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Abeer Alawad

Professor of interior Design, King Abdul-Aziz University, KSA, aalawad@kau.edu.sa

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Adapting and interacting with home design during the COVID-19 pandemic

Abeer A Alawad

Department of Interior Design and Furniture, King Abdulaziz University, Jeddah, Saudi Arabia, aalawad@kau.edu.sa

Abstract:

The spread of COVID-19 and its associated health risks have caused people to stay inside their homes for long periods, changing the home's function from simply being a dwelling to a place that supports varied activities. These new activities were not planned for the original house design; the pandemic forced people to fit these activities within the available space during lockdowns. The purpose of this study was to identify how people adapted and interacted with their home designs during the COVID-19 pandemic. The research followed the screening process recommended in the PRISMA Statement by reviewing the literature on home design published during the pandemic to provide an overview of how people adapted and interacted with their home design in different countries. Five databases were searched, and 10 studies were ultimately included. The review showed that people adapted the available spaces by connecting the features of existing spaces with new activities. For example, the privacy of bedrooms allowed them to become learning or workspaces through the addition of appropriate furniture and accessories. Previously unused spaces also began to be occupied. People changed the way they view their homes. However, challenges remained for some activities because of the absence of appropriate infrastructure, leading to a lack of space, storage, privacy, lighting, quiet, views, and fresh air. This study's contribution should help designers and those working in the housing sector to design flexible housing that is suitable for sudden and stressful conditions and guarantees its residents' quality of life.

Keywords:

home design, living space, interior design, interior space, COVID-19 pandemic

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1. Introduction

After the World Health Organization (WHO) announced the emergence of COVID-19 and the subsequent wide reach of the virus, which caused global confusion, people all over the world rushed to their homes to quarantine to avoid infection [1]. Home became the universal safe place. The COVID-19 pandemic has changed people's daily habits, emphasising the home's role in supporting social links between the family, and strengthening the psychological and spiritual health of human beings [2]. The time available for family activities and communication was increased, while time with others decreased due to the associated closure of outdoor activities and distanced communication becoming more common than face-to-face communication [3, 4]. The most comfortable spaces in the home have taken on the role of living rooms where the family gathers, which, in turn, is linked to entertainment activities [4].

This close contact with the dwelling has changed people's perception of the concept of the house from a place of residence [3, 5] to one of work, education, sports, and well-being. Hajjar [1] glorified the home's role by positing that house design may play as important a role as the vaccine in reducing the pandemic's impact by encouraging

people to stay at home, socially distance, and quarantine. Conversely, another study argued that though home isolation is undoubtedly beneficial for reducing COVID-19's spread, it is not conducive to protecting physical and mental health [6]. Other studies have confirmed that though home quarantine is the first solution to maintain physical health in the pandemic context, it threatens mental health and causes problems such as boredom and loneliness [7]. In addition, events that impose more spatial isolation have a significant impact on the overall well-being of society [8]. WHO has made several recommendations for healthy housing [1]; however, the length of the quarantine periods and people's interaction with home spaces directly and centrally created psychological, social, and economic challenges in many different societies. Nevertheless, some studies have tried to develop temporary solutions that enable people to stay at home and avoid the outdoors and have recommended future models. However, if there is an infected person in the house, do protective homes allow isolation and prevent the spread of the virus? As the world is experiencing this pandemic, it is still not clear what the future holds; therefore, we ought to consider preparing homes that will be suitable for long-term isolation and for all human needs.

Zarrabi et al. [9] highlighted that housing design preferences differ between each country due to their social, cultural, and economic conditions. Families' daily routines, types of profession, and needs also differ [10], as do their average ages, interests, and the nature of the activities they undertake in the home [2]. However, there are basic needs that a home must meet regardless of other variables, providing safety, comfort and satisfaction for human beings and meeting all their renewable needs, whether fixed or temporary, to ensure quality of life. Among these basic needs mentioned by Zarrabi et al. [9] are the enjoyment of the home's interior spaces, its capabilities to help residents overcome this period and the implementation of healthy housing design standards in the house's interior spaces. The priorities and preferences of residents must also be considered to enable providing better solutions, improving housing development programs, and increasing housing quality [9]. Moreover, small, cramped, untidy, poorly lit and uncomfortable spaces are the least pleasant to live in [4]; therefore, sustainable, safe, habitable, and resilient housing is required to meet renewable conditions and needs [6]. The COVID-19 pandemic offers an opportunity to consider housing flexibility in terms of responding to human requirements while preserving its basic role [2].

