

The Best-fit Design of Future Homes in the Post-Pandemic Era: A Case Study in Iran

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Abstract

The COVID-19 humanitarian situation is unparalleled, and there can be no return to the "old normal." According to reports, the COVID-19 Pandemic is now a significant public health issue that could have an influence on people's quality of life as well as environmental sustainability and social responsibility, as well as architecture and home designs. Bearing this in mind, this qualitative research was conducted to (1) to explore the extent to which the architects apply innovative strategies to fit the needs for the homes in the post-Pandemic era, and (2) to explore the architectural needs and wants of the residents in the post-Pandemic era. To fulfill these, semi-structured interviews were used to collect the data. A total of eight architects and ten residents living in apartment buildings were recruited by purposive sampling. The interviews were processed using thematic analysis. It was reported by majority of the architects that the most important innovative strategies to fit the needs for the homes in the post-Pandemic era are independent buildings, energy-related design changes, more human-centered design concepts, green open spaces, and advanced technology. As for residents, their architectural needs and wants in the post-Pandemic era were HVAC system, green open spaces, inappropriate designs, and lack of self-sufficient strategies. Further discussion on the findings have been reported in this research.

Keywords: post-pandemic era, Covid-19, best-fit design, future homes, architecture, apartment building

1. Introduction

1.1 Background of the Study

The coronavirus Covid-19 began to spread before the end of 2019, and by the end of March 2020, it had spread worldwide (Allu-Kangkum, 2021; Elrawy & Abouelmagd, 2021; Ibrahim, et al., 2020; Leal Filho, et al., 2021; Salama, 2020; WHO, 2020). The WHO's classification of the outbreak as a "Public Health Emergency of International Concern" on January 30, 2020 was changed to a "Pandemic" on March 11, 2020 due to the new disease's rapid spread and severity (Leal Filho, et al., 2021; Tokazhanov, et al., 2020). Technically, there can never be a return to the "old normal" because of the unparalleled humanitarian crisis known as COVID-19. Humans are affected differently depending on their social class or caste, their gender and age, and the country where they live. This pandemic forced many countries including Iran to shutdown with a total or partial lockdown to curb the spread of the virus (Allu-Kangkum, 2021). It has been asserted that the COVID-19 Pandemic has become a major public health concern worldwide, which can impact, in particular, environmental sustainability and social responsibility, as well as people's quality of life (Severo, De Guimarães, & Dellarmelin, 2021), architecture and urbanism (Salama, 2020), built environment and physical surrounding, architectural practices (Ateek, 2020), the way we design our living spaces, general society and urban environment, and urbanization, as well as building construction (Tokazhanov, Tleuken, Guney, Turkyilmaz, & Karaca, 2020). Knowing the fact that in addition to many aspects of life worldwide being impacted by the COVID-19 Pandemic, architecture and home designs have been influenced as well. It is asserted by Peters and Halleran (2020) that unquestionably, the global housing crisis brought on by COVID-19 is also a global health issue, and the term "New Normal" has gained popularity as a way to characterise the projected changes in human life that will result from COVID-19's effects (Alraouf, 2021). Bearing this in mind, finding out how such impacts have changed architects' perspective when designing the future home in a country like Iran and how residents in the houses feel about the required aspects for such a crisis motivated this research to both shed the light on the phenomenon and to investigate its diverse aspects.

1.2 Statement of the Problem

The rise of globalization and modernization policies have changed people's needs and their understanding of People's demands and concepts of home have altered as a result of globalisation and modernization initiatives. Today, the built environment is where most of us spend a significant portion of our everyday time (Ateek, 2020). Additionally, they have changed the way our constructed environment looks for a very long time, causing us to respond, learn from our mistakes, and eventually adapt in new ways. New designs will take into account the new values, habits, housing, and workspace requirements because architecture is about way of living. Architects and urban planners will take on the role of the new "treaters" who work to avoid epidemics since architectural practises will change as a result of the pandemic (Köksal & Umnu, 2020). In light of this, it is thought that architecture is a crucial tool for responding to and even preventing infectious diseases (Ateek, 2020).

In the so-called Post-Pandemic Era, as academic disciplines and professions, by gaining new insights into how a pandemic would affect cities and urban ecosystems in the present and the future, architecture and urbanism may both support efforts. This can be done by doing research to understand the effects of COVID-19 and establishing new understandings pertinent to the characteristics of urban settings that result from these discoveries both on the residents living under the shadow of the pandemic while being even quarantined for long time and the architects who have to take measures and even apply guidelines introduced by governments and authorities to fight the spread of the disease and bring more comfort and ease for the inhabitants during such pandemic, particularly in the future (Salama, 2020). It is difficult to avoid paying attention to the physical surroundings and reconsidering our everyday routines in the built world under these unique and challenging circumstances (Ateek, 2020).

People spent the majority of their everyday lives indoors (in quarantine), which made them feel overwhelmed and upset while the virus was spreading. This is one of the most significant problems the COVID-19 pandemic produces. Enhancing the quality of public and private spaces will be essential if the community is to share and engage in the built environment, which is intended for a variety of essential activities. In order to sustain human health and psychological demands, interior architecture must come up with innovative solutions. Smart and digital technologies will drive innovation in tomorrow's design and transform every aspect of our surroundings (Zaher, 2020).

It is important to note that architects, along with other stakeholders and practitioners, are in charge of identifying new conceptions relating to emerging lifestyles that result from new spatial environments that integrate working and living patterns and, in the end, developing design responses toward creating healthy environments that successfully accommodate the infected populations while addressing the associated social and psychological consequences (Salama, 2020). Nonetheless, to date, there is no enough or accessible first-hand investigations done in Iran to respond to the needs and wants of the residents concerning the design of their homes especially during pandemics and to address the extent to which the architects have endeavored to apply strategies which help combat the pandemics by bringing appropriacy and adequacy into their designs (Ateek, 2020).

1.3 Research Objectives

Having taken into account the problems and issues associated with the design of the homes during the covid-19 outbreak and the need for forward-thinking designs for the future, the following objectives were formulated in the current research:

- To explore the extent to which the architects apply innovative strategies to fit the needs for the homes in the post-Pandemic era.
- To explore the architectural needs and wants of the residents in the post-Pandemic era.

