meo et al (2022)	Italy	10	COVID-19 has triggered positive perceptions of the benefits of urban green spaces, leading to increased use of urban green spaces.
50	Yamazaki et al (2021)	Tokyo (Japan)	19	Lack of exercise, stress buildup, and decreased well-being due to closures can be problematic, and these can be ameliorated through the use of Urban Green Spaces.
51	Kim et al (2023)	Korea	1	More and more people are recognizing the importance of urban wastewater treatment systems.

Sr.#	Author (Year)	Study area	Citations	Findings
52	Duan & Zhu (2020)	China	2289	The COVID-19 outbreak exposed many problems with psychological interventions in China.
53	Chakraborty & Chatterjee (2020)	West Bengal (India)	188	The pandemic threatened the survival of the respondents and negatively affected their mental state.
54	Gao et al (2020)	China	2848	The high frequency of mental health disorders is positively connected with regular exposure to social media.
55	Moghanibashi-Mansourieh (2020)	Iran	914	COVID-19 anxiety levels were higher in the general Iranian population.
56	García-Dolores et al (2023)	Mexico	2	The COVID-19 virus has an impact on mental health all across the world, and one of the major consequences is suicide.
57	Mouratidis, & Yiannakou (2022)	NA	70	Analyzed the relationship between urban, health and well-being before and during COVID-19.
58	Martínez & Short (2021)	NA	102	Pandemic impacts on public space, transportation, connectivity and economy.
59	Lai et al (2020)	NA	150	Urban scientists, planners, and designers have a key window of opportunity because to the COVID-19 pandemic. This window exposes us to the biggest natural experiment in several areas of urban activity and population mobility.
60	Guida & Carpentieri (2021)	Milan (Italy)	144	Equal access to essential services necessitates an age-friendly approach in urban design policies.
61	Hu et al (2021)	Washington (United States of America)	123	Characteristics of the built environment as well as the social environment can significantly affect public health.
62	Pouso et al (2021)	NA	377	Ecosystem services, including being outside in nature in particular, may be good for people's emotional and psychological wellbeing.
63	Poortinga et al (2021)	UK/ Britain	148	Access to green areas, whether in the public or private sector, is crucial to health and happiness.
64	McGuirk et al (2020)	NA	59	COVID-19 presents risks and opportunities for pursuing inclusive innovations in urban governance and urban planning.
65	Wu et al (2022)	Wuhan (China)	5	COVID-19 brings an uphill battle to city management.

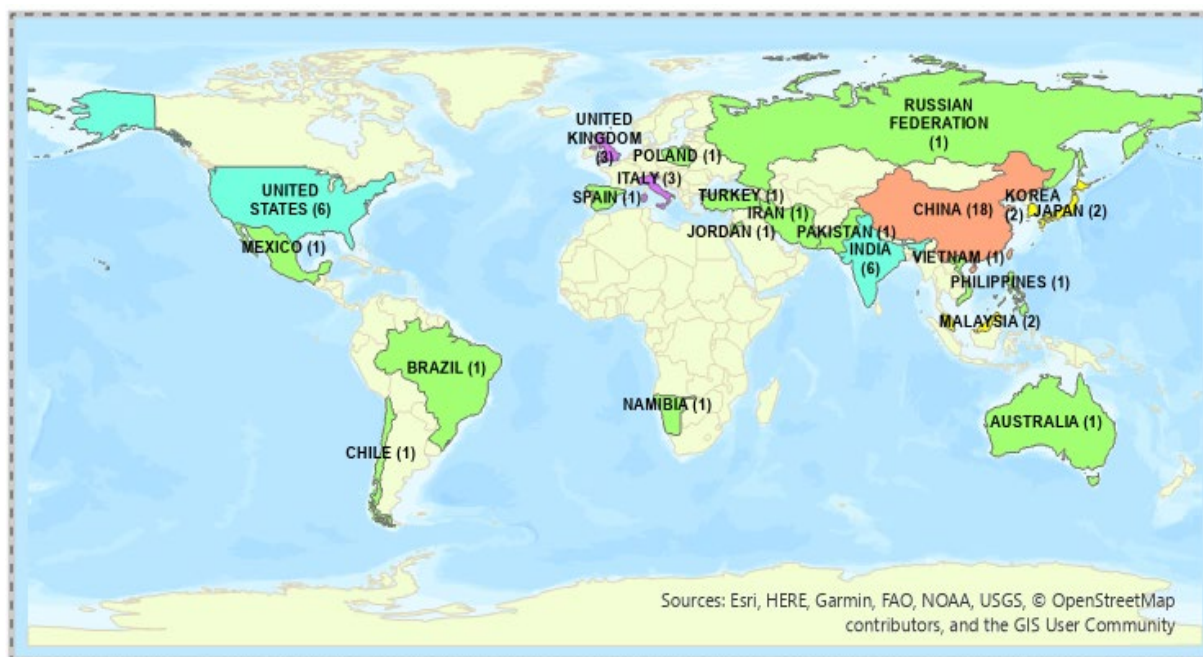


Figure 2: Spatial Distribution of Reviewed Studies

3. RESULTS

3.1 Environmental Quality

3.1.1 Air Quality

The COVID-19 pandemic is the latest and more severe of the many epidemics that have affected the world over the past few decades, with significant impacts on the global environment, particularly in air quality.