People's view of suitable housing for the future has changed due to their experience with their current spaces during quarantine periods [9]. The pandemic indicated the need to change the design concept of living spaces and housing patterns, and reconsider service distribution and accessibility [10]. It will take time to build a model that will enable disease control [1]. New activities have appeared within housing units, which has led to the reconfiguration of interior spatial organisation of the home to suit new forms of daily routine and new requirements [8]. As such, people have begun to adapt homes according to new needs. The quarantine periods made people more aware of their homes and the environment around them, causing them to redesign previously underused spaces and find appropriate ways to convert spaces not previously fully exploited to meet new needs. In this way, people have been working intelligently to recreate the environment in which they live.

According to the results of AlKhateeb and Peterson's [3] study, prior to the COVID-19 pandemic, people believed that there were important internal spaces in the home, such as guest bedrooms. However, their view of these spaces changed because of the pandemic, and they were reused for other activities, such as game rooms for children, exercise areas, and home offices. People

also began to use kitchen corners for entertainment and to simulate cafés for drinking coffee. People came to need home gyms, additional bedrooms, and places to work and study remotely. Conversely, the need for two separate living rooms and hospitality rooms decreased, with fewer visitors due to movement restrictions. Families' demand for additional food storage space also increased as opportunities to shop were limited. Further, some unused guest rooms were converted into offices, while dining rooms were converted into school spaces for education and rooftops were transformed into places to enjoy the outdoors.

A study by Bettaieb and Alsabban [2] found that the function of the reception room had changed, and it began to be used as a space for daily living and play or as a home office. People reconsidered the priorities and uses of furniture in terms of space and size and disposed of items to adapt to new needs, allocating spaces for play, sports, storage, and entertainment. The authors also highlighted the need for natural lighting and ventilation, due to small or limited windows.

Different adaptations were related to the type of housing and its location: as one study noted, the use of balconies increased during the pandemic period. The study showed repeated use to give the psychological experience of outdoor space. Balconies are used mostly at night for talking and eating, and their use has been extended during the pandemic period [11]. Meanwhile, Valizadeh and Iranmanesh [8] studied the exploitation of space and found that the use of balconies and openings had changed; obtaining a beautiful view was one of the most important elements for improving the quality of indoor life. Hajjar's [1] study summarised the most frequent activities that participants undertook during quarantine, which included watching television, cooking, sports, gardening, and reading.

The results of Hijazi and Attiah's [5] research revealed that the lack of space in apartments pushed residents to work from their kitchens or reception areas, and various individuals inside the house participated in the use of this space. Hajjar [1] found a similar result, despite focusing on a different country; his study in Lebanon showed that people were performing work and study activities in public places inside the house, including living rooms, dining rooms and reception rooms, but they lacked privacy. Many people have taken an interest in agriculture, and gardening and roof planting represent ideal ways to negate the feelings of loneliness and the lack of contact with the outdoors and outside life. Jaimes Torres et al. [6] observed that bedrooms were designated as working spaces, along with other common spaces, with the

subsequent adaptation of furniture and the use of laptops. Some previous activity spaces were separated to make room for new activities, such as dining rooms and bedrooms, which were exploited for teleworking or studying.

Entertainment and sports have also been linked to living rooms and spaces that are open to the outdoors [4]. Despite the agreement of many studies on the challenges faced by people in their homes, there is diversity among these challenges. A study of Mexican homes observed that they contained open spaces that touch the outdoors, such as courtyards and gardens, and this was reflected in satisfaction with levels of general lighting and suitable air quality for most inhabitants. However, noise insulation and thermal comfort did not reach satisfactory levels for a significant part of the sample [6].

During the lockdown periods, families faced several challenges, such as a lack of privacy; finding a suitable environment to work [2, 5]; noise and adapting to the differences among the users of each space [2]. Hijazi and

Attiah [5] noted that it is difficult to change or re-divide spaces in the home to improve employees' performance when working from home since the home's main function is living; however, due to the pandemic, many concepts have changed regarding the type of activities that should take place in the home. Home workspaces may be neglected in terms of design as people tend to prefer finishing work tasks at their main workplace rather than taking work home [5].

