Case Study
ISSN (Online): 2350-0530
ISSN (Print): 2394-3629

International Journal of Research - GRANTHAALAYAH
May 2022 10(5), 93-109

THE EFFECT OF RESIDENTIAL DESIGN ON HUMAN HEALTH IN THE COVID-19 LOCKDOWN PROCESS: THE CASE OF STUDY BOLU/TURKEY

Orhun İnce [1], Ali Osman Kuruşcu [2], Ali Rıza Parsa [3]

[1] Research Assistant, Department of Architecture, Faculty of Architecture and Design, Kocaeli University, Kocaeli, Turkey
[2] Assistant Professor, Department of Architecture, Faculty of Architecture, Yıldız Technical University, İstanbul, Turkey
[3] Associate Professor, Department of Architecture, Faculty of Engineering and Architecture, Istanbul Esenyurt University, İstanbul, Turkey

Received 14 April 2022
Accepted 18 May 2022
Published 11 June 2022

Corresponding Author
Orhun İnce,
orhunince20@gmail.com

DOI
10.29121/granthaalayah.v10.i5.2022.4621

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

People spend most of their lives indoors. One of the most important of these places, which meet basic needs such as security and shelter, is residences. In various periods, the time spent in closed areas may increase. Various diseases, which emerged at certain points in human history, caused closures and quarantines, increasing the time individuals spend in the house, and harmed societies physically, socially, and economically. As of March 2020, the Covid-19 virus has caused semi and full closure practices in many parts of the world due to its contagiousness. During these closure periods, the effects of housing life and housing design on human health came to the fore. A field study was conducted by selecting the province of Bolu, which has a high earthquake risk and experienced various closure periods, to better understand what the users experienced in their houses during the closure periods and the points where they were dissatisfied. Within the scope of this field study, residential users from various occupations and age groups were selected and a survey study was applied. Within the scope of the article, the results of this survey study are evaluated and the precautions and suggestions that can be taken on the houses in the context of Covid-19 are discussed, and housing designs are criticized in line with the wishes of the users. Considering the results of the survey, to design houses that are healthier and provide the user comfort; natural lighting and ventilation, flexible space design and biophilic design are suggested.

Keywords: Pandemic, Residential Building, Architecture, Covid-19

1. INTRODUCTION

Throughout human history, various infectious diseases have emerged in many parts of the world, spread through people, animals, or consumer goods, and have caused economic, social, and physical damage to communities living in different geographies. These diseases are sometimes called epidemics and sometimes

pandemics. In the most general sense of the word epidemic or epidemic; It is defined as an infectious disease that appears in a community at a certain time and tends to spread Anomaly (2014) The word pandemic, on the other hand, is used for diseases that have spread to wider areas such as a country, continent or the whole world compared to an epidemic. In Ancient Greek, the word pan refers all, and the word demos refers people Söğüt (2020). The coronavirus, emerged in Wuhan, China in December 2019 and outspread around Asia, Europe and then the whole world. It has been proclaimed a pandemic by the WHO (World Health Organization) as of March 2020.

The coronavirus, which spread rapidly also in Turkey, has caused full and half closure practices in various periods. In addition, people who contracted the virus also experienced two-week quarantine processes in their homes or health institutions. Due to closure practices, many working areas have adopted remote working methods during these periods. As a result of all these situations, a large part of the society has started to spend most of their time in their houses. Under normal conditions, on average, a person spends about 87% of his life indoors. 69% of this rate is residences Klepeis et al. (2001) It is possible to say that these values increase during the closing periods. As the time spent inside the residences increases, the problem of indoor air quality, which is an important factor, has also come to the fore. Indoor air quality has a major efficacy on the health and working efficiency of users. Unfortunately, some studies reveal that indoor air pollution is greater in most cases than outdoors Figure 1, EPA (2001).