Controlling COVID-19's rapid spread, many nations enacted stringent national precautionary measures, including quarantine policies, the closure of public areas, and a reduction in the use of public transportation (Chen et al., 2020a; Wang et al., 2024b). China was the first country to identify COVID-19 cases and the first to take action. Since then, home quarantine has been introduced for almost all Chinese to effectively avoid the spread of COVID-19 (Wells et al., 2021). The implementation of strong quarantine procedures has been shown to be helpful in stopping the spread of COVID-19 (Lau et al., 2020). Various studies have reported an additional advantage of lockdown measures, namely enhanced air quality (Wen et al., 2022).

The typical social, economic, and industrial activities came to a standstill due to the blockade, which may explain this phenomenon. During this time, anthropogenic emissions are greatly decreased, which ultimately results in an improvement in the air quality in some cities. In the Beijing-Tianjin-Hebei region of China, NO₂ concentrations decreased significantly during the period of the tightest city closure, with a maximum decrease of 65.28% (Ren et al., 2023). During 2020-2022, air quality in Japan improved relative to the average of 2015-2019, as aerosol optical depth increased by 9.13% in 2020, decreased by 6.64% in 2021, and decreased by 12.03% in 2022; particulate matter PM_{2.5} and PM₁₀ decreased by 10.22%, 62.26%, and 0.39% in 2020, 2021, and 2022, respectively (Zoran et al., 2023). During the lockdown, the ambient surface levels of PM_{2.5}, NO₂, O₃, and CH₄ in Pakistan decreased by 38%, 50%, 45%, and 25%, respectively (Karim & Rappenglück, 2023). During the COVID-19 pandemic, a study in India analyzed the quality of spatial and temporal variation of PM_{2.5} concentrations in different air by observing the Calcutta monitoring station (AQMS). This study showed that the mean PM_{2.5} concentrations (µg/m³) was slightly higher before the blockade (139.82) and rapidly decreased to 37.77 (72.99% reduction) during the blockade period, with significant improvement in its air quality (Biswas et al., 2022).

However, research suggests that the drop in PM concentrations was insignificant. In some cases, the principal contributors to aerosol concentrations are sources other than transportation, such as household heating, the food sector, and the combustion of biomass (Menut et al., 2020). For example, Wang Lingyun et al. collected continuous samples of airborne fine particulate matter (PM_{2.5}) in Linfen (a typical heavy industrial city in China) before and during the COVID-19 urban blockade and interestingly, they found no reduction in ambient persistent free radical (EPFR) concentrations in PM_{2.5} after a normal life pause (Wang et al., 2024a). Even part of the evidence points to an increase in PM_{2.5} concentrations during the period when the facility was closed. This is the case in some regions of northeast China, for example, as a result of an increase in the use of household heating systems during the winter months and an increase in the number of industrial operations in the surrounding area. The researchers Fu et al. found that an increase in residential emissions of 15%, coupled with decreases in industrial emissions of 15% and transportation emissions of 90%, resulted in a slight decrease in AQI of 3.1% (Fu et al., 2023). This suggests that the decrease in emissions associated with the blockade was largely offset by the increase in residential emissions, resulting in very little change in air quality in Northeast China (Fu et al., 2023).

3.1.2 Environmental Factors

The impact of pandemics on the natural environment and human impact is extensive. The authors state that when looking at how pandemics affect cities, most studies focus on three main areas: the urban heat island effect, pollution in cities, and green spaces in cities.

Urban heat island (UHI) refers to the phenomenon in which cities are warmer than their surroundings. Beginning in 2020, the COVID-19 pandemic had an enduring impact on urban heat intensification, mitigation, and adaptation. For example, in the early stages of the epidemic, multiple governments prioritized preventive measures such as home quarantine to mitigate the spread of the pandemic. These measures mitigated urban temperatures by reducing anthropogenic heat release (Rugani & Caro, 2020). Similarly, the shutdown and downsizing of industrial production has significantly limited GHG emissions (Cooper, 2020; Helm, 2020; Rupani et al., 2020). Apurba Tewari et al. used Landsat-8 OLI/TIRS data to examine changes in the spatial and temporal heterogeneity of these urbanization indicators during full and partial closure in 2020 and 2021, using 2019 as a baseline. Bokaro, Dhanbad, and Ranchi were chosen from the coal mining belt of eastern India for the investigation. The results showed significant decreases in surface temperature values at all sites, with the largest decreases at mining sites (i.e., Bokaro and Dhanbad), where surface temperature values decreased by about 13-19% during the blockade (Tewari & Srivastava, 2023). However, other researchers have pointed out that the global adoption of "stay at home" policies has led to an increase in household electricity and natural gas consumption (Rugani & Caro, 2020), thereby increasing GHG emissions (Hamwey, 2020). Yang et al. found that summer atmospheric convection in eastern China was enhanced by precipitous emission decreases during the COVID-19 epidemic, leading to sea level pressure anomalies in the northwest Pacific. The pandemic also affected urban precipitation. The northwest Pacific sea level pressure anomaly converged water vapor in eastern China and further enhanced urban rainfall in the region (Yang et al., 2022).