1.4 Significance of the Research

It is evident that throughout the human history, pandemics have emerged, influencing the people and causing casualties and even death, among which, Covid-19 (2019), H1N1 (2009), SARS (2002) and MERS (2012), and some others. The fact is that notwithstanding such progress in the science, still humans are unable to even anticipate the future diseases, which are almost unknown. Running this research and the results reported could contribute to the architecture and house design body of literature in that residents' needs and wants are to be taken into account, not only in face of numerous architectural aspects, but also from the view point of the residents' safety and health; the latter has been almost discarded and reconsidering the building structure and design norms could be significantly beneficial for the design of future homes, which could be to some extent fulfilled by the findings reported in this research and many other similar ones.

2. Literature Review

In Tehran, Zarrabi, Yazdanfar, and Hosseini (2021) assessed the health indicators in the home setting in the COVID-19 apartment type. A questionnaire was used to assess the indicators of physical and mental health as well as socioeconomic lifestyle changes that have an impact on the interior design of apartment buildings. The findings suggested that factors including natural light, perspective, acoustics, and open or semi-open space are particularly significant in relation to mental wellness. Therefore, planners, builders, and architects should pay attention to mental health factors when designing apartments. Furthermore, it was noted that inhabitants' top concerns included open or semi-open space, natural light, visibility, and the acoustics of the interior area (terrace). The least critical factors were the layout of the house and the office. Overall, it was found that residents in all economic brackets ranked their mental health as their top priority, underscoring the need to leave home during the quarantine period to avoid any potential psychological harm. Both the physical and lifestyle-based (socioeconomic) components of health were given equal weight. Homes with materials that promote better insulation, windows that are the right size and orientation for natural light and views, balconies with additional depth, and internal living walls may be effectively positioned when marketed to Iranian homes.

Alraouf (2021) also examined the COVID-19's beneficial effects from a sociological and urban standpoint. Additionally, the study sought to analyze the main effects on various urban sectors and suggest important elements that need to be taken into account for better planning and response. It was found that the present epidemic has demonstrated society and the city's capacity for quick adaptation and change. Additionally, a shift to a more compacted urbanism was underlined along with the necessity for a more compacted and town-like scale of cities. It was argued that shifting focus from planning projects for the creation of communities as land subdivisions to projects for happy, healthy, and sustainable human-friendly communities is necessary. It was also advised to put more of an emphasis on public areas including parks, walkways, lively streets, accessible waterfronts, and gathering places. Finally, it was suggested that both residential and commercial spaces be reviewed to suit usage patterns during the prolonged lockdown in order to produce more practical, healthy, and ethically satisfying living situations. Additionally, it was determined that residential units and businesses needed to seriously address the expanding impact of the digital era on learning, working, buying, and leisure.

Co-housing communities' well defined urban-territorial components and how the social distance regulations affected them were both the subjects of a study by Giorgi et al. in 2021. The findings stressed the value of open spaces for conducting communal activities as well as the necessity of feeling like you are a part of a "safe" community with people you know and trust in the event of a medical emergency. Despite the fact that the disaster made socialization worse, living in co-housing communities was rated as a "very beneficial scenario" overall.

The effects of lockdown during COVID-19 on the health and comfort of university students were evaluated by Millán-Jiménez et al. in 2021, along with any potential effects that the home's features may have had. In terms of health, it was discovered that 89% of respondents had neuropsychiatric illnesses, 38% had put on weight, and 59% had consumed alcohol. The majority of people gave their home a favorable comfort rating, saying that it was cozy in terms of temperature and noise at night, and that they got along well with their roommates. However, individuals without a balcony or patio would have like to have access to outdoor areas. Additionally, since their bedroom was where they studied and spent the majority of their time, they would have preferred it to be bigger. They felt trapped in an urban setting, whereas others who value open landscapes experience tranquility there. It was discovered that university students' health and comfort while confined may have been negatively impacted by the house's lack of open spaces, the surrounding environment, and the inability to make the most frequently utilized places more flexible.

In a study, Peters and Halleran (2020) looked at the quality of life in urban mid- and high-rise apartment housing and discovered that post-pandemic housing design needs to pay attention to a variety of factors, including window placement and views to support stress recovery, lighting levels, bedrooms designed for restful sleep, living rooms with better indoor air quality and access to nature, and lastly unit sizes and layouts that enable physical distancing and preoccupation with other things.

While concentrating on potential solutions, D'alessandro et al. (2020) incorporated the building's hygiene and well-being. The findings demonstrated that the well-being and public health recommendations for a healthy, safe, and sustainable housing are framed into: visible and accessible green elements and spaces; flexibility, adaptability, sharing, and crowding of living spaces; compliance functions located within the buildings; re-appropriation of the basic principles and archetypes of sustainable architecture; thermal comfort and indoor air quality (IAQ); water consumption and wastewater management

According to Zaher (2020), WHO-recommended design solutions were described from the perspective of interior

designers. They suggested that renovating interior spaces that are ecologically friendly for both new and existing buildings should be one of the top focuses of the post-Coronavirus phase.

In a study, Sofo and Sofo (2020) stated that individuals are dealing with unknown and challenging circumstances as a result of the Covid-19 pandemic and suggested transforming indoor areas into food gardens during the Covid-19 quarantine. In this time of compelled seclusion, they stressed the advantages of plants (psychological, health, economic, and productive). They argued that a vegetable garden in a home might have positive effects on recreation, health, the economy, and the environment. Regardless of the Covid19 epidemic, this type of garden has the capacity to influence market trends, public perception, and environmental results. Additionally, it was asserted that backyard vegetable gardens could offer a modest method for the sustainable exploitation of natural resources, promoting independence, self-governance, sustainability, and environmental protection.

In order to serve four different population targets, Maldonato et al. (2020) set out to demonstrate a mental health first aid service set up within the setting of an Italian university public hospital. According to research, worry and a fear of spreading disease were the primary reasons that people in general and medical professionals sought psychological assistance. Additionally, clients assessed their current quality of life as being poorer than both their imagined and former quality of lives, emphasizing the significance of psychological first aid interventions. This program may serve as a model for assisting mental health practitioners in creating comparable services in their local contexts, fostering health and community resilience.

Pinheiro and Luis (2020) made an effort to determine whether COVID-19 can alter the built environment (BE) and utilize certain strategies for sustainable structures or urban regions. According to their findings, the BE is crucial in promoting public health initiatives and lowering the risk of infections. The analysis of prospective COVID-19 interventions reveals that there are well-referenced alternatives available, ranging from gradual adjustments (space organization, construction of physical barriers) to structural changes (windows, balconies) with various timelines and scales (ranging from changes in building materials to the design of urban areas). They stated that a critical exploratory assessment enables the identification of actions that may help not only to decrease the risk of COVID-19 transmission (or even prevent it), but also to boost resilience, enhance air quality, and reduce energy or material requirements, potentially increasing the sustainability of the BE.

