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Housing and urban design for COVID-19 pandemic; design for prevention of virus spread

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Abstract

The new COVID-19 disease, which is affecting the world and has infected and killed many people, has rapidly changed people's lifestyles and, accordingly, changed people's needs, including their demands on their living environment. As the disease progressed, people were forced to stay at home to escape the disease. Even cities and public spaces could no longer be used. These situations, as well as the anxiety caused by this unknown disease, quickly led to mental health problems such as depression, isolation, aggression, stress, and physical illnesses due to inactivity. Given that the living environment of people, and above all, their homes, has a direct impact on the physical and mental health of people, profound and fundamental changes and decisions in the design and construction of houses are necessary for this situation where people have to spend most of their time in their homes. On the other hand, people need to socialize with each other and do their daily and essential tasks easily, even in a pandemic situation. Therefore, the urban design must also have significant changes in accordance with these conditions. In this article, we will review the design strategies of the city and the design and construction of houses to better respond to them in such situations.

Introduction

From the devastating onset of cholera in mid-nineteenth-century London to the typhoid epidemic in New York City more than a century ago, diseases have profoundly affected modern urban planning, design, and development. For at least the past 200 years, our responses to the spread of such diseases have led to healthy urban environments. The construction of modern sewage systems, water treatment facilities, hospitals and clinics, health education boards, and the setting and design of laws to disinfect and limit the spread of the disease have had a significant impact on public health (1). In December 2019, a new disease was identified and registered, later renamed COVID-19 (2). The COVID-19 pandemic brought some changes, and for this reason, humans must change their lifestyle and the way they design and build their living environment. The human living environment will have a significant impact on both the mental and physical health of individuals and consequently the whole society. Unlike previous epidemics, COVID-19 was not confined to one place and quickly spread throughout the world, greatly influencing people's personal and professional lives (3).

Extensive research has shown that air is

Key point

Due to the direct impact of living space on people's health, especially during pandemics and infectious diseases, new decisions and strategies are needed to design and build living spaces.

the first and foremost route of contagion of COVID-19 from human to human, and this new virus can survive in the air for up to 4 hours. The second way is to transfer from the surfaces and through the view of people infected with the surfaces. Depending on the material, different levels of the virus survive on them at different times. For example, the COVID-19 virus can survive on metal surfaces for up to 9 hours while it can survive on a piece of paper only for 2 hours. Eventually, in a short time, the changes caused by COVID-19 in people's lives have forced people to stay home to save their life (4).

At this time, the effects of "urban design" and "home design" and the need for safe and secure spaces for work and leisure for people became apparent. COVID-19 became a major turning point for designers, architects, and decision-makers in determining the importance of designing and building responsive living environments. Public

spaces were no longer usable as well as workplaces, schools, and universities were closed. Hence, people spent a longtime in home quarantine (5), as a result, residential buildings became one of the primary and most effective infrastructures. The "home" became a space beyond the living space, which had a significant impact on people's physical and mental health. The COVID-19 pandemic showed that many systems, including homes and cities, did not respond to such challenges. Therefore, governments were forced to use traditional methods such as quarantine because there was no drug or vaccine to control the pandemic. Social distance, the use of masks and the disinfection of surfaces to prevent the spread of the virus. Finally, the home quarantine method had the greatest impact around the world. These conditions caused significant changes in people, such as stress, aggression and depression. From the beginning of the quarantine period, the "houses" became different places. Bedrooms to workrooms, kitchens to internet meeting rooms, and balconies and terraces (if any) became the only resting and leisure spaces. Urban designers and architects can play an important role in improving many health outcomes and ultimately people's health by making appropriate design decisions. In 1946, the World Health Organization (WHO) defined health as "a complete state of physical, mental, and social health."

However, the houses were not safe either. Because if even one person were infected, the house itself would become a direct source of virus transmission due to people's close relationship with each other (6).

Under such circumstances, living space has become an essential feature for people's health. Despite providing some conditions to prevent the spread of the virus, if this space is designed inappropriately, may have negative psychological and physical effects on people. The characteristics of the built environment such as dimensions, facades, natural light, balconies, and indoor space quality can affect people's mental and physical health issues. Therefore, some factors include fear of infection, frustration and insufficiency, insufficient resources and information, financial losses, abandonment of daily physical activity, due to the fact that the characteristics of the built environment such as dimensions, facades, natural light, balconies, and indoor quality home play a crucial role. More than half of the world now lives in urban areas, and this population is projected to continue to grow. Many factors affect people's health, urban environments, and their construction. Therefore, urban design and architecture are recognized as influential factors in people's health. In particular, contemporary health challenges require interdisciplinary solutions. In general, health has moved beyond the traditional realm of physicians, nurses, and hospitals to embrace a "broad range" of specialties and approaches (7). This expanded field of medicine (known as medicine plus) encompasses a wide range of specialties. Urban designers and architects are among the main influential experts in this new field.