Studies of pandemic pollution in cities have focused on air pollution, water pollution, and plastic pollution. In terms of air pollution, as described in section 3.1.1, the pandemic has led to improvements in air quality in most cities. In terms of water pollution, the large amount of antibiotics and disinfectant solutions used by medical care and people to treat and prevent the pandemic flowed into medical and domestic wastewater, exacerbating water pollution to some extent. Additionally, the use of various plastic-based personal protective equipment (PPE) to prevent infections has increased. Emerging reports suggest that PPE has exacerbated microplastic contamination in the oceans during the COVID-19 pandemic (Chand, 2021). The COVID-19 pandemic resulted in a significant 5-10% increase in global plastic production, which could potentially impact soil quality through increased levels of microplastics (MP) (Zhao & Zhang, 2023). Urban plastic pollution has worsened because the pandemic mismanaged personal protective equipment (PPE), which included an estimated 129 billion masks and 65 billion gloves used monthly worldwide (Prata et al., 2020).

The impact of the pandemic on urban green spaces is divided into two aspects. On the one hand, due to the embargo policy, human activities were reduced, urban green spaces were less damaged by humans, and green spaces were restored to some extent. On the other hand, during this period of the COVID-19 pandemic, people saw the valuable value of green spaces in parks for health purposes (Rojas Quezada et al., 2022). In metropolitan areas marked by systemic inequality, limited access to green spaces might compromise citizens' health and the community's ability to bounce back from adversity. More and more individuals are realizing the value of green space in the post-pandemic period, and cities are responding by planting more parks and other green areas.

3.1.3 Social Impact

The COVID-19 pandemic impacted all aspects of urban society by analyzing most of the studies that focused on health care systems, transportation, education, urban safety, and social issues (social inequality, racial discrimination, etc.).

The high number of people battling the virus may be the feature of a pandemic that is the most frightening. This large number of patients generates a serious scarcity of health resources, notably medical professionals, and a breakdown in the system that delivers health care. When Chen et al. compared medical staff resources with death and confirmation rates in 16 cities in Hubei province that were first worried about the worst outbreaks, they discovered a strong inverse link (Chen et al., 2020b). This indicates that medical staff resources play an essential role in maintaining control of the pandemic. However, in cities with severe epidemics, it is difficult to ensure the availability of sufficient medical staff (Chen et al., 2020b). This period also drew attention to pre-existing deficiencies in health care the system and its governing bodies. The health system in the Brazilian state of Amazonas collapsed in January 2021, particularly in the city of Manaus, where acute Covid-19 patients perished due to a dearth of healthcare resources and medical respiratory therapy supplies (de Carvalho et al., 2023). Essential health services have been severely affected by the COVID-19 epidemic, especially because of the embargo limitations. Telemedicine offers a safe, efficient, and effective option when it comes to satisfying the needs of both patients and health systems (Noceda et al., 2023). Throughout the COVID-19 pandemic, Maimaitiming et al. observed that telemedicine enabled patients to effectively communicate with their physicians (Maimaitiming et al., 2023). In 2020, Maimaitiming compared the number of telemedicine users and active online physicians in several specialties to the numbers before and after the announcement of human-to-human transmission in 2019, using data acquired from haodf.com in China. They found a significant increase in telehealth services after the announcement of COVID-19 human transmission. In addition, China is easing the strain on the health care system in the worst areas of the pandemic through nationwide "peer-to-peer" support measures of at least one province helping one city (Chen et al., 2020b). Thus, the emergence of the pandemic brought to light the problems of the urban health system, while telemedicine and cross-city medical assistance alleviated the problems of health system collapse.

The pandemic of COVID-19 had a significant effect on urban traffic. Valencia (Spain) restricted all non-essential movement at the onset of the pandemic in an effort to contain the virus. As a consequence of this, Seifert discovered that the patterns of traffic use exhibited by users of the bicycle-sharing system (BSS) in Valencia shifted while the emergency was underway. After the pandemic outbreak, only 37% of users maintained their mode of travel. These users rode the same number of days as the previous year, resulting in fewer connections while network density and speed increased. There was a slight increase in the number of trips people took in the morning relative to evening trips (Seifert et al., 2023). Additionally, pandemics influence how people travel. A return to normalcy and fewer limitations allowed residents' perceptions of public transportation to stabilize (Beck & Hensher, 2020). Many locals avoided driving altogether or shifted from using public to private transportation options throughout the outbreak (Pawar et al., 2020). Zhang et al. used a mesoscale viewpoint to analyze the structural and geographical changes in China's intercity transport mobility network before, during, and after the COVID-19 epidemic. While the intercity network was in its usual phase, it changed to an asymmetrical structure with a mix of core-periphery and local communities during the blockade phase. Following the blockade, it transitioned again to a core-periphery nested multi-community structure. This suggests that the COVID-19 outbreak and travel restrictions deconstructed the original hierarchical structure of China's intercity mobility networks, rendering them more localized or regionalized even during the recovery phase (Zhang et al., 2022). Niu et al. state that different transportation networks in different regions and cities have different causal impacts on mobility intervention strategies. Communities that had metro access, strong transit connections, or were close to an airport had a substantial rebound impact from return-to-work orders and a declining effect from health emergency response (Niu & Zhang, 2023).