Figure 1

Figure 1 The entry of the coronavirus into the closed space by infecting the individual

With the increase in the time spent in the house, the effect of the house design on the psychological and physical health of the user has started to come to the fore. Users have noticed and criticize the negative and deficient aspects of their homes. Considering that one of the most important aims of architecture and sustainable architecture is the principle of designing for people, it can be said that various criticisms and changes should be made because of recognizing these criticisms and negativities. Considering the existence of problems such as the increase in the time spent indoors and the inability to provide indoor air quality, the threat in these areas is not only the coronavirus, but also ensuring the comfort and health of the user in a sustainable way. To handle this situation in a more positive way, it is necessary to take various measures and make changes in certain parameters. This period also recalled the following important question: “What would be the consequences of an earthquake that may occur while many people are at home during these closure processes?” As in every city in Turkey, full and part-time closure practices have been implemented in Bolu in various periods. Bolu city centre is located at a point close to many active fault lines, and this situation recalls the issues of building and structural system adequacy, as well as the safety of life and property of the users in case of an earthquake that may occur during the closure period. Due to this situation,

Bolu province was chosen within the scope of the study, various questions were asked to the residents residing in the center of the city and inferences were formed as a conclusion.

1.1. SELECTED CRITERIA FOR HEALTHY BUILDING DESIGN

Life and many compulsory business lines continue their activities during the pandemic. For these functions to continue in a safer and more sustainable way, business areas, public spaces and individual residences must be designed to limit the spread of the virus. However, there are some points to be considered in housing design so that the physiological and psychological health of the users is not damaged in case of closure. Certain main topics have been selected to produce safer and generally healthier places in terms of virus spread. These determined titles are the dimensions and flexibility of the spaces, the possibility of natural lighting and ventilation, the choice of materials, biophilic design, indoor user comfort and user and building safety.

1.2. SIZE AND FLEXIBILITY OF SPACES

People may feel the need to change or transform the spaces they constantly use in their homes due to the activities that come in and out of their lives periodically. This situation may also vary depending on the age, occupation, and level of movement of the user Tatlı (2008) Especially considering the closure period, most of the business lines have been tried to be carried out remotely from the home environment. In addition, individuals infected with the virus have undergone quarantine processes in the room in order not to infect other members of the house. In these situations, housing needs to be designed in a flexible and transformative way to allow for various activities, movement, and security in case of quarantine.

The most important issue to be considered to ensure the flexibility in question is the design of the structure. The structural system is the system that keeps the building standing and transfers the static and dynamic loads on the structure to the ground. If flexibility is considered while choosing the structure, systems with dense shear walls such as tunnel form molds should not be preferred. In general, instead of choosing structure elements that cannot be changed and take up large space, it is recommended to prefer skeleton systems Uzel (2001)

1.3. NATURAL LIGHTING AND VENTILATION

As seen in the past pandemics, it has been considered important and recommended for the indoor spaces and especially the residences to receive natural daylight and to be bright, in terms of user health. The use of natural daylight in buildings can not only create positive aspects for human health, but also increase the visual comfort of the users and enable them to perform the actions they perform in the space more effectively Kazanasmas (2009)

Natural ventilation occurs because of wind and pressure difference from the gaps or openings opened on the building envelope Figure 2 The air flow created by natural ventilation methods can not only provide air conditioning in the interior, but also ensure that the pollutants in the interior are removed from the environment Yüksek and Esin (2011) Considering the energy consumption during the life cycle of buildings, approximately 94% of the energy consumed is consumed due to air conditioning, ventilation, and heating systems Scheuer et al. (2003)

Figure 2

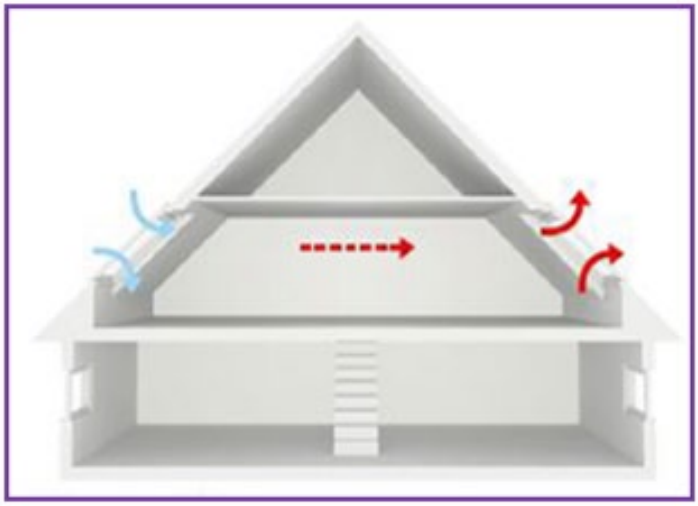

Figure 2 Natural ventilation circulation with the help of openings in the building envelope. (muntes.net)