3. Method and Procedure

3.1 Research Design

This study benefits using the qualitative design. Qualitative research captures information that is not numerical in nature (Shaheen & Pradhan, 2019). It records people's attitudes, feelings and behaviours, and provides an in-depth but usually indicative picture about why people act in certain way (Campbell et al., 2020). As such, semi-structured interviews were used to collect the data in order to address the research objectives formulated in this study. A semi-structured interview is a qualitative research method that combines a pre-determined set of open questions (questions that prompt discussion) with the opportunity for the interviewer to explore particular themes or responses further (Striepe, 2021; Shukri, Wahab, & Jamala, 2021).

3.2 Sampling Procedures and the Study Context

The interview participants, either the architects or the residents, were recruited using purposeful sampling. The reason for purposive sampling is the better matching of the sample to the aims and objectives of the research, thus improving the rigor of the study and trustworthiness of the data and results (Campbell et al., 2020). In a qualitative study, a relatively small and purposively selected sample is employed to increase the depth of understanding. Purposive sampling is used to select respondents that are most likely to yield appropriate and useful information and is a way of identifying and selecting cases that will use limited research resources effectively (Campbell et al., 2020; Shaheen & Pradhan, 2019). Having this in mind, the groups meant for this study, including the architects and residents of the apartment buildings were contacted by considering the inclusion criteria. As for the architects, the ones with work experience in the field of architecture and house design with academic degrees were contacted from among the practitioners working in Mashhad, northeastern Iran and for the residents, they were contacted from among the ones living in apartment buildings and the ones who experienced the quarantine and lockdown during Covid-19. The residents who were recruited were contacted in person by the researcher in the most populated apartment buildings in the western region of Mashhad. Prior to the participation, all the participants filled out the consent form and were willing to take part in the research. Moreover, they granted the permission to record their voices anonymously for further analysis and coding.

3.3 Data Collection and Data Analysis

Having agreed on the date and time of the interviews, each interviewee was met by the researcher and the interview

sessions were recorded. The time for interviews ranged between 20 minutes to max 40 minutes. Then the interviews were processed using thematic analysis, which consists of the five steps (Serban & Visser, 2022): (i) data extraction – the interviews were transcribed, read and key points were extracted, (ii) data coding – the initial innovative strategies to fit the needs, as well as the architectural needs and wants of the residents were defined, (iii) code to themes translation – for each transcript the initial codes were combined into potential themes, (iv) high-order theme modelling – the themes were compared and merged, or dropped if the evidence was not sufficient, (v) synthesis assessment – arguments for the extracted data were established.

3.4 Demographic Findings of the Participants

As stated earlier, Table 1 exhibits the overall information about the study participants. A total of eight experienced architects working in Iran participated in this study, of which around two third (62%) were males whereas above a third who were females (Figure 1). Besides, in terms of work experience, it was found that the highest category belonged to the ones having above 16 and above years of experience (38%), followed by 50% totally belonging to the ones having work experiences if 6-10 and 11-15 years, respectively. The last went for the ones with 1-5 years of work experience. To summarize, 88% of the participants had years of experience more than 5 years (Figure 2). Finally, with respect to their educational level, while only one architect held PhD, 62% had MA/MSc and 25% had a BA/BSc (Figure 3).

Table 1. Overview of the demographic data of the architects

ID	Position	Gender	Experience	Education
A1	Senior Architect	M	6-10 years	MA
A2	Architect	M	16 above	BA
A3	Architect	F	1-5 years	BA
A4	Senior Architect	M	16 above	MA
A5	Senior Architect	F	6-10 years	MA
A6	Head Architect	M	11-15 years	MA
A7	Director	F	16 above	PhD
A8	Senior Architect	M	11-15 years	MA