The closure of numerous schools around the world as a result of the COVID-19 pandemic has posed significant challenges to education systems around the globe. Due to enforced social isolation, multiple forms of offline social interaction, including education, migrated online at the onset of the COVID-19 crisis. This shift resulted in arguably the most significant educational revolution in modern history (Essa et al., 2020). Instructors have been compelled to adopt new teaching technologies, which has resulted in improved student comprehension and attention to ideas. Besides, online teaching benefits students by allowing them to attend lectures at any time and place and to submit queries at any time, a very advantageous practice (Essa et al., 2020). Moreover, online education has recorded lectures and multiple review sessions that allow students to fully understand the concepts. However, for subjects that require practice, online education has some drawbacks. For example, in anatomy,

Choudhary argues that despite technological advances, cadaver dissection has been considered the most effective method of teaching anatomy. Students are deprived of cadavers and other valuable learning tools when the dissection room is not available to them. These tools include models, pathological specimens, skeletons, and dissections (Choudhary, 2021). In addition, education policymakers must comprehend the factors that prevent certain children from receiving an adequate education, such as inadequate school and teacher preparation, lack of curriculum guidelines, and in some cases, lack of infrastructure. Due to these and other factors, there is a wide range in the quality of online education across countries and schools. This makes people concerned that existing gaps in educational achievement between socioeconomic groups could widen if we don't do something about it (Co-operation & Development, 2020).

Urban security includes aspects such as information security, food security, water security, and transportation security. Aspects such as transportation security have been discussed in other sections, and this paragraph focuses on urban food security during the pandemic. Gerber et al. found that by the end of 2021, food security and the healthiness of food choices had improved for most Americans, despite reduced access to food services and retail, although a significant proportion of Americans were experiencing deterioration, and these changes were heterogeneous. Positive federal, state, municipal, and community responses to the pandemic may have played a role in improving food safety and the healthiness of food choices during the COVID-19 pandemic. The COVID-19 pandemic has created social problems such as social inequality and racial discrimination. Pandemics disproportionately affect minorities and the lowest socioeconomic strata. Due to economic hardship, people at the bottom of the socioeconomic ladder are more exposed to risk, they tend to suffer more from congenital diseases and have limited access to services. The wealthy population enjoys more and superior resources such as medical care, which is where they get a better recovery. To some extent, this contributes to increased social inequality. New York City's most current data shows, for example, that Blacks and Latinos had double the death rate of whites (Wade, 2020). Besides, because the COVID-19 pandemic was first identified and reported in China, it led many to believe that Chinese and yellow people had the disease, making them subject to racial discrimination. Cheah and colleagues made the startling discovery that Chinese American families were subjected to high rates of racial discrimination in a variety of forms (Cheah et al., 2023). The mental health and well-being of individuals may suffer greatly in the later years of the epidemic as a result of collective and substitutive racism (Cheah et al., 2023). Pandemics are not just a health crisis; pandemics also have geopolitical significance. The distribution of global public goods is impacted, the dynamics of rivalry between China and the US are amplified, and the global order is injected with instability as a result of this health crisis (Bahi, 2021).

3.2 Economic Impact

Urban economies have been severely impacted by the prolonged economic development stagnation caused by the COVID-19 pandemic culminating in a prolonged blockade. Although studies on this subject are still in their early stages, preliminary results show that the pandemic significantly affected metropolitan tax revenues, citizen income, tourism, and industrial supply chains.

Local governments were the primary responders to the COVID-19 pandemic, but the response also reduced government revenue streams. McDonald found that local governments in North Carolina counties in the United States faced a shock to sales and use tax revenues from COVID-19; After that, they calculated how it would affect county budgets and showed that many municipalities were already struggling financially and that falling sales tax revenues were a major problem for their capacity to react to the virus and stay afloat (McDonald & Larson, 2020). A sharp decline in people's income would be the long-term effect of a recession in Russia, according to Kakaulina's research. Revenues from individual income taxes will consequently fall. Budget deficits will reach 416.6 billion rubles by the conclusion of fiscal year 2020. Assuming the economy is untouched by the epidemic, this amounts to 9.7 percent of total personal income tax receipts and 0.4 percent of Russia's GDP. Government revenue is projected to fall the most in areas that have performed very well in terms of personal income tax receipts per capita (Kakaulina, 2021). In particular, India's fiscal system has been severely impacted by the limitations imposed by the COVID-19 epidemic. NAIK et al. make an effort to investigate how the initial wave of COVID-19 affected the distribution and collection processes, as well as how it affected GST revenues in various states across the nation. They find a sharp decline in GST revenue in the months following the announcement of the embargo. Large cities show little impact of the COVID-19 pandemic on GST revenue. In contrast, smaller cities like Manipur and Goa show significant differences in GST revenues and distribution between the pre-and post-embargo periods (Naik & Haldankar, 2021). Moreover, in the post-pandemic period, the Chinese government took the initiative to reduce or waive corporate taxes to promote industrial recovery, which put local governments under fiscal pressure for a short period (Pan et al., 2022).