Natural lighting and ventilation methods to be considered while designing the building envelope can also be supported by shaping the structural system. With the right choice of carrier material, the column dimensions can be reduced, and more interior space can be obtained. For example, when a cross-laminated wooden carrier element is preferred in a building, it is observed that 10% is saved in the interior Anttonen (2015)

1.4. MATERIAL SELECTION

Multi-storey residences, mass residences, etc., where the same environments are used by more than one group, have great importance when it's come to the points that individuals must touch to advance in these common areas. It is important for the health of the user to ensure that these points are cleaned regularly and that these points are as few as possible.

On the other hand, at points that cannot be designed with photocell or remotely activated, the use of materials that can be easily cleaned and on which the virus cannot survive for a long time will have positive results. In this context, copper-containing metals or alloys of bronze or brass are recommended for the points that must be touched. The Covid-19 virus can survive for 40 minutes on a brass mine and 120 minutes on a copper mine Isha et al. (2020)

The products and materials preferred in the housing, can also affect the health of the user. It can be said that recyclable and natural materials such as wood, stone, straw, clay, and wicker will pose fewer problems for human health, since they contain less synthetic products than artificial products Öztürk and Bayrak (2017) It is recommended to use more natural and recyclable wood instead of concrete and metals that may contain particles harmful to human health in structural elements.

1.5. BIOPHILIC DESIGN

Incorporating live plants in the building and on its shell has emerged as a frequently used practice within the principles of sustainable architecture, especially in 21st century. These applications are also called biophilic design in general. Biophilic design can be explained as the integration of the built environment and building interiors with nature to design spaces that are healthier and less stressed Browning et al. (2014) Biophilic design can also be explained as the integration of living plants into building elements to eliminate the desire of people to return to nature and to inherit the need for nature and integration with nature Figure 3 Kellert (2014)

Figure 3

Figure 3 Yıldız Technical University Faculty of Architecture

It can be said that the application of biophilic design principles, which are used in normal conditions, especially in office environments, will have positive results in terms of user health, when today's Covid-19 conditions are considered. It is thought that living plant tissue, designed, and integrated with building elements, will be beneficial for our physical and mental health in the houses where we spent a long time during the closure period. This situation will meet the human need to be with and touch nature Kellert (2014) With biophilic design methods, a positive approach is created in terms of sustainability as well as reducing the stress of the user.

In addition to the use of live plants, the use of wood as a building material reduces the stress seen in the users and ensures the formation of healthier and more sustainable spaces. Pleasant and healthy spaces can be created by using wood as building materials Muilu-Mäkelä et al. (2014) Again, in terms of health, if wooden materials are designed to be resistant to mold and fungus during production, they can positively affect the health of the user by showing anti-bacterial properties. From the user's point of view, it can be said that wooden materials are natural and aesthetic Anttonen (2015)

1.6. USER COMFORT

User comfort in the indoor environment can be grouped under main titles such as thermal comfort, acoustics, lighting, and vibration TSEN (2008) When these comfort conditions are not provided, people can feel restless and demoralized, and

at the same time, their work performance decreases. In addition, although the comfort conditions are determined by using certain criteria, in many cases it can vary from person to person due to individual differences Parsons (2002)

From the point of view of thermal comfort, it is known that the suitable room temperature for a person at rest will be 18-25 °C. Considering the humidity rate, it should be between 50-60% as a variable. The presence of moisture in the air above this rate can lead to the formation of fungus in building materials, colds, and fatigue in humans Neufert et al. (2000) It has been observed that the virus can hang in the air for up to 3 hours when the indoor humidity is between 20-30% and falls to the ground when it is 40-60% It is thought that by paying attention to the humidity in the common areas of the houses, the virus can be kept below the respiratory level and destroyed by regular cleaning Söğüt (2020)

Certain mechanisms or situations around and inside the dwellings can cause sound and vibration. When a certain threshold is exceeded, situations may occur that will adversely affect the health and comfort of the user. This can cause damage to structures as well. The cause of vibrations can be divided into exterior and interior resources. In order not to adversely affect the function and safety of the building and human health and comfort, it is necessary to design by considering the structural vibrations and to take precautions with the necessary details Işık and Kuruşcu (2018)

1.7. USER AND BUILDING SAFETY

To ensure user safety, first, the structure in question must be able to safely carry and meet various loads coming from exterior and interior. This attribute has become even more important during the closure period when people pass most of their time in their houses indoors Klepeis et al. (2001) At this point, disasters such as earthquakes, fires and floods may adversely affect the users and the structures must safely meet the loads that may arise from these disasters.