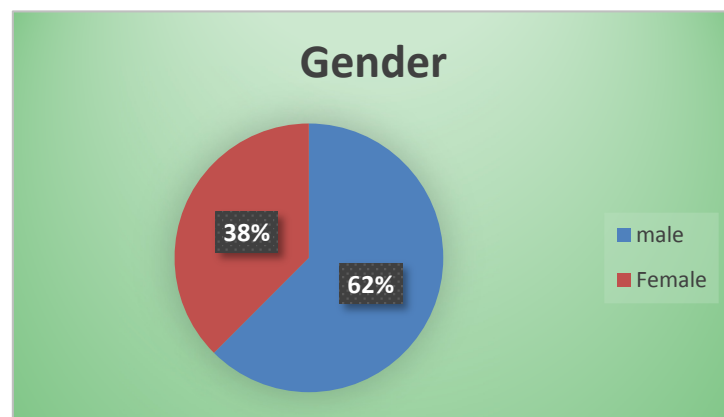


Figure 1. Architects' gender

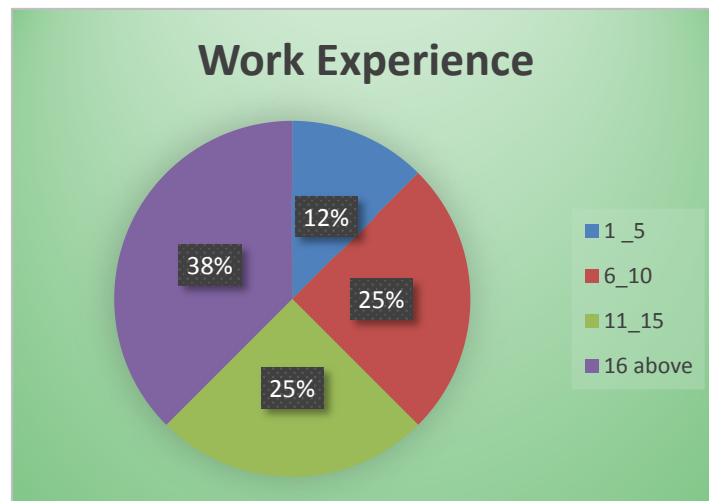


Figure 2. Architects' work experience

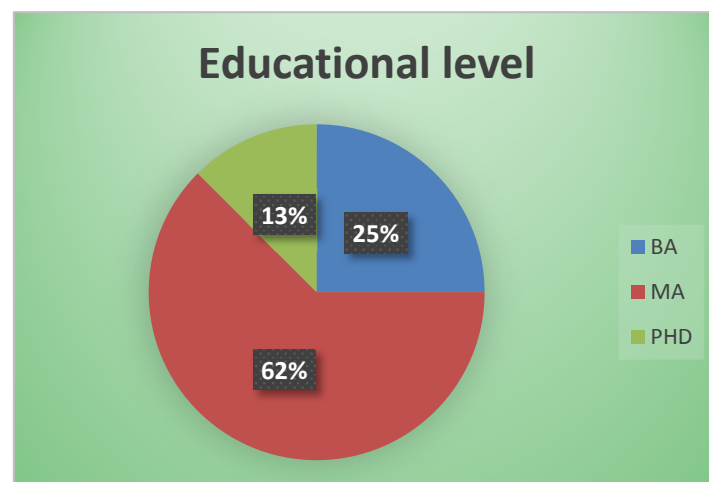


Figure 3. Architects' educational level

As for the residents, the number reached a total of 10 participants, who responded to such demographic questions as gender, work experience, educational level, similar to the architects participating in this research, in addition to other demographic information including duration of living in their apartments, ownership status, number of children, whether there is a balcony or garden, number of windows, or presence of a garden yard or a playground. Table 2 depicts the demographic information related to the residents participating in this study.

Table 2. Overview of the demographic data of the residents

ID	Gender	Experience	Education
C1	M	6-10 years	BA
C2	M	16 above	MA
C3	F	1-5 years	BA
C4	M	16 above	MA
C5	F	6-10 years	BA
C6	M	11-15 years	BA
C7	F	16 above	MA
C8	M	11-15 years	MA
C9	F	1-5 years	BA
C10	M	11-15 years	BA

It was found that 60% of the residents participating in this research were males, versus 40% females (Figure 4). Around 60% had work experiences more than 10 years (11-15 & 16 above) while a portion of 40% reported having work experiences less than ten years (Figure 5). Concerning their educational level, almost two third held an MA degree, a portion of one fourth had a BA, and 13% held a PhD degree (Figure 6). Another question was about their residency duration living in an apartment, and the highest proportion (60%) stated that they had lived in an apartment for a period 6-15 years and above, while 20% had lived in an apartment for 1-5 years whereas another 20% mentioned a period above 15 years (Figure 7). In terms of ownership, a great portion of 60% were tenants living in rented apartments while 40% were the owners (Figure 8). Having children was another question and only 30 % mentioned having no kids at all, while the rest of the sample had 1, 2, or more children (Figure 9). The other three questions aimed at asking details about the apartment building. As for presence of a balcony/garden in the apartment, for 60%, the answer was NO, versus 40% who had a balcony or garden (Figure 10). Moreover, 60% highlighted that heir apartments had 1-2 windows, which seems not to be appropriate, and that 20% had between 3-4 windows, and another 20% was 5 and above (Figure 11). Lastly, 90% mentioned they had no yard or playground in their buildings.