The impact of the COVID-19 pandemic was particularly severe on individual citizens, not only in terms of their health but also in terms of their income and consumption. At the beginning of the pandemic, a strict lockdown policy was imposed, with many industries and companies closing and people being isolated in their homes. The prolonged embargo led to the bankruptcy of many companies and resulted in a long-term lack of income or loss of jobs for many people who had to work for companies (e.g., in the service and tourism industries). Li et al. discovered that in Guangdong Province, China, unemployment increased by 72 percent and unemployment benefit claims increased by 57 percent relative to the same period in 2019 (Li et al., 2023). In turn, the inability to secure long-term income has reduced consumption levels and put many residents and households at risk of bankruptcy and displacement, exacerbating the problem of poverty. In general, vulnerable groups are disproportionately impacted by the pandemic, the economic downturn, and rising unemployment (A. Sharifi & A. R. Khavarian-Garmsir, 2020).

The COVID-19 pandemic severely impacted the tourism industry, with protracted embargo policies resulting in a 75% decrease in international visits and a \$2.4 trillion loss in global GDP (Chavarria et al., 2022). Cities that rely heavily on tourism are facing issues they have never faced before as a result of unprecedented worldwide travel restrictions and "stay-at-home" tactics. In 2020, the total loss of tourism revenue in China due to COVID-19 ranged from US\$618,995,929,706 to US\$665,682,125,283, with many prominent tourist cities experiencing a precipitous drop in revenue (Qiang, 2022). In addition, the pandemic resulted in a large number of unemployed tourism workers who had little or no income during the pandemic (Vu et al., 2022). With almost 46% of the tourist workforce laid off as a direct result of the COVID-19 pandemic, Jordan's unemployment rate rose sharply. As a result, the income of those who work in the tourist industry decreased and the unemployment rate rose from 19% in 2018 to 24% in 2020 (Al-Qadi et al., 2023). In a separate study, Napieraa et al. found that the COVID-19 pandemic had a negative and geographically diversified impact on urban hotels. Large tourist cities were found to be more affected by the pandemic than smaller cities that frequently received domestic tourists, because large tourist cities frequently received both international and domestic tourists (Napierała et al., 2020).

As the global spread of the pandemic continues to fester, production, investment, and trade contract significantly and the global economy faces a greater risk of recession, which also has a greater impact on the Chinese industrial chain (Hamzah et al., 2020). As a consequence of the COVID-19 pandemic, numerous manufacturers in China ceased production. This caused catastrophic disruptions to the global supply chain, as China is a key supplier of raw materials and intermediate goods to many countries. The pandemic had a devastating effect on the supply chain, particularly the food supply chain. Movement restrictions were one of the effects of COVID-19, which caused problems in the supply chain. A significant issue emphasized by the pandemic is the susceptibility of urban areas to supply chain disruptions, especially those involving food supply. The main causes of disruptions are mobility restrictions that prevent the movement of food from farm to market or international trade restrictions that are put in place to ensure that domestic food supplies are met. For instance, the government of Malaysia has made it more difficult to move about the country by installing travel restrictions and roadblocks in various parts of the country. The first several weeks of travel restrictions impacted many food supply chains, particularly in metropolitan areas, because many Malaysian supply systems rely on land transit, such as trucks, to convey supplies from farms distant from cities (Aday & Aday, 2020). In addition, Korean scholars have found that imports and exports of final products change dramatically during a pandemic, but intermediate products change relatively little, making the impact greater for firms that rely on imports versus exports (Koo, 2020). As the impact of the pandemic on the international industrial chain will continue to amplify, there will be a significant adjustment in the international industrial layout and a rise in industrial protectionism in the future. Basic life and health industries and security industries will accelerate their return to sovereign countries, leading to a restructuring of the international division of labor system (Zhu, 2020).

3.3 City Residents

The COVID-19 pandemic affects all aspects of citizenship, and the main focus on the impact of the pandemic on citizens is on their physical health, their lifestyle, their mental health, and their sense of citizenship.