For a house to be suitable for new activities, it must be rearranged for these new activities; however, the interior spaces must be flexible, that is, suitable for multitasking, easy to separate, and convertible [8]. Thus, future housing design should consider adaptive forms. The architectural program for housing in the digital age, which does not include spaces or services that allow it to comply with remote activities, has been questioned [6]. Social interaction without physical interaction has been maintained by advances in digital technology and the Internet of Things [8]. However, these advances may increase electrical loads and affect safety if they have not been previously anticipated in architectural designs [2]. Clarifying pandemic impacts on living environments will help improve the quality of life, even after the pandemic subsides, by creating better designed residential environments that meet user needs [8].

Some studies have indicated that people's satisfaction level with their housing is good: Hijazi and Attiah [5] found that 63% of their study's participants were satisfied with levels of productivity while working from home, and the

respondents had adapted workspaces for individual and shared use. The study suggested to improve productivity while working fully or partially from home, including solutions that create privacy, as well as flexible furniture and mood enhancers [5]. In general, families are satisfied with the size of their homes but would like to have better-landscaped spaces or better outside views [6]. Moreover, various studies have examined how people interact with home design and put forward several proposals; however, there remain many challenges due to the different activities and the specificity of each, whether they be work, education, or entertainment activities.

This study aims to identify how people adapted and interacted with home design during the COVID-19 pandemic by reviewing the literature published on the pandemic and house design. The novelty of the study lies in its original synthesis of past research findings related to the COVID-19 pandemic and house design. The study's findings will benefit home designers and those working in the housing sector to design flexible housing that is suitable for sudden and stressful conditions and guarantees its residents' quality of life.

2. Methods

A systematic literature review approach was taken. Figure 1 illustrates the research foci. Since the review was structured according to the PICO criteria, it did not aim to compare homes with the various activities that were developed during the COVID-19 pandemic but rather to provide an overview of how people adapted and interacted with their home design during this pandemic.

Two hundred and sixty-seven studies were reviewed, and 10 were ultimately selected that fit the study's inclusion/exclusion criteria. Searches based on the research foci in Figure 1 were conducted from January 2020 to July 2021. The searches were conducted in electronic databases, including Scopus, (ISI) Web of Science, Science Direct, Emerald Insight and Google Scholar. The study conducted a preliminary systematic literature review to identify which terms were being used to report on and interpret home design by using the following search string to search titles and/or abstracts and using quotation marks to render two-word phrases as singular search terms during the search: ('home design' OR 'living spaces' OR 'interior design' OR 'interior space') and ('COVID-19' OR 'coronavirus' OR 'pandemic'). The research was undertaken between 2020 and 2021 (one year) because the WHO China Country Office was informed of cases of 'pneumonia' with an unknown cause detected in Wuhan City, Hubei Province of China on 31 December 2019 [12].

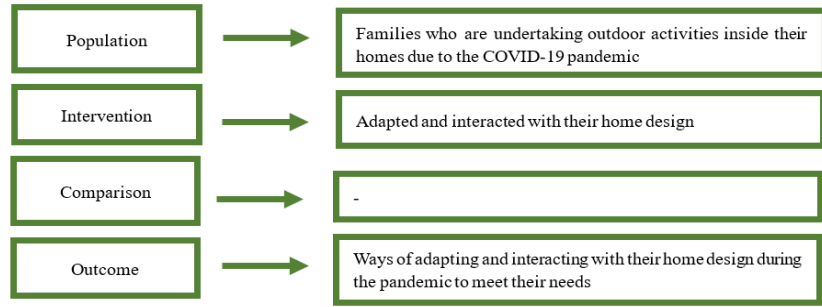


Figure 1. Research foci structured according to PICOC criteria

The study surveyed articles and conference papers to maintain the review’s quality, given that the pandemic is a recent and ongoing event. The articles’ abstracts and conclusions were reviewed in-depth to analyse and filter the materials to ensure a high level of quality and their relevance to the study’s aims. Careful evaluation of each research paper was conducted at a later stage. Figure 2 shows the inclusion and exclusion criteria used to

select the documents, which were published in English and Arabic only. There were two articles in a language other than English, which were excluded from the study. Duplicate records were also filtered and excluded. The PRISMA Framework template was used to design the comprehensive review process, as shown in Figure 3.