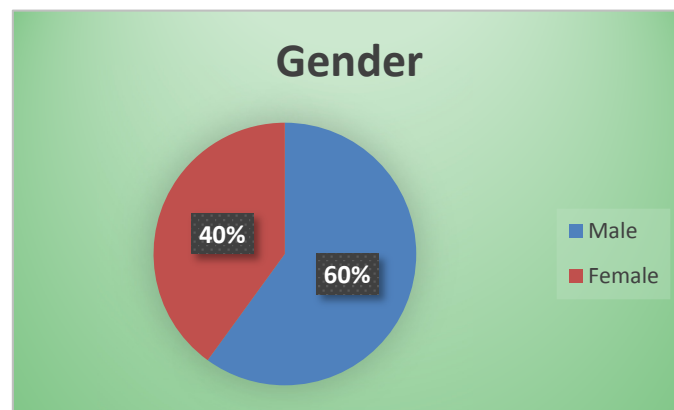


Figure 4. Residents' gender



Figure 5. Residents' work experience

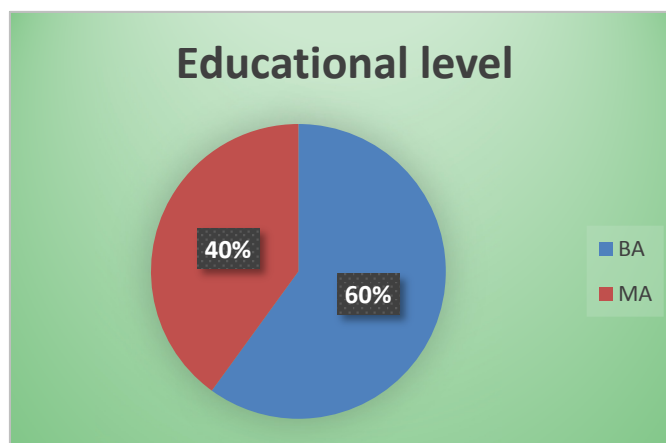


Figure 6. Residents' educational level

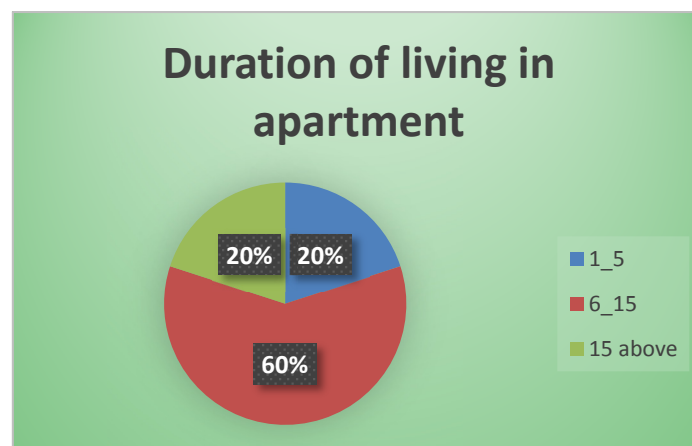


Figure 7. Residents' duration of living in the apartment

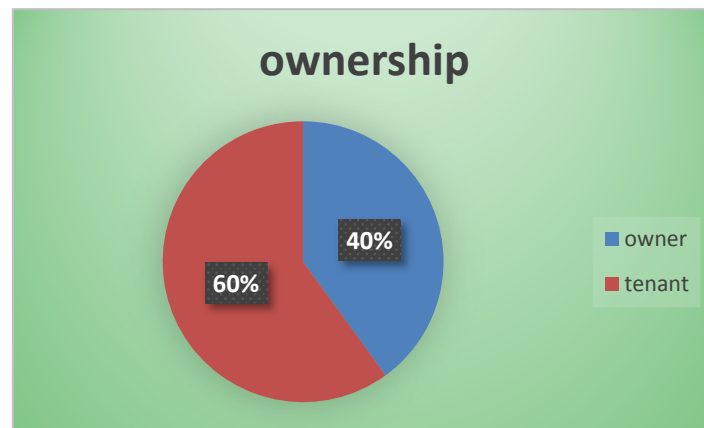


Figure 8. Resident's property ownership

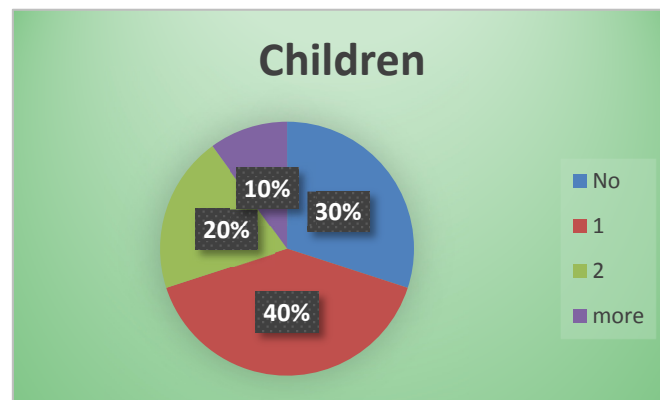


Figure 9. Residents' number of children

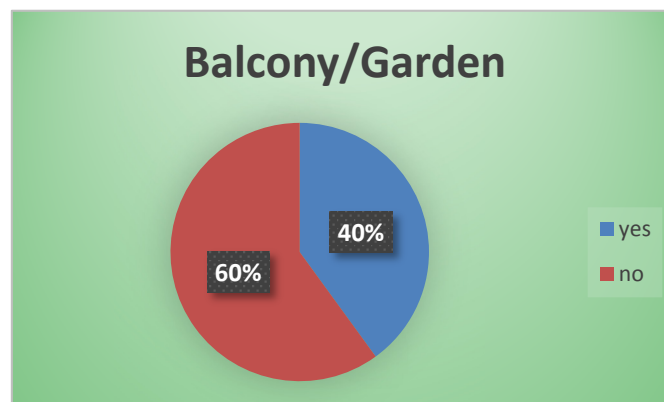


Figure 10. Presence of a balcony/garden in the apartment

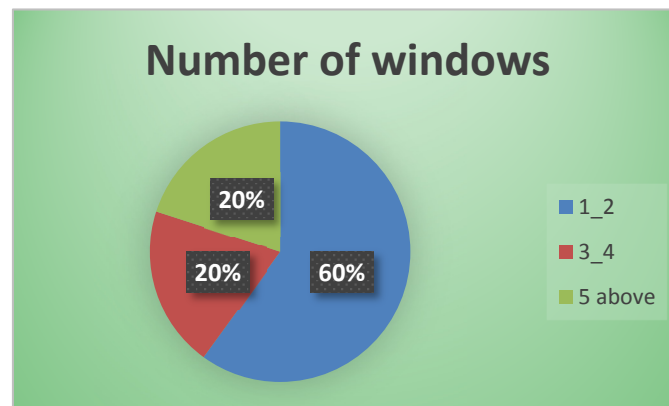


Figure 11. Number of windows



Figure 12. Presence of a garden yard and playground in the apartment

4. Results and Findings

The main objective in this research was to identify and define the best-fit design of future homes in the post-pandemic era through a case study in Iran. As such, two research objectives were formulated consistent with the literature review, the literature gap, and statement of the problem. What come next are the findings related to these two formulated research objectives.

4.1 Applying Innovative Strategies to Fit the Needs for the Homes in the Post-Pandemic Era

To address the first research objective, a number of eight architects participated in the semi-structured interviews. After running the thematic analysis (Serban & Visser, 2022), potential themes were extracted, which could be categorized and labeled as follows. A great deal of architects asserted that the pandemic has brought many owners and future builders to consider building “*Independent Buildings*”. They mainly underlie that after Coronavirus Pandemic, architectural design has gone through the stage of “design for an independent building in case of emergencies”. Recommending “*energy-related design changes*” such as adding geothermal wells has been a way to reduce energy consumption. A3 highlight that:

“many of the architects in Iran have come to the conclusion that it is necessary to design new energy and water self-sufficient buildings implying that some changes or additions will be required such as geothermal wells as a way to curtail water and electricity consumption”.

A4 said:

“using geothermal wells is an eye-catching option to substitute fossil fuels, preserve water and decrease energy consumption as water pumps are used to heat the building”

Apart from energy-related design changes, some architects pointed out that there have been considerable modifications and preferences demanded by the clients, considering the fact that wider spread of “*human-centered design concepts*” have been witnessed with the aim of accommodating the inhabitants’ needs, wants, as well as

catering the aim of enhancing life quality. A 1, for instance, maintains that:

“Clients requests are altering under the effect of house quarantine. During and post the pandemic, they ask for decreasing the number of guest rooms since fewer gatherings will be held during and probably after the pandemic, while they mostly demand for adding some other spaces, which were not asked previously, such as an office to work from, a hobby room or a garden instead”

and A6 mentions that:

“the clients are increasingly asking for spaces which were not demanded before, such as a work station inside the house/apartment as well as home-cinemas or TV rooms to help them gain more entertainment. And this is indeed a paradigm shift, both in the design and the construction”.

A 8 highlighted that:

“Green open spaces have been demanded by the clients, which is the new luxury. Under the effect of pandemic, and by knowing that green spaces are useful especially during lockdowns, many clients ask for courtyard, garden, green roofs, and other forms of green spaces”

and A 4 pointed out that:

“in designing current and future residential and public buildings, it is necessary to integrate open spaces with the interiors which makes them to be more exposed to natural ventilation and light, as well as natural elements”.

In relation to the green space required for the homes, there have been comments on “adding more windows” to the apartment buildings as it not only helps fresh air in, but also allows a better view to the nature, and even to the green spaces provided, having diverse benefits then. A 8 pinpointed that”

“in Iran, according to the law, the bedrooms outlooking the neighbors’ yards and balconies have to be installed at a height above around 2 meters, to just provide narrow lighting and even without access to have it opened. Yet, clients now are asking for wider and taller windows giving them more view of the outside, which is at times against the law”.