The COVID-19 pandemic has dramatically changed urban lifestyles. There are many impacts of the pandemic on urban lifestyle, and the current related studies mainly focus on urban green spaces and urban residents' travel patterns, etc. Since the social impact of the pandemic was examined and analyzed in the transportation study, only the impact of the pandemic on urban green spaces is described here. In response to the pandemic outbreak, governments in various nations and regions enacted various restrictions and measures to compel citizens to adopt an entirely new way of life. More free time, more job flexibility, and the urge to relax in nature to alleviate stress and anxiety are only a few of the reasons why people's usage of green areas has been affected by these limits (De

Meo et al., 2022). Urban green areas improve people's physical and emotional health by providing habitat preservation, pollution management, recreational possibilities, and leisure time (De Meo et al., 2022). Due to lockdown policies, workers are also required to minimize their commutes to work, older individuals are prohibited from using exercise facilities, and children are prevented from attending school. Urban green spaces (UGS) could have mitigated the resulting lack of physical activity, accumulated tension, and diminished quality of life. Japanese researchers found that telecommuters who started using UGS during the epidemic were different from older persons and families with children who had used UGS before the outbreak. Small parks were frequently utilized by senior citizens and families with children, who valued the human connection. Valuing the stress-relieving qualities of greenways, temples, and sanctuaries, teleworkers utilized them frequently (Yamazaki et al., 2021). Particularly, the rate of increase in the use of UGS was quite high among groups that used UGS infrequently prior to COVID-19 (Kim et al., 2023).

The COVID-19 pandemic caused psychological distress among infected and uninfected individuals in addition to claiming lives (Duan & Zhu, 2020). According to the findings of a study conducted in India during COVID-19 (Chakraborty & Chatterjee, 2020), a significant number of respondents often checked their temperature, submitted themselves to blood tests, and went to the doctor out of anxiety and fear of infection, regardless of whether or not they were experiencing any symptoms. Low learning productivity during confinement is linked to frequent exposure to pandemic news/social media, which makes college students more susceptible to stress and anxiety (Gao et al., 2020; Moghanibashi-Mansourieh, 2020). The prolonged blockade, however, leads to the inability to socialize properly, reduced access to nature, and reduced income, which, combined with the fear of viruses, ultimately increases the chance of mental illnesses such as anxiety and depression. In particular, immature minors are at a dramatically increased risk of developing mental illness. In addition, according to numerous studies, suicide rates are found to increase significantly during a pandemic. García-Dolores et al. studied suicide rates in Mexico from 2016 to 2021, and they found that suicide rates remained constant from 2016 to 2018 (approximately 5.42 per 100,000 people) and increased slightly in 2019 (6.60 per 100,000 people). 6.60 per 100,000). However, it increases sharply in 2020 (10.45 per 10,000 people), returning to the levels of previous years by 2021 (6.95 per 100,000 people) (García-Dolores et al., 2023). The pandemic effects on mental health are not limited to the duration of the pandemic but persist even after it ends. In the aftermath of the epidemic, scientists are focusing on ways to lessen its effect on people's mental health.

3.4 Urban Planning

According to previous research, urban planning arose as a response to a succession of crises, playing a crucial role in sanitation crises, health crises, and epidemics in particular. There is always a direct or indirect connection between major urban planning issues and public health concerns. These issues include urban density, urban shape, suburban and compact growth, and the nature of open and green public places (Mouratidis & Yiannakou, 2022). The COVID-19 pandemic affects all aspects of urban planning, such as land use, transportation infrastructure, green infrastructure, public facilities, healthcare facilities, residential environment, and urban environment. This pandemic compels us to rethink the very nature of urban space and may present a chance for us to build cities that are both safer and more environmentally friendly (Martínez & Short, 2021).

Throughout their history, cities have undergone many changes in response to the constant backlash of disease, and cities today suffer from the effects of new coronavirus pandemics, implying that current or near-future cities must change (Hyun et al., 2022; Martínez & Short, 2021). Concerns regarding traditional planning concerns, such as low-density vs high-density built environments or suburban versus compact urban forms, are once again at the forefront as a result of the severe health crisis that is currently taking place (Lai et al., 2020). When it comes to health services, research has shown that people, particularly vulnerable populations like the elderly, rely on close proximity and easy access to ensure prompt delivery (Guida & Carpentieri, 2021). In terms of urban design, the layout of modern cities emerged long after previous pandemics and their effects were forgotten. As a result, the post-pandemic urban layout will face new design challenges. In terms of urban transport, the pandemic has changed the way people travel and their attitudes towards public transportation to some extent. In addition, pandemic outbreaks and travel restrictions deconstructed the original hierarchy of intercity transportation mobility networks. These changes make future planning compromises that must be faced and addressed. In terms of green space, the mobility restrictions imposed during the pandemic increased the risk of isolation and the tension and anxiety that accompanied it (Pouso et al., 2021). Because green spaces (both public and private) can bring benefits to one's emotional and mental health as well as safe spaces for activity engagement, they are regarded as being particularly crucial for minimizing the detrimental effects that COVID-19 will have on one's health and well-being (Poortinga et al., 2021; Ugolini et al., 2020). In terms of urban management and governance, cities are central to

the response to COVID-19 emergencies. Urban regions are witnessing the rise of diverse new ecosystems of creative urban governance. These ecosystems hold great promise for reshaping urban decision-making, creating new institutional settings, re-establishing multi-scale interactions in cities, and igniting alternative power dynamics (McGuirk et al., 2021).