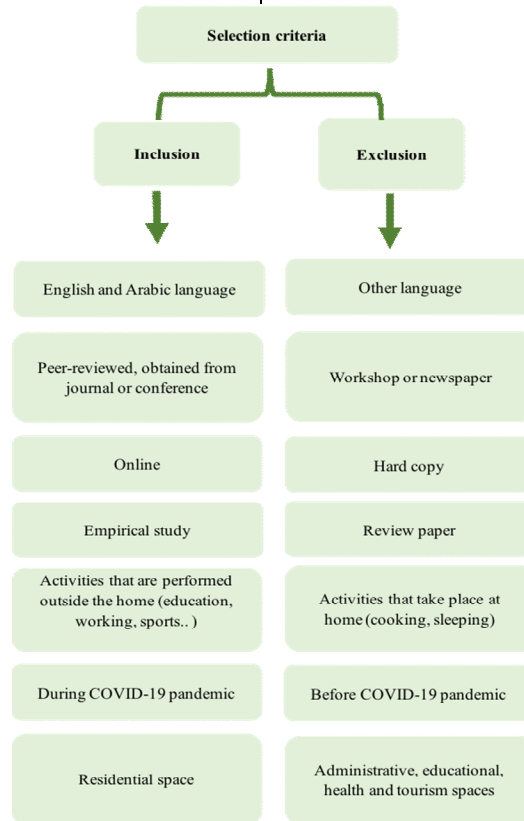


Figure 2. Inclusion and exclusion criteria

Several studies were found that related to the effects of isolation on mental and psychological health. Another group focused on the evaluation of the current elements found within homes, while another focused on future proposals for flexible home designs after the COVID-19 pandemic. However, the current study focused on people’s interactions with interior spaces, regardless of the

nature of the activity created, whether work, education, or entertainment, as the focus was on the tools used to collect data within the available research and defining whether they measured interior design aspects and the way people interacted with them to try to adapt their homes during the COVID-19 pandemic.

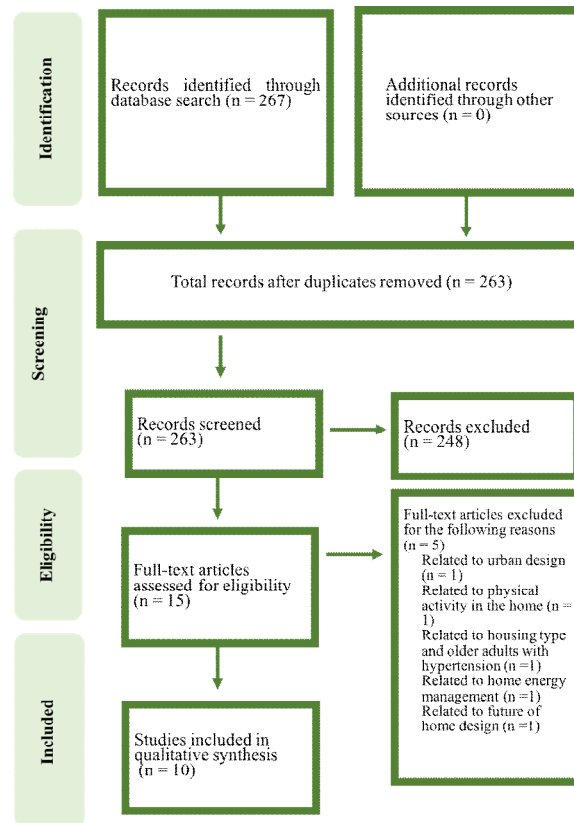


Figure 3. PRISMA 2009 flow diagram

3. Descriptive Analysis

In terms of subject areas, the studies were categorised as follows: one study discussed interior space design and health; one study discussed home workspaces; and eight studies investigated the diversity of adaptation, flexibility, and how people dealt with interior spaces, as shown in Figure 4.

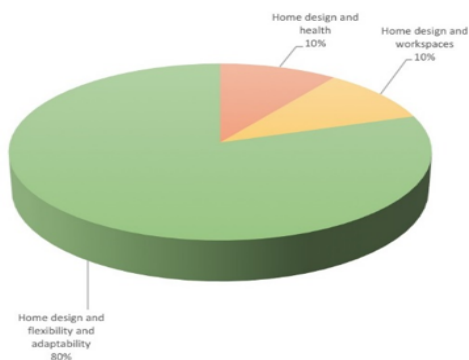


Figure 4. Percentage of studies in each research area

The studies covered the continents of Asia, Africa, Europe, and America. The largest number of studies were from the Kingdom of Saudi Arabia, and the rest were equally distributed across different countries (Figure 5). There are certainly other related studies; however, they require time to be published because the topic is complex and

important. Moreover, there are studies in other languages, although all the reviewed studies were in English, even if they were conducted in different countries with multiple languages.