Considering the Covid-19 pandemic and residential life in particular, meeting earthquake and seismic loads is of great importance for user safety, and at this point, the structural system should be carefully considered. Earthquake is called the damage of the vibrations that occur after the various movements of the plates that provide the formation of the earth's crust and their interactions with each other by transmitting them to the surface and environments in waves.

Figure 4

Figure 4 Bolu after the 12 November 1999 earthquake (Bolu Municipality Archive)

At this point, in order to design more resistant structures against seismic loads; site selection should be done well, and soil properties should be known, the centre of mass and rigidity should be well determined by choosing simpler, compact, and symmetrical building forms instead of complex forms, joints should be used where necessary. When detailing the design issues like; soft floor, short column, resonance between the structure and ground should be taken account Önel and Akbulut (2002) The use of balconies is of great importance in terms of user health, but when these areas are designed as consoles, they cause great damage due to their oscillations in the event of an earthquake. As an exemplary solution, these areas should be designed with cantilever beam lengths not longer than 2 meters, as restricted by the regulations.

1.8. PREPARATION OF THE SURVEY

The problems faced by each city differ. For this reason, a model should be created to design buildings that are healthier and resistant to various diseases and disasters, and this model should be adapted to various cities or regions when necessary. A survey study consisting of questions prepared under these main titles was conducted to better adapt the criteria determined to produce healthy spaces, which were explained above, to new designs. Bolu, located in the Black Sea Region of Turkey, was chosen as the pilot city of the survey study. Due to its location on important highways and its prominence with nature tourism, it has been observed that the increase in cases has increased rapidly in various periods of the Covid-19 pandemic and the number of people infected with the virus has increased. Since the province of Bolu is located on active fault lines, it experiences seismic tremors at regular intervals Figure 5

Bolu city centre has a population of approximately 180,000 people Bolu (2022) There are 43 neigh borhoods and approximately 20,900 residences in the central district. The majority of these houses are multi-storey houses between 3 and 5 floors. Bolu (2022) Bolu province suffered great material and moral damage in the earthquakes that took place on February 1, 1944, and on August 17 and November 12 in 1999 Figure 4. For this reason, the people of Bolu province are familiar with the concept of earthquake. The fear of an earthquake can be clearly seen among the public, especially in those who remember the earthquakes that took place in 1999. In the last 50 years, in Turkey; 4 earthquake regulations, namely 1975, 1997, 2007 and 2018, were put into effect. Although these regulations have become more comprehensive over the years, revisions have also been made in some years. For example, While the maximum ratio of curtain wall edges was 5 times in the 1975 regulation, this coefficient was increased to 7 times in 1997. This situation raises questions about the adequacy of the regulations regarding the buildings damaged in the 1999 earthquake.

Figure 5

Figure 5 Representation of Bolu's location with fault lines in and around Turkey. Modified from; seismo.berkeley.edu and Okay, Kaşlılar-Özcan, İmren, Güney, Demirbağ, Kuşçu

Various scientific research methods resources were used during the determination of the sample size. After selecting the province of Bolu as the study population, it was determined that the simple random sampling method would be used. In this selection system, while creating the sample set, there is a possibility that the individuals in the population will be selected equally. By choosing this method, it was aimed to create a diverse and rich sample group in terms of various ages, occupations, housing types and ownership. While determining the size of the sample set, the formulas of Karasar, and Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz and Demirel were used.

As a result of Karasar's formula, a confidence rate (z) of 95% and a deviation value (e) of 5 points were considered, and the predicted standard deviation (ss') was chosen as 50%. The z value of the 95% value taken as the confidence level is 1.96. As a result of the formula, the value of 384.16 is reached and the sample size is chosen as 384 Figure 6, Karasar (2010).