4. DISCUSSION

The synthesis provided in Section 3 attempts to synthesize early findings on how COVID-19 affects various aspects of urban development. The impact of the pandemic on urban development was organized in five areas: environmental quality (air quality and environmental factors), social impacts, economic impacts, urban residents, and urban planning.

In fact, the factors affecting urban development are not independent of each other, and the influencing factors are also mutually influential and dependent on each other. Cities are centers of social and economic development, and population is an important factor in urban development. Population is the foundation of urban development. As the population size grows, the functions of cities expand. Cities with large populations can attract more people and capital to form advantageous industrial clusters and improve the competitiveness of the city's economy. At the same time, large cities can also provide more medical and other public service facilities, attracting more people to gather. Therefore, population size is the foundation of urban development and an important reflection of urban competitiveness. Excessive population size will also bring some problems. The carrying capacity of a city is limited, and overpopulation will bring environmental pollution, traffic congestion and other issues to the city, affecting the quality of life of urban residents. In addition, overpopulation will also aggravate the tension of urban resources and increase the difficulty of urban governance. It can be seen that the impact of COVID-19 pandemic on various aspects of urban development is also interactive and dependent. For example, the prolonged embargo policy imposed during the COVID-19 pandemic led to the bankruptcy of many enterprises and economic downturn, which in turn resulted in the unemployment of a large number of urban residents, not only lowering the quality of life of residents, but also further affecting social stability. Therefore, it is important to integrate all aspects affecting urban development when proposing recommendations and measures to deal with the pandemic. Only in this way can effective measures be proposed to deal effectively with the pandemic.

Table 3 summarizes the issues that impede urban development identified in the analysis of the impact of the COVID-19 pandemic on urban development and provides recommendations to address each exposed issue. Researchers, planners, practitioners, and policymakers should reflect on these challenges and take action to address the problems exposed in urban development in order to promote sustainable and healthy urban development and provide lessons for future urban responses to emergencies such as pandemics.

All in all, the COVID-19 pandemic is an opportunity and a challenge for urban development. To some extent, the pandemic has had a positive impact on urban development, such as reduced emissions of air pollutants. However, the pandemic has had more negative impacts on urban development and has brought to light the problems of urban development. Summarizing the problems of urban development and the experience of resisting pandemics, and making suggestions to solve the problems will help improve the ability of cities to cope with pandemics and other emergencies, and promote the sustainable and healthy development of cities.

Table 3: Major Pandemic Challenges and Post-COVID-19 Development Suggestions.

Thematic category	Detailed Categories	Major issues revealed by the pandemic	Major recommendations for post-COVID-19 development
Environmental quality	Air quality	<ul style="list-style-type: none"> Major pollutants have been reduced in cities such as China, Japan and Pakistan due to the implementation of lockdown policies, closure of public areas and reduced use of transportation. However, there are also a few cities where air quality has not improved significantly due to urban heating and heavy industry, among other reasons. 	<ul style="list-style-type: none"> Use of new energy vehicles such as electric vehicles to reduce pollution from vehicle exhaust. Cities should continue to optimize and upgrade the urban industrial structure, strive to develop clean and light industries, and increase the area of urban green space to promote continuous improvement of urban air quality. Develop and improve the air pollution emission system, and increase the supervision, of industrial waste gas after meeting the standards in the emission.
	Environmental factors (Urban heat island effect, urban pollution and urban green space)	<ul style="list-style-type: none"> Many governments have prioritized preventive measures such as lockdown policies, transportation and industrial shutdowns to make the urban heat island effect less severe. An increase in summer air convection in eastern China was caused by the abrupt drop in emissions during the epidemic. This, in turn, caused an anomalous rise in sea levels in the northwest Pacific Ocean. As a result, water vapor converged in eastern China, increasing the amount of rainfall in the region's metropolitan areas. The large amount of antibiotics and disinfectants used by medical care and people flowing into medical and domestic wastewater contributed to some extent to water pollution. The pandemic has increased the use of various plastic-based personal protective equipment, leading to a significant increase in global plastic production and, to some extent, increasing plastic pollution. Green spaces have been restored to some extent as a result of the embargo policy and the reduction of human activities, which have reduced the damage to urban green spaces by humans. 	<ul style="list-style-type: none"> It is advised that the industrial structure and urban layout be optimized, that greenhouse gas emissions be reduced, and that the amount of urban green space be increased to lessen the impact of the urban heat island effect. Cities should strengthen their urban emergency response capabilities, such as improving urban early warning and flood resilience. Cities should prioritize increased regulations for wastewater and other pollutant treatment to reduce the impact of water pollution and plastic pollution, among others, on urban development.