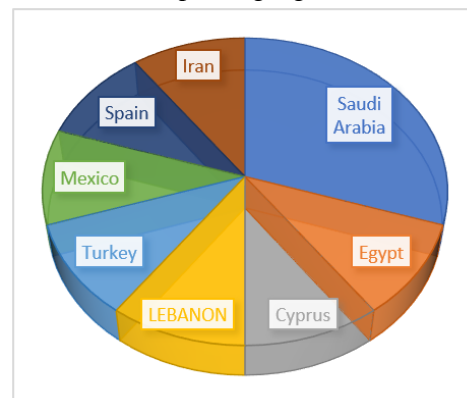


Figure 5. Percentage of studies published in each geographical region

The present study focused on articles published in 2020 and 2021. The main purpose of year-wise distribution was

to understand the number of publications in the selected year and to meet the review criteria. The pandemic emerged at the end of 2019; however, the global lockdowns began in 2020. Figure 4 shows the articles' years of publication and reveals that the largest number of articles were published in 2021, with significantly less being published in

2020. This is evidence that the number of published articles increased year on year, which is due to the extension of the pandemic and extended procedures for publication.

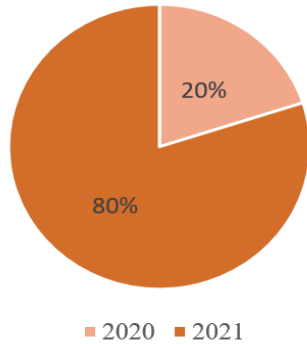


Figure 6. Distribution of article publication years

4. Results

The reviewed literature dealt with people’s interactions with interior spaces and how these spaces were shaped to adapt current spaces to new activities. The studies were divided into three categories, including home design and health, home design and workspaces, and home design and flexibility and adaptation, which was covered by the majority.

4.1 Home design and health

One study examined health and internal spaces, as shown in Table 1.

Table 1. Literature on home design and health during the COVID-19 pandemic

Author	Title	Country	Methods & Sample	Recommendations
Akbari <i>et al.</i> (2021)	Housing and mental health during outbreak of COVID-19	Iran	Quantitative approach Online questionnaires 421 residents living in Tehran 70.3% of the participants were women	The study recommends the design of semi-open spaces because they have a significant impact on residents’ satisfaction and the application of design solutions that improve people’s mental health during crises. It also calls for research in different regions to collect the opinions of culturally diverse individuals.

Akbari *et al.*’s [7] study surveyed residents’ lives during the pandemic lockdown in Iran. Online questionnaires were distributed that asked about respondents’ demographic data, the house characteristics, residential satisfaction, and housing preferences and included a general health questionnaire. Questions on housing type (private or low/high rise housing), space (bedroom, living room, kitchen, etc.), environmental factors (daylight, air, view, acoustic quality, and green space) and function and activities (indoor or outdoor exercise, education/work, cultivation and gardening, social interaction) were included. The respondents comprised 421 residents. The results revealed that the average preference for environmental factors was higher than for spaces, functions, and activities. The respondents’ most important priorities were air, daylight, and view quality. Moreover, among the functions

and activities, users preferred cooking, cultivating plants and maintenance. Better mental health was associated with roof height, green spaces, and indoor exercise; residents who lived in private homes had better mental health than those in low-rise or high-rise housing.

Many studies have examined home design and health, in general, and mental health, specifically; however, Akbari *et al.*’s [7] study examined the quality of the internal space through an analysis of the types of spaces, buildings and activities in which they are held. This rendered it more pertinent to the focus of the present review than other studies because it analysed levels of satisfaction resulting from practising various activities inside the home and evaluated these experiences.

4.2 Home design and workspaces

One study discussed workspaces and internal spaces, as shown in Table 2.