A5 mentions that:

“most client today ask for windows which run from the floor to the ceiling, giving them better and more view of the outside world” and A3 repeated that *“one most-frequently wanted option for the bedrooms is larger windows”.*

Since many clients asked for “addition of technology” to the buildings to help reduce the outbreak and enhance safety, the architects in this study emphasized the role advanced technology to remodel the design of the future homes and high-rise buildings where larger numbers of resident live. To illustrate this, A2 expressed that *“to design new houses, their team is adding options like voice-activated elevators, automatic doors, automatic sanitizers installed in the lobbies and the like.”* Moreover, it is asserted by A1, A2, A3, and A8 that any device or gadget helping to reduce direct contact of hands and also any tools to help social distancing would all be considered when designing future homes. In line with this, A6 highlighted that installing automatic thermometers in the public areas will be a plus. Besides, A7 emphasized that *“in the modern designs of the buildings, one indispensable element is to add new touchless technologies”.*

To summarize, majority of the architects reported that the most important innovative strategies to fit the needs for the homes in the post-Pandemic era are independent buildings, energy-related design changes, more human-centered design concepts, green open spaces, and advanced technology. The next part elaborates on the themes mentioned by the residents.

4.2 Architectural Needs and Wants of the Residents in the Post-Pandemic Era

Analyzing the apartment building residents yielded the following themes, which are among the most frequently-stated items. One of the main concerns raised by majority of high-rise buildings residents was that they felt highly terrified of the number of people sharing the same *“Heating, Ventilation, and Air Conditioning (HVAC) system”* with them and touch the same elevator buttons. C1 reported that:

“in the high-rise building we are inhabiting has not been designed to organize as many people as possible while hygiene and public health were not considered in considerate way. As an example, the elevator buttons are designed so that everyone touches it and there is no anticipation of the virus to be transferred while installing the elevator”.

Moreover, C2 proclaimed that:

“many health authorities have pinpointed the importance of fresh air to be ventilated through the closed areas, such as the parking, hallways, elevator, and the like. Moreover, the same HVAC is installed for all the neighbors to use simultaneously. This threatens our health and the lift has an incapable fan”.

C10 also said that:

“it is necessary to have proper sanitation to lessen the likelihood of getting infected, which can be achieved by better ventilation, not only inside the houses but also in the elevators or lobbies and public spaces in the buildings”.

C3 and C4 also highlight that dense spaces are no longer welcomed and such dense places, as in the elevators and lobbies may elevate virus transmission routes. C1 also mentioned that:

“better indoor air quality and better air ventilation would be still a downside of the current high-rise buildings”.

Another concern raised by most of the inhabitants of the high-rise buildings interviewed in this research was to have green open spaces and highlighted their role in various aspects. For example, C10 said:

“an interface with plants and green structures as well as utilizing materials which are mostly natural in the interior of the buildings portrays a pleasanter trace” while C7 said: “plants have a huge contribution to improved mental health for the duration of house quarantine”.

Moreover, C3 put that:

“mood disorders and depression as well as sadness will be healed and alleviated by green spaces, especially during pandemics like Coronavirus outbreak”.

C1 mentions that adding and developing greener spaces will not only bring more intimate spaces but also help recover and improve mental states. To majority of the participants, residential buildings were infrastructures essential in nourishing the disrupted communities in and after Covid-19 outbreak. C 2 highlighted that:

“housing is more than just a living space, where the environment and comfort has to be taken into account, especially during the breakdowns”.

C5 mentioned that:

“the houses we are living in need to adopt changes to become resilient to the possible upcoming outbreaks and quarantines as they suffer from challenges in facing the outbreaks”.

Referring to lack of adaptability in the current buildings in combating the pandemics, C9 pinpointed that:

“post-pandemic architecture should consider hygienic building materials which could be sanitized easily and rapidly, while the ones today faced issues when being sanitized”.

Interestingly, C5 expressed that:

“in the current residential buildings, the residents have no self-sufficient strategies, meaning that they are unable to grow food during self-isolation time, when the transportation or supply of food will be limited during pandemics” and she further claims that “I have been able to grow some vegetables at home in the small garden we have and this not only provided green space but also small-scale vegetable supplies, leading to lesser need for outing and shopping”.

In a nutshell, architectural needs and wants of the residents in the post-Pandemic era are HVAC system, green open spaces, inappropriate designs, and lack of self-sufficient strategies. Figure 13 summarizes the best-fit design of future homes in the post-pandemic era as extracted via interviews in the present study in the context of Iran.