The WHO has recently called for "health in all policies."

Urban design and COVID-19 pandemic

The COVID-19 pandemic, which has affected millions to date, is a reminder that urbanization has changed the way people, communities, and communities interact. Looking at urban environments, it can be seen that this increase in urban population has negative effects such as lack of water resources, lack of land, lack of green and recreational spaces, overcrowding, poor housing, air pollution and lack of health facilities, that increase the risk factor for the spread of infections and diseases (8). On the other hand, with the increase in the population of cities, encroachment on animals' natural habitats has occurred, which has increased the common diseases of humans and animals. Research shows that COVID-19 is also an animal-borne disease (9). Furthermore, the lack of suitable open or semi-open public spaces has a significant transfer rate (10).

Urban design strategies for the prevention and control of epidemic diseases

In a comprehensive study, Capolongo et al (11) provided solutions to cities' response to situations such as pandemics. The first five strategies are immediate activities and the second five strategies are long-term strategies which is explained previously (11). Other researchers have explored the solutions, which we discuss in the following sections.

Expansion of cycling infrastructure

During the pandemic, public transportation was one of the main sources of virus transmission. Subways, buses, and commuter trains usually carry large numbers of people daily, and this congestion causes the disease to spread further. Therefore, it is better to design basic infrastructure for cycling in urban design. When using a bicycle, a proper distance between people is observed, and it also takes people to their destination. Additionally, during the quarantine period when sports clubs are closed, bicycles compensate for the lack of sports activities (12).

Expand trails

By widening the sidewalks, the necessary distance between people is maintained, and less virus is transmitted. On the other hand, walking is essential for people's mental and physical health, and if the conditions are not provided, it can cause much harm to people during pandemics and quarantine (13).

Expansion of green spaces and public open spaces

The impact of COVID-19 on life changes cannot be ignored, even at its end. Fear of public outdoor space and fear of viruses and germs are undeniable cases in this regard. Previously, the living area was divided into four sections; climate-controlled private space (house), private space without climate control ability (balcony and terrace), public space with climate control capability (closed public

space), and public space without climate control capability (park). The current situation adds two categories to the previous ones, which include semi-public spaces with the ability to control the climate and ventilation (common spaces to socialize with selected people) and semi-public spaces without the ability to control the climate (roofs).

These spaces not only contribute to the stability of the city and moderate the climate but also in pandemic conditions by creating healthy and safe spaces that allow people to be present and socialize with each other. Humans need to talk to each other to ensure their mental health. Additionally, being in green spaces and touching plants can help reduce anxiety and depression caused by diseases such as COVID-19 (14).

Lack of focus on public facilities in one place
Public facilities should be located and designed so that they do not focus on one point. This both prevents people from concentrating in a small area, reducing the spread of the virus and reducing the distance to reach the facilities (15).

Housing design and COVID-19 pandemic
The practical architectural components in the field of health and hygiene can be divided into two components; home space and home structure. The space component includes factors such as spatial organization, size and number, and flexibility of spaces. The structural component also includes the type of materials and the characteristics related to their implementation. The coronavirus posed a new challenge to many specialties, including architecture. The prevalence of the disease and the feeling of isolation during the lockdown period can cause stress and consequently mental health problems (16). In addition, the presence of anxiety and depression during COVID-19 involvement can prolong the course of treatment and endanger a person's health (17) because there is a direct relationship between mental health and the immune system's response to the body's protection (18). Since the home is the main place where people live and directly affects their mental health, it should be designed and implemented to give people the most peace and away anxiety from them. Here are some key pointers in moving homes forward to prevent the spread of infectious diseases.

Home design strategies in the face of COVID-19
Accessible and visible green space
Numerous scientific studies have shown that exposure to green spaces with seeing and touching plants will significantly affect mental and physical health. These spaces allow people to breathe clean air, create a place for sports activities, and can be a space for relaxation. These spaces can also be used as safe and healthy spaces to establish social relationships between people. Studies show that having green space indoors can improve cardiovascular disease, diabetes, depression, aggression,

anxiety and more(19, 20).