Table 2. Literature on home design and health during the COVID-19 pandemic

Author	Title	Country	Methods & Sample	Recommendations
Hijazi and Attiah (2021)	Saudi residences’ adaptability:	Kingdom of Saudi Arabia (KSA)	Quantitative approach Online survey	The study makes suggestions to improve the settings within the current

	how employees worked from home during COVID-19 lockdowns		300 employees from different sectors and regions in the KSA	spaces of the home, in addition to putting forward a number of future research avenues that can help ensure the quality of the interior space and furniture.
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Hijazi and Attia's [5] study focused on employees who worked from home during lockdown. The study aimed to determine the adaptability of current interior spaces to the concept of working from home and to enable residents to work productively. The researchers developed a questionnaire on three axes: the workplace (before the pandemic), the design of home workspaces (during the pandemic) and work productivity (during the pandemic). The results showed that 42% of the participants worked in their living rooms; only 42% used a desk and chair; 38% did not use any particular furniture; 46% had added some elements to the space in which they worked to help them better adapt to working from home; while 63% of the participants were satisfied with their productivity levels.

The second axis of Hijazi and Attia's [5] questionnaire was particularly relevant to the present study as it related to home workspace design (during the pandemic). This axis comprised eight elements, namely the type of housing; defining areas in house layout and their original functions: the size of the space that housed the workspace; the people that used or shared the workspace; the type of furniture; the specific area

or items such as drawers and stationery and the addition of mood enhancers such as plants and water elements; the extent of interest in placing items that add a certain atmosphere such as artwork, candles, lighting and others; and satisfaction with the home workspace.

The researchers' suggestions were divided into four categories. The first related to how the current settings for home working can be adapted to improve productivity and highlighted the need for privacy and mood enhancers to increase satisfaction. With a study of acoustics. The second related to units and kits to facilitate flexible work in any area of the home, highlighting the necessity to produce flexible and affordable units. The third recommended exploratory research work to explore the comfort of office settings such as colours, textures, and patterns, etc. The fourth suggested analysing and improving the internal quality of homes, including the type of lighting, available ventilation, and noise reduction.

4.3 Home design and flexibility and adaptation

Eight studies discussed flexibility and adaptation and internal spaces, as shown in Table 3.

Table 3. Literature on home design, flexibility and adaptation during the COVID-19 pandemic

Author	Title	Country	Methods & Sample	Recommendations
AlKhateeb and Peterson (2021)	The impact of COVID-19 on perceptions of home and house design in Saudi Arabia	Kingdom of Saudi Arabia	Mixed methods Online surveys 1,250 participants before lockdown 484 participants after lockdown Interviews with 14 participants from the second survey from different regions in the KSA	The study recommends designing a flexible home space and taking care of spaces for guests as they are a cultural requirement, as well as outdoor spaces. It also suggests future research study on whether similar user perceptions will continue after the pandemic or will change.
Abd Elrahman (2021)	The fifth-place metamorphosis: the impact of the outbreak of COVID-19 on typologies of places in post-pandemic Cairo	Egypt	Quantitative approach survey 90 participants (30 per district) Online and physical surveys in Cairo	The study recommends that a reconfiguration of spaces with urban and architectural considerations can create a better environment for residents.
Valizadeh and Iranmanesh	Inside out, exploring	Cyprus	Quantitative approach surveys	The study recommends customizing the open spaces in

(2021)	residential spaces during COVID-19 lockdown from the perspective of architecture		88 students	each residence and introducing spaces that are more transformable, more appropriate for multitasking, breathable, and easily detachable.
Hajjar (2021)	Exploring a new housing design paradigm for post pandemic multi-story buildings in Lebanon	Lebanon	Quantitative approach surveys 153 participants living in Lebanon	The study recommended making modifications to ensure privacy in interior spaces, as well as stressing the importance of the provision of additional spaces that serve the new activities. It also indicated the need for the availability of balconies and green areas, and concluded that the spaces of the house should be flexible and adaptable spaces.
Aydin and Sayar (2021)	Questioning the use of the balcony in apartments during the COVID-19 pandemic process	Turkey	Quantitative approach surveys 160 people living in an apartment block in Konya	The study recommended considering the functional and behavioural components of balconies when designing apartments as they increase user satisfaction.
Torres <i>et al.</i> (2021)	Habitability, resilience, and satisfaction in Mexican homes to COVID-19 Pandemic	Mexico	Mixed quantitative and qualitative approaches Online questionnaire 970 participants Analysis of interior space pictures from 558 participants	The study recommended rethinking new architectural design paradigms and ensuring adequate housing.
Cuerdo-Vilches <i>et al.</i> (2020)	A mixed approach on resilience of Spanish dwellings and households during COVID-19 lockdown	Spain	Mixed approaches More than 1,800 surveys and 785 qualitative	The study recommended designing flexible home spaces and open spaces that have contact with the outdoors.
Bettaieb and Alsabban (2020)	Emerging living styles post-COVID-19: Housing flexibility as a fundamental requirement for apartments in Jeddah	Kingdom of Saudi Arabia	approach 12 families residing in Jeddah	The study suggested developing the foundations of flexible housing design after the COVID-19 pandemic, which in turn, would activate the role of housing according to social and cultural variables.