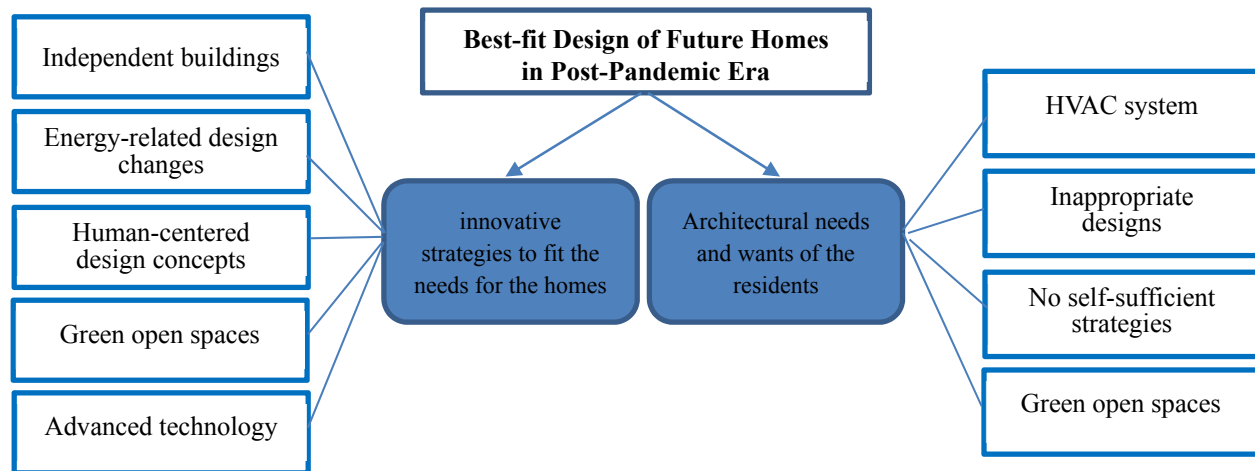


Figure 13. the best-fit design of future homes in the post-pandemic era

5. Discussion

The results of this survey could be considered from two angles; one the one hand, the residents in high-rise buildings presented their own concerns as well as the challenges and issues they face when residing in such buildings through pandemics; on the other hand, the architects pronounced the trendy and new demands offered and required by the clients when designing new buildings or even as for renovating the current buildings to bring adaptability in reaction to pandemics. Peters and Halleran (2020) detail that mid-rise and high-rise apartment buildings suffer from various intrinsic challenges, which are even exacerbated by the COVID-19 influences on apartment living. The largest challenge identified in this research was improper ventilation and the problem with the HVAC system (Pinheiro & Luís, 2020). This finding has been previously reported in the literature by some studies. To illustrate this, the results reported by Peters and Halleran (2020) emphasize the priority of constructing living rooms in the future with better indoor air quality, with a focus on natural ventilation. Besides, it is stated by Allam and Jones (2021) that building could lead to illnesses, referred to as sick buildings syndrome, illuminating the impact of building design on human health as well as the sicknesses that they could bring about. Eltarabily and Elghezanwy (2020) illustrated this by underscoring that a lack of ventilation of residential buildings contribute to the likelihood of distribution of respiratory diseases while Qian, Miao, Liu, Zheng, Luo, and Li (2021) admit that the disease could spread via the ventilation yards of the high-rise buildings. To have a restorative environment, it is highly advised that operable windows be used for natural ventilation which could lead to low-environmental effects and then environmental sustainability as a result (Peters, 2017; Peters & Halleran, 2020). It is then recommended that future homes should enjoy the design principles where light and air are at the center of health-promoting architecture (Peters & Halleran, 2020). It is also pinpointed by Jefferies, Cheng, & Coucill (2020) that although physical space and improvised digital networks have given local communities a foundation of support, mental health and physical needs also call for high-quality flexible hard and soft urban spaces with latency, indicating that architecture, urbanism, and town planning need to be designed to accommodate unanticipated future changes. Furthermore, they emphasize the importance of comprehending and designing for high quality, complex interactions between physical space and uses at a variety of scales given that COVID-19 restrictions are anticipated to remain in place and that digital modes of delivery for work and education are also likely to persist. The ongoing COVID-19 pandemic, according to D'alessandro (2020), is a stark reminder of how the lockdown period changed how people and communities live, work, and interact. As a result, it is crucial to build an environment that is resilient, particularly indoor spaces like homes, workplaces, public buildings, and entertainment venues. After all, it would seem rational to alter the way cities are planned to make them healthier and more stable to withstand any challenges in the future given the growing populations of both inhabitants and cities. While the majority of people in the globe use social isolation to prevent the spread of disease, it's crucial to concentrate on functional city strategies that have good technological and sustainable features; these aspects aid in monitoring and gathering infection database (Eltarabily & Elghezanwy, 2020). It's possible that post-COVID-19 housing will have comparable objectives and prioritize health and wellness, building on the growing popularity of the WELL building rating system and other developments in this area (Peters & Halleran, 2020).

References

- Allam, Z., & Jones, D. S. (2021). Future (post-COVID) digital, smart and sustainable cities in the wake of 6G: Digital twins, immersive realities and new urban economies. *Land use policy*, 101, 105201. <https://doi.org/10.1016/j.landusepol.2020.105201>
- Allu-Kangkum, E. L. (2021). Covid-19 and Sustainable Architectural Education: Challenges and Perceptions on Online Learning. *Journal of Educational Research*, 6(2), 7-13.
- Alraouf, A. A. (2021). The new normal or the forgotten normal: contesting COVID-19 impact on contemporary architecture and urbanism. *Archnet-IJAR: International Journal of Architectural Research*. <https://doi.org/10.1108/ARCH-10-2020-0249>
- Ateek, G. (2020). *Future of sustainable architecture: rethinking COVID-19 a pandemic or turning point?*. Bahçeşehir University.
- Ceylan, S., Şahin, P., Seçmen, S., Somer, M. E., & Süher, K. H. (2020). An evaluation of online architectural design studios during COVID-19 outbreak. *Archnet-IJAR: International Journal of Architectural Research*. <https://doi.org/10.1108/ARCH-10-2020-0230>
- D'alessandro, D., Gola, M., Appolloni, L., Dettori, M., Fara, G. M., Rebecchi, A., ... Capolongo, S. (2020). COVID-19 and living space challenge. Well-being and public health recommendations for a healthy, safe, and sustainable housing. *Acta Bio Medica: Atenei Parmensis*, 91(9-S), 61.
- Elrawy, S., & Abouelmagd, D. (2021). Architectural and Urban Education in Egypt in the Post Covid-19 Pandemic. *European Journal of Sustainable Development*, 10(2), 91-91. <https://doi.org/10.14207/ejsd.2021.v10n2p91>
- Eltarabily, S., & Elghezanwy, D. (2020). Post-pandemic cities-the impact of COVID-19 on cities and urban design. *Architecture Research*, 10(3), 75-84.
- Fathalizadeh, A., Hosseini, M. R., Vaezzadeh, S. S., Edwards, D. J., Martek, I., & Shooshtarian, S. (2021). Barriers to sustainable construction project management: the case of Iran. *Smart and Sustainable Built Environment*. <https://doi.org/10.1108/SASBE-09-2020-0132>
- Fezi, B. A. (2020). Health engaged architecture in the context of COVID-19. *Journal of Green Building*, 15(2), 185-212. <https://doi.org/10.3992/1943-4618.15.2.185>
- Giorgi, E., Martín López, L., Garnica-Monroy, R., Krstikj, A., Cobreros, C., & Montoya, M. A. (2021). Co-housing response to social isolation of COVID-19 outbreak, with a focus on gender implications. *Sustainability*, 13(13), 7203. <https://doi.org/10.3390/su13137203>
- Jefferies, T., Cheng, J., & Coucill, L. (2020). Lockdown urbanism: COVID-19 lifestyles and liveable futures opportunities in Wuhan and Manchester. *Cities & health*, 1-4. <https://doi.org/10.1080/23748834.2020.1788771>
- Kaklauskas, A., Lepkova, N., Raslanas, S., Vetloviene, I., Milevicius, V., & Sepliakov, J. (2021). COVID-19 and green housing: a review of relevant literature. *Energies*, 14(8), 2072. <https://doi.org/10.3390/en14082072>
- Khakzand, M., Atighehchi, F., & Yasini, S. P. (2017). The role of architecture in establishing social supports affecting mothers' mental health after childbirth recovery process in the maternity wards of Tehran's general hospitals. *Int. J. Architect. Eng. Urban Plan*, 27(1), 1-8.
- Leal Filho, W., Azul, A. M., Wall, T., Vasconcelos, C. R., Salvia, A. L., do Paço, A., ... Frankenberger, F. (2021). COVID-19: the impact of a global crisis on sustainable development research. *Sustainability science*, 16(1), 85-99. <https://doi.org/10.1007/s11625-020-00866-y>
- Maldonato, N. M., Bottone, M., Chiodi, A., Continisio, G. I., De Falco, R., Duval, M., ... & Scandurra, C. (2020). A mental health first aid service in an Italian university public hospital during the coronavirus disease 2019 outbreak. *Sustainability*, 12(10), 4244. <https://doi.org/10.3390/su12104244>
- Megahed, N. A., & Ghoneim, E. M. (2020). Antivirus-built environment: Lessons learned from Covid-19 pandemic. *Sustainable cities and society*, 61, 102350. <https://doi.org/10.1016/j.scs.2020.102350>
- Millán-Jiménez, A., Herrera-Limones, R., López-Escamilla, Á., López-Rubio, E., & Torres-García, M. (2021). Confinement, comfort and health: Analysis of the real influence of lockdown on university students during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 18(11), 5572. <https://doi.org/10.3390/ijerph18115572>
- Organisation for Economic Co-operation and Development. (2020a). *Building a Coherent Response for a*