Figure 6

$$(z)\left(\frac{ss'}{\sqrt{n}}\right) = e \qquad (1.96)\left(\frac{50}{\sqrt{n}}\right) = 5$$

$$\left(\frac{1.96 \times 50}{5}\right)^2 = n \qquad 384{,}16 = n$$

Figure 6 Calculation formula of the sample size

In another formula, the size of the universe (N) must be determined first. Since the research was based on the central district of Bolu province, the value of 180,000, which is the population of the central city of Bolu, was considered. For the population estimation, the deviation value (d) was determined as 0.05 and the confidence ratio (z) was determined as 95%. As the standard deviation, the preference rates of the participants were determined as 0.5 over the p and q values. The z-value corresponding to the confidence ratio is 1.96 Figure 7, Büyüköztürk et al. (2014).

Figure 7

$n_0 = (z^2 \times pq) / d^2 \qquad n_0 = (1{,}96^2 \times 0{,}25) / 0{,}05^2 \qquad n_0 = 384{,}16$

$n = n_0 / [1 + (n_0 - 1) / N]$

$n = 384{,}16 \ / [1 + (384{,}16 - 1) / 180000]$

$n = 383{,}35$

Figure 7 Calculation formula of the sample size

1.9. IMPLEMENTATION OF THE SURVEY

The survey was prepared online and delivered to the participants over the internet. During the distribution of the survey, distribution was made among various age and occupational groups to ensure more accurate results. Before the application of the survey, a pre-evaluation was carried out with a control group consisting of 5 people from different age groups. The survey was applied to users residing in Bolu province. The survey consists of 26 questions in total. 18 questions were prepared according to a 5-point Likert scale, and the remaining questions were multiple-choice. At the end of the survey, an open-ended question was included to learn the suggestions and requests of the users. During the evaluation of the results, these suggestions were also grouped and evaluated.

2. SURVEY RESULTS

In the evaluation phase of the survey results, first, a radar chart was created to clearly see the extent to which the 6 topics, which were the subject of the study and briefly explained in the suggestions section, were included in the experience of the users. The titles of this radar chart can be summarized as space, materials, lighting and ventilation, plant use, comfort, and structural safety. The graph was created by taking the arithmetic average of the answers given to the questions asked under these titles.