A study in Saudi Arabia by AlKhateeb and Peterson [3] explored people's attitudes towards their homes during lockdown. Online surveys were distributed before and after the lockdown, and personal interviews were conducted with fourteen individuals who volunteered after completing the second survey to assess the importance of the types of home spaces and their related impressions before and after the lockdown period. The results revealed that respondents' views of their homes' interior spaces and their general understanding of the house changed during the lockdown. The residents moved away from traditional cultural activities such as

hospitality, and the related spaces were converted into spaces that serve family activities such as study, working from home, and entertainment. Their need for two separate living rooms decreased, while their desire for home gyms and additional bedrooms and need for storage space increased.

Abd Elrahman's [10] case study aimed to identify COVID-19's impact on three upper-middle-class districts. A survey was conducted to investigate people's daily life practices and routines in their dwellings, which featured private and public outdoor spaces, during quarantine. The study's results revealed different considerations and

new criteria for housing patterns in Cairo after the pandemic, and the suggested spatial reconfiguration differed from one residential classification to another according to the residents' needs. It also appeared that the greater the number of physical spaces and level of privacy enjoyed by residents of the housing classification, the greater their tendency to reconfigure their homes.

A study by Valizadeh and Iranmanesh [8] targeted a group of architecture students and discussed shifts in the spatial organisation of residential space and indoor activities during the COVID-19 pandemic. The questionnaire covered three components: indoor activities, organisation in indoor spaces and quality of life. It aimed to measure changes that occurred in home activities and activities that participants previously did outside but were practised indoors during the pandemic. The results showed a blurring of the boundaries between public and private activities. In terms of spatial configuration, the balcony was found to be the most important space for redesign with long periods of indoor time. Participants said they found themselves spending more time near windows and openings. In addition, the successful transition of remote work, education, exercise, and social interactions to a housing unit is the best quality of life indicator. Cooking was reported as an emerging activity rather than a shift. Face-to-face gatherings declined, and online contact increased. The most important requirement in terms of balconies and openings was a good view. Flexibility was also shown to be an essential characteristic.

Hajjar's [1] study aimed to develop a new model for housing design during and after the pandemic and investigated people's housing experiences during the pandemic to design a successful residential model. A questionnaire was applied that covered three elements of personal information, housing units, and interior space modifications during the pandemic. The results showed that the participants who had both city and village homes preferred to quarantine in village homes. Moreover, they spent the most time in living rooms, bedrooms, and balconies, respectively. The percentage of participants choosing to work/study in a home's public spaces (living/reception/dining rooms) was the highest at 47%, while slightly fewer respondents (45%) used private spaces (bedroom). Meanwhile, the activities that participants undertook the quarantine included, in order of popularity, watching movies, cooking, sports, gardening, and reading during quarantine. Their view of required spaces in a dwelling changed.

Aydin and Sayar's [11] research evaluated the functional and behavioural performance of apartment balconies before and after the pandemic

by analysing its dimensions and components. The results showed that the importance and use of balconies increased during the pandemic and that gender, age, family size and number of children in the house did not affect balcony use. In the evening, balconies were used as a social space to talk and eat, while their day use increased in quarantine; they continued to be used for food production and processing. Due to the pandemic, users had gained an awareness of balconies' importance.

A study by Torres et al. [6] evaluated the use, perception, and degree of residents' satisfaction with the possibility of staying at home during a pandemic. Data were collected through a questionnaire and pictures of interior spaces supplied by the participants. The study analysed socio-demographic data; housing characteristics; habitability; usage habits and occupations; energy equipment and services; and energy consumption patterns. The results showed that there was an increase in total energy consumption. Most respondents were satisfied with their homes' general lighting and air quality, while their satisfaction with noise insulation and thermal comfort was lower. Families' daily habits were modified by the pandemic, and spaces had adapted to new functions, both individual and shared. Participants also procured appropriate furniture and laptops. In both years, families were satisfied with the size of their homes, but wished for better-landscaped spaces or better views outside.