- Sustainable Post-COVID-19 Recovery*. OECD Publishing
- Organisation for Economic Co-operation and Development. (2020b). *Building back better: a sustainable, resilient recovery after COVID-19*. OECD Publishing.
- Peters, T., & Halleran, A. (2020). How our homes impact our health: using a COVID-19 informed approach to examine urban apartment housing. *Archnet-IJAR: International journal of architectural research* <https://doi.org/10.1108/ARCH-08-2020-0159>
- Pinheiro, M. D., & Luís, N. C. (2020). COVID-19 could leverage a sustainable built environment. *Sustainability*, 12(14), 5863. <https://doi.org/10.3390/su12145863>
- Qian, H., Miao, T., Liu, L., Zheng, X., Luo, D., & Li, Y. (2021). Indoor transmission of SARS - CoV - 2. *Indoor Air*, 31(3), 639-645. <https://doi.org/10.1111/ina.12766>
- Rume, T., & Islam, S. D. U. (2020). Environmental effects of COVID-19 pandemic and potential strategies of sustainability. *Heliyon*, 6(9), e04965. <https://doi.org/10.1016/j.heliyon.2020.e04965>
- Salama, A. M. (2020). Coronavirus questions that will not go away: interrogating urban and socio-spatial implications of COVID-19 measures. *Emerald Open Research*, 2. <https://doi.org/10.35241/emeraldopenres.13561.1>
- Serban, A., & Visser, J. (2022). Adapting software architectures to machine learning challenges. In *2022 IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER)* (pp. 152-163). IEEE. <https://doi.org/10.1109/SANER53432.2022.00029>
- Severo, E. A., De Guimarães, J. C. F., & Dellarmelin, M. L. (2021). Impact of the COVID-19 pandemic on environmental awareness, sustainable consumption and social responsibility: Evidence from generations in Brazil and Portugal. *Journal of cleaner production*, 286, 124947. <https://doi.org/10.1016/j.jclepro.2020.124947>
- Shaheen, M., & Pradhan, S. (2019). Sampling in qualitative research. In *Qualitative techniques for workplace data analysis* (pp. 25-51). IGI Global. <https://doi.org/10.4018/978-1-5225-5366-3.ch002>
- Sharghi, A. & Asadi, S. (2020). Effect of Built Environment on Health Dimensions during the Quarantine: A Cross-Sectional Study Following the Covid-19 Pandemic in Iran. *Journal of Rescue and Relief (JORAR)*, 12(4), 242-253. <https://doi.org/10.32592/jorar.2020.12.4.2>
- Sharifi, A., & Khavarian-Garmsir, A. R. (2020). The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management. *Science of the Total Environment*, 749, 142391. <https://doi.org/10.1016/j.scitotenv.2020.142391>
- Shukri, S. M., Wahab, M. H., & Jamala, N. (2021). The Architectural Concept of Malay Royal Town. *Journal of Design and Built Environment*, 21(3), 52-62. <https://doi.org/10.22452/jdbe.vol21no3.4>
- Shulla, K., Voigt, B. F., Cibian, S., Scandone, G., Martinez, E., Nelkovski, F., & Salehi, P. (2021). Effects of COVID-19 on the sustainable development goals (SDGs). *Discover Sustainability*, 2(1), 1-19. <https://doi.org/10.1007/s43621-021-00026-x>
- Sofo, A., & Sofo, A. (2020). Converting home spaces into food gardens at the time of Covid-19 quarantine: All the benefits of plants in this difficult and unprecedented period. *Human Ecology*, 48(2), 131-139. <https://doi.org/10.1007/s10745-020-00147-3>
- Striepe, M. (2021). Combining concept mapping with semi-structured interviews: adding another dimension to the research process. *International Journal of Research & Method in Education*, 44(5), 519-532. <https://doi.org/10.1080/1743727X.2020.1841746>
- Takewaki, I. (2020). New architectural viewpoint for enhancing society's resilience for multiple risks including emerging COVID-19. *Frontiers in Built Environment*, 6, 143. <https://doi.org/10.3389/fbuil.2020.00143>
- Tokazhanov, G., Tleuken, A., Guney, M., Turkyilmaz, A., & Karaca, F. (2020). How is COVID-19 experience transforming sustainability requirements of residential buildings? A review. *Sustainability*, 12(20), 8732. <https://doi.org/10.3390/su12208732>
- Van Barneveld, K., Quinlan, M., Kriesler, P., Junor, A., Baum, F., Chowdhury, A., ... Rainnie, A. (2020). The COVID-19 pandemic: Lessons on building more equal and sustainable societies. *The economic and labour relations review*, 31(2), 133-157. <https://doi.org/10.1177/1035304620927107>
- Zaher, N. H. E. D. A. (2020). Design solutions for interior architecture post coronavirus (COVID-19). *Journal of*

Arts & Architecture Research Studies, 1(2), 117-133. <https://doi.org/10.47436/jaarsfa.v1i2.71>

Zarrabi, M., Yazdanfar, S. A., & Hosseini, S. B. (2021). COVID-19 and healthy home preferences: The case of apartment residents in Tehran. *Journal of Building Engineering*, 35, 102021. <https://doi.org/10.1016/j.jobe.2020.102021>

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