During the COVID-19 pandemic, most people became increasingly distant from green spaces with the onset of home quarantines. One of the best solutions to solve this problem is to design green spaces inside the house, including green roofs, green walls, terraces, and balconies, both in existing and new buildings. The results of research on COVID-19 showed that a direct relationship with green space is very effective in accelerating the recovery process of patients and the return of treatment staff and reducing their stress. In residential complexes, in addition to private green spaces, it is better to design and build public and semi-public open spaces in such a way that residents can socialize with each other by observing social distance (21).

Consistent and flexible home plan
The house's interior should be designed to meet the needs of different family members with different ages. Due to quarantine and telecommuting conditions, home spaces should be such that they can be easily and quickly converted to different functions during such pandemics. Spaces that can be used in addition to living space as work space, sports space, leisure space and study space. Therefore, the design of houses should be done according to the principle of "flexibility" and "compatibility." Having enough space considering the number of residents is also one of the crucial points in this field. The plan of the house should be such that the privacy of the people is protected and they feel comfortable and confidential (11).

It is necessary to design an interface space equipped with an airlock in the front entrance of the houses. This space should be equipped with disinfection equipment, and also spaces for storing contaminated, and disinfected equipment should be installed separately. Kitchens are another space that should be designed as two separate clean and dirty spaces.

Observing the principles of sustainability in design and construction
Although the issue of sustainability has been considered by experts for many years, in the pandemic situation, the importance of this issue became more prominent. Since people spend most of their time at home, providing thermal comfort, daylight and natural ventilation is very important for their mental and physical health. Due to the closure of most businesses and people facing financial problems, the design of low-consumption buildings in terms of energy became much more critical. Buildings, especially houses, should be designed and constructed in such a way that there is minimal need for mechanical and electrical equipment for air conditioning and lighting, thus reducing the amount of water and electricity bills (22).

Effective strategies in this field are the main shape and direction of the building, window to wall ratio, use of suitable materials for each climate, use of sunlight, use of wind, use of high-efficiency structures, and green

structures(23).

Sustainable buildings have a significant impact on people's health. In situations like the COVID-19 pandemic, the presence of natural ventilation in the home is vital. Because in the presence of a person infected with the virus in the house, the disease can be easily transmitted to other people if there is no proper natural ventilation system. All spaces in the house should have windows with appropriate proportions and sizes. Ventilation should be such that it prevents the air from moving from one part of the room to another. Besides, the ventilation system must constantly purify a sufficient amount of fresh air and enter the space (24).

Management of resource consumption, especially water resources

In this situation, the need to consume more water was felt. During this period, there was an urgent need to regularly wash hands, clothes, and utensils to prevent disease. Hence, there are many concerns due to the scarcity of water resources. Therefore, it is necessary to consider facilities for controlling consumption, reusing water, and purifying and disinfecting it. It is better to have water storage facilities in the houses, thereby people always have access to clean water (25).

Health and waste management

Since the beginning of the pandemic, research has shown that sewage can be a major source of the COVID-19 virus. Therefore, there is a need for at least two toilets in each house for a population of more than two people. Because if one of the people is infected or suspected of having the virus, he should have a separate health service. Equipment should also be provided that automatically disinfects the bathroom space at least once a day (26).

Waste storage and disposal should also be managed. Because people's waste may be infected with the virus and, if not managed, can contaminate the environment and people and spread the disease (27).

Smart homes

In the face of the COVID-19, the strategy for the need for smart and automated homes has reached its peak. Using smart systems makes it easier to use the features and activities, increases security, and helps prevent the spread of virus. Light and ventilation system sensors that automatically activate or deactivate ventilation and lighting systems without the need for human touch can help reduce both energy consumption and virus spread (28).

Materials

Following the COVID-19 epidemic, designers and users have found that building materials, especially finishing materials and furniture, play an important role in promoting health. Because the virus survives for a long time, depending on the type of material on them, surfaces that people touch (e.g., doors, handles, windows, tables, switches and sockets) must be regularly disinfected. For this reason, materials must be selected and applied in such a way that they can be washed and disinfected and not be damaged (29).

Conclusion

Despite significant advances in urban planning and architecture, as well as new advances in medical science, the new COVID-19 disease has shown that many countries are still unable to build a healthy city and home. Due to the direct impact of living space on people's health, especially during pandemics and infectious diseases, new decisions and strategies are needed to design and build living spaces. According to the review conducted in this article, important strategies in urban design can be such things as creating green and open public spaces with sufficient space so that people can use the space at an appropriate distance. Providing spaces for cycling and walking is also a basic solution. In housing design, factors such as natural ventilation and flexible spaces are crucial.

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