Figure 8

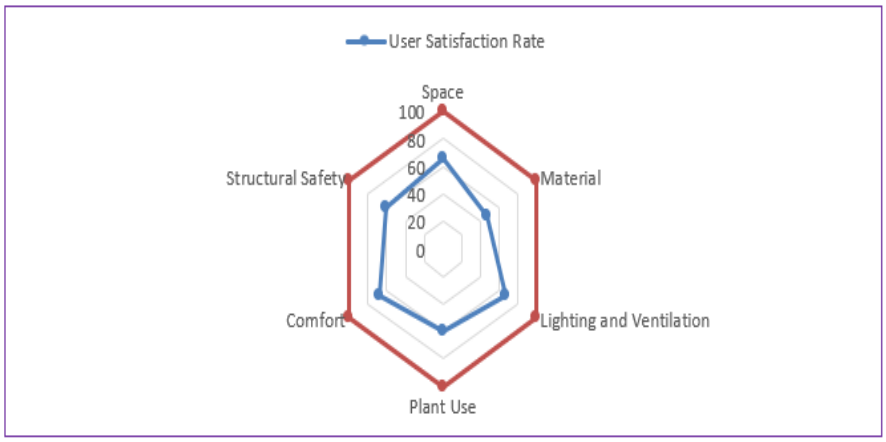

Figure 8 Radar chart

Table 1

Table 1 Survey results summary

Questions					
1. Your age?	**18-24**	**25-30**	**31-40**	**41-50**	**50-65**
	%14,9	%12,6	%28,4	%27,9	%16,4
2. How do you perform your job?	Workplace	Remote		Student	Unemp.
	%66,6	%5,4		17%	11%
3. Type of residence and the that you reside?	Ground F.	1-3. F.		4+ F.	Detached H.
	5%	%39,3		%38,3	%17,4
4. Home ownership?		**Yes**		**No**	
		%66,6		%33,4	
5. Contacted the virus?		Yes		No	
		%40,4		%59,6	
6. Individual room and/or bathroom ownership?	**Both**		**Only room**		**Neither**
	53%		%38,5		%8,3
7. Ensuring the cleanliness of the place?	5	4	3	2	1
	%43,6	%36,4	%14,3	%5,1	%0,7
8. Venting objects, clothes etc. from outside?	5	4	3	2	1
	%32,7	%38,3	%18,1	9%	%1,9
9. Natural ventilation?	5	4	3	2	1
	%38,3	%43,9	%10,5	%6,3	1%
10. Natural lighting?	5	4	3	2	1
	%43,1	%39,1	%6,8	9%	%2,1
11. Garden, terrace, balcony, roof garden adequacy?	5	4	3	2	1
	%31,9	%32,8	%11,5	%16,3	%7,5
12. The size of the spaces?	5	4	3	2	1
	33%	%36,1	%13,9	%13,7	%3,3
13. Buildings disaster resilience?	5	4	3	2	1
	%24,1	%36,6	%24,8	%11,3	%3,1

14. The place where you spend the most time?	**Living**	**Kitchen**	**Ind. Room**	**Balcony**	**Other**
	56%	%11,4	25%	%5,5	%2,1
15. Taking care of plants?		Yes		No	
		%58,1		%41,9	
16. The effect of taking care of plants on the individual?	5	4	3	2	1
	%18,2	%38,4	27%	11%	%5,4
17. Landscape proficiency?	5	4	3	2	1
	%29,9	%34,9	%13,2	%14,6	%7,5
18. Feeling peaceful during the closure?	5	4	3	2	1
	%20,8	%36,8	%20,5	%17,2	%4,7
19. Are the problems related to the building?	5	4	3	2	1
	%5,6	%21,7	%19,7	%38,3	%14,8
20. Do the changes you make in your home have positive effects?	5	4	3	2	1
	13%	%47,3	%23,4	%11,4	%4,8
21. Cleaning of residential common areas?	5	4	3	2	1
	%14,1	%34,4	%24,4	20%	7%
22. Ventilation and lighting of common areas?	5	4	3	2	1
	11%	%24,1	%29,7	%26,4	%8,8
23. Cleaning of common areas?	5	4	3	2	1
	%13,3	%27,6	24%	%24,9	%10,2
24. Points that must be touched in the common area?	5	4	3	2	1
	%9,5	%39,2	%14,6	%31,5	%5,3
25. Disposal of waste in the pandemic process?	5	4	3	2	1
	%14,1	%31,9	%22,3	%21,6	%9,9

As can be seen in the graph, when we look at the results of the survey, the main areas that the participants are satisfied most about their residences are; With a satisfaction rate of 67%, user comfort and lighting and ventilation qualities come. Afterwards, there are spatial qualities with 66%, plant use with 60% and material preferences with 48%, respectively. Under these main titles, the questions asked to the participants will be explained in detail. As can be seen from this graphic, most of the complaints experienced by the users during the closing processes are due to the deficiencies in the material area. When we look at the other topics in general, the fact that there is no closeness to the full satisfaction levels in any subject shows that these issues cannot be fully resolved in terms of users. To better classify the participants of the survey, they were asked about their age, the way they work or the way they work, the characteristics of the houses they live in, whether their houses belong to them, whether they were caught in a virus that could cause individual closure, and at what point they spent most of their time during the closure process Figure 8

Table 2

Table 2 Comparison of the opinions of the age groups participating in the survey

Number of participants	Age groups	Peaceful at closure	Not peaceful at closure	Residence is the issue	Residence is not the issue
Participant: 57	18-24	36%	37%	30%	42%
Participant: 48	25-30	46%	23%	33%	40%
Participant: 109	31-40	60%	25%	28%	56%
Participant: 107	41-50	50%	14%	20%	60%
Participant: 63	51-65	57%	14%	17%	67%

Most of the participants are in the 31-40 and 41-50 age group. These age groups also cover the two most populous ranges among the groups considered. For this reason, it is predictable that the participation in the survey is high within these ranges Bolu (2022)

When the questions that measure the happiness of the individual and the relationship of the problems experienced with the residence during the closure period in the survey are evaluated on age groups; During the closure period, the 31-40 age group was the group that felt the most happy and peaceful, with a rate of 60%. When we look at the opposite situation, the number of people who say that they do not feel happy during the closure periods is seen in the 18-24 age group at most. It can be said that this is since age groups have different physical and psychological needs.

In addition, when asked about the relationship of the problems experienced with their residences, the rate of people who said that the problems encountered were caused by the residence increased as the age range decreased. In this context, the rate of people who relate their problems to their residences is mostly seen in the age group of 24-30. Again, looking at the opposite situation, the rate of people who say that the problems experienced are not related to their residences increases in direct proportion to the age range. The rate of people who say that the problems are not related to their residences is mostly seen in the 51-65 age range Table 2

When we look at the types of residences of the people participating in the survey, it is seen that 82.8% of them live in multi-storey buildings. Since it is thought that there may be a relationship between this question and some of the questions in the survey, the answers were examined comparatively. When the answers of the people living in multi-storey houses to the questions asked about the common areas of the house are evaluated; About 45% of users think these common areas are clean and safe. To the question about the measures taken in the common areas of the residence and at the entrance of these areas, 38% of the participants answered that no action was taken. The rate of the number of users who think that the surfaces that need to be touched to progress in these areas and at the entrance are seen as 48%. The rate of users who think that the ventilation and lighting of these areas are sufficient is 41% Table 3

Table 3

Table 3 Comparison of qualities in various types of housing in the survey

Housing types	Adequate view	Peaceful at closure	Residence is the issue	Residence is not the issue	Adequate lighting	Adequate ventilation	Adequate balconies	Adequate space size
Ground F.	63%	68%	26%	32%	68%	79%	68%	68%
1-3. F.	61%	55%	26%	56%	81%	86%	65%	70%
4+ F.	66%	34%	12%	31%	74%	82%	54%	67%

Detached H.	84%	73%	22%	66%	87%	90%	93%	81%

Figure 9

Figure 9 Housing distribution in the survey

While 71% of users living in multi-storey houses gave a positive answer to the question about the ventilation of objects brought into the house from outside, 75% of users living in detached houses answered positively. It is seen that the highest satisfaction rate in questions such as natural lighting, ventilation, housing size and the adequacy of open spaces, which are asked to the participants about their houses, is among those who live in detached houses. When the answers given to the same four questions are evaluated over the type of residence, the second category with the highest satisfaction rate is 1-3 Floors. Considering the less satisfaction rates; While the users residing in the 4th and above floors in multi-storey houses are satisfied with the natural lighting and ventilation qualities, it is seen that the users residing on the ground floors are more satisfied with the adequacy of the open spaces and the adequacy of the size of the house.

When viewed proportionally, the rate of users who are satisfied with the view of their house and think that it is good for them is mostly seen in people residing in detached houses. The same situation can be seen in the question of feeling happy and peaceful in the house during the Closure. The rate of the number of users who say they feel happy is mostly seen in people residing in detached houses. In this process, the lowest rate of associating the problems experienced with the house is in detached houses. Considering the users who associate their problems with their residence, the highest rates are; in multi-storey residences, on the ground floors and 1-3. In general, approximately 26% of the people living in multi-storey residences stated that they thought that the problems they experienced during the closure period were caused by their residences. This rate is seen as 22% for users living in detached houses Figure 9, Table 3

As seen in the survey results, to the question “Do you think your house is resistant to disasters?” While 60.7% gave a positive answer, 14.4% gave a negative answer. 25% of the participants gave an intermediate level response, which can also be interpreted as indecision. At this point, it can be said that the people of Bolu are sensitive to various disasters and especially earthquakes based on their experiences, but they do not have enough information about their houses. In this context, it can be said that most of the buildings in Bolu should receive engineering service to increase awareness and prevent loss of life and property.

At the end of the survey, “Are there any qualities or qualities you would like to change about the housing you live in during the pandemic process?” 126 people answered the question by expressing their various suggestions and complaints about their own houses. This number shows that 32.8% of the respondents are not

satisfied with their housing. When the comments are compared among the types of residences; While only 4.5% of users living in detached houses have complaints, 38.8% of users living in multi-storey houses have complaints.

When the suggestions and complaints received are examined, these comments can be grouped under 7 main titles. These titles are housing change, need for a garden, lack of terrace and balcony, insufficient lighting, insufficient size, common areas and privacy.

Figure 10