The study by Cuerdo-Vilches et al. [4] evaluated users' perceptions of the home and its characteristics, highlighting the adaptations families made to dwellings. The results showed that the users' experiences differed depending on dwelling characteristics and the family residing there. The study also clarified the relationships between the priority activities undertaken during the pandemic, the subsequent changes in habits and the importance of considering flexible housing, since users' new needs require spatial flexibility and provision of supplies and equipment in each space to allow access to the Internet and remote communication. Further, the study established the importance of internal environmental quality in terms of lighting, ventilation, thermal insulation, and noise insulation due to health effects on residents.

Bettaieb and Alsabban [2] conducted their research in Jeddah, Kingdom of Saudi Arabia. The study explored the determinants associated with apartment flexibility by analysing the extent to which new psychological, social, and cultural needs were met during the pandemic. The participants comprised 12 families who lived in apartments in different city neighbourhoods. Interviews were

conducted addressing elements of flexibility. The study's results showed that families increased their acquisition of electronic devices as a kind of compensation for their lack of outdoor activities, allocated "café corners" within the residential space, distributed different functions inside the house and used different spaces for new education, work and entertainment activities. They also reconsidered the priority and uses of furniture. The study indicated that there is a lack of flexibility regarding the functional, cultural, and structural aspects of residential buildings.

5. Conclusion

The reviewed studies revealed that families began to think practically by exploiting house spaces to meet family members' new needs resulting from the suspension of outdoor activities (Figure 7). It is worth noting that these changes occurred through considering previously practised activities and transforming them into new, suitable activities, such as creating kitchen spaces for coffee corners instead of going out to cafés, converting guest rooms that enjoy privacy into offices for work and using dining rooms as education spaces. Moreover, each family's requirements varied according to different variables, including gender, age, marital status, type of housing and community culture.

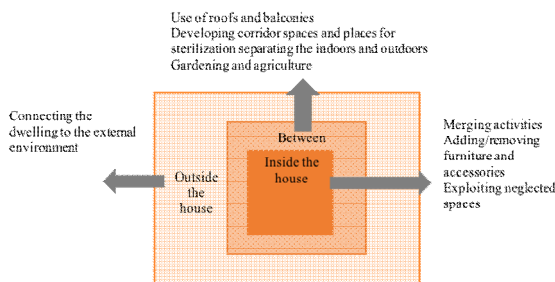


Figure 7. Overview of adapt and interact with home design

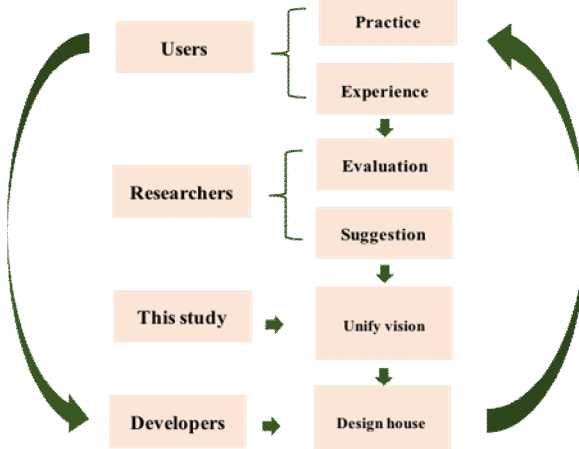


Figure 8. Significance of the study

The experience of confinement led to evaluating the design and performance of home spaces, which, in turn, reflects the requirement for new design models that meet users' needs and ensure quality of life. Home experiences can reveal its suitability for their requirements; thus, researchers should consider residents' opinions and propose solutions based on user needs. The present study contributes to the literature by synthesising the extant research on different user needs according to various determinants and uniting them into a template to guide developers (investors, planners, architects, designers) to build suitable and beautiful housing. In today's open and globalised world, one country's population lives in another, carrying with them their customs, traditions, and needs. Therefore, the present study seeks to unify the visions of making a suitable home for all, with different determinants. The importance of the study is illustrated in Figure 8.

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