Social impact	Healthcare systems, transportation, education, urban safety and social issues	<ul style="list-style-type: none"> • Health systems collapse. • Transportation closures and changes in personal travel behaviors and modes. • As a result of travel limitations and the COVID-19 pandemic, China's intercity mobility network became more decentralized and less hierarchical than it had previously been. • The transition from offline to online occurred in many areas, including education, forced social isolation, and many types of social contact. • For subjects that require practice, online education has certain drawbacks. • Disparities in educational outcomes between socioeconomic groups may increase, which exacerbates educational inequities. • Food safety is put to the test. • Pandemics create social problems such as social inequality and racial discrimination. 	<ul style="list-style-type: none"> • Reassess how well the health system matches the surrounding community to ensure health care safety. • Improve the online healthcare system to address unexpected illnesses in the population. • Rationalize new parking spaces to address the shortage of parking spaces. • Future urban planning should be reasonably designed to accommodate changes in traffic structure. • Improve the online education system and adopt more diversified practice methods such as simulation exercises to cope with the inability to conduct educational practices in emergencies. • The government should subsidize poor students and increase educational facilities in poor areas. • The government should take more responsibility for urban safety. • Raise the level of civic education and improve the overall quality of citizens. • Take some measures to punish racial discrimination and reduce the phenomenon of racial discrimination.
Economic impact	City tax revenue, citizen income, tourism, industrial supply chain	<ul style="list-style-type: none"> • The pandemic has reduced local government tax revenues of all types. • The pandemic also affected personal income and consumption, with increased unemployment and poverty. • Famous tourist cities saw a precipitous drop in income. • Severe disruptions in global supply chains. • Businesses that depend on imports and exports are more affected. 	<ul style="list-style-type: none"> • The government should take a series of measures to restore production and the economy. • The government has promoted industrial recovery and provided some subsidies to vulnerable groups. • The government and attraction managers should increase their efforts to promote tourist attractions and reduce admission prices, etc., to attract tourists. • The government should take measures to prioritize the supply of food, such as having reasonable food reserves and using public distribution vehicles to facilitate the transportation of supplies. • Cities should optimize their industrial structure to form a more complete industrial structure and improve the efficiency of essential goods production.

City residents	Citizens' physical health, citizens' lifestyle, citizens' mental health	<ul style="list-style-type: none"> • It affects people's health. • Changing people's urban lifestyles and blocking policies affect citizens' use of green space. • Prone to stress and anxiety, increased risk of depression and higher suicide rates. 	<ul style="list-style-type: none"> • The government should ensure the stable operation of the citizens' healthcare system. • Increase the number and size of green spaces and parks near residential areas • The government should focus on the role of psychologists to provide psychological guidance to citizens
Urban planning	Various aspects of urban planning	The COVID-19 pandemic has affected all aspects of urban planning, such as land use, transportation infrastructure, green infrastructure, public facilities, medical facilities, residential environment and urban environment, bringing to light the problems of urban planning.	Re-improve the urban planning program in response to the changes that occurred in the city during the pandemic and the problems that were revealed.

There have been a number of severe pandemics in human history. The COVID-19 is the latest in a series of pandemics, and one that has had a wider range of impacts, affected more areas, and lasted for a longer period of time. Studying the impact of pandemics on urban development will not only provide an understanding of the problems exposed in urban development during pandemics, but will also further enable us to propose countermeasures to the problems identified. The ultimate goal is to improve the ability of cities to cope with pandemics, so that they can do a good job of precise joint prevention and control during the outbreak of a pandemic to reduce the mortality rate, and during the recovery period to strengthen cooperation in the fields of economy and transportation, and to support each other with integrated development, so as to slow down the impact of pandemics on the economy of urban agglomerations, and to promote the recovery and sustainable development of cities. It will also provide lessons for future cities to cope with other emergencies such as pandemics and promote the sustainable and healthy development of cities.

There are, of course, limitations to this study. First of all, being in the early stages of the post-COVID-19 pandemic, the impact of the COVID-19 pandemic on urban development is still ongoing and there may be impacts that have not yet been detected. To address this, research on the impact of pandemics on urban development should continue to be implemented to continually improve the study. In addition, this study did not analyze certain aspects of some themes thoroughly enough. For example, in the areas of urban planning and smart cities, this study is deficient. In the future, more research should be done on the pandemic's impact on urban planning and smart cities to make up for the shortcomings of this study.

5. CONCLUSION

Cities around the world have been the focus of COVID-19 pandemic spread. The pandemic and its impact on cities have allowed researchers to reflect on current problems with urban development, changes in urban development, and how cities will develop and plan for the future in order to make positive shifts in urban resilience and sustainability for continued healthy urban development. This paper attempts to synthesize early findings on how the COVID-19 pandemic has affected various aspects of urban development. This study organizes the impact of the pandemic on urban development into five domains: environmental quality (air quality and Environmental factors), social impacts, economic impacts, urban residents, and urban planning. It also details the impact of the COVID-19 pandemic on various aspects of urban development. In the systematic analysis, it was found that during the pandemic, current problems of urban development were exposed and some changes occurred in the city. The authors make systematic recommendations to address the exposed problems. pandemic COVID-19 is an opportunity and a challenge for urban development. This study hopes to improve the ability of cities to respond to emergencies such as pandemics and promote sustainable and healthy urban development by systematically describing the problems of urban development during pandemics and the experience of resisting pandemics and making recommendations to solve the problems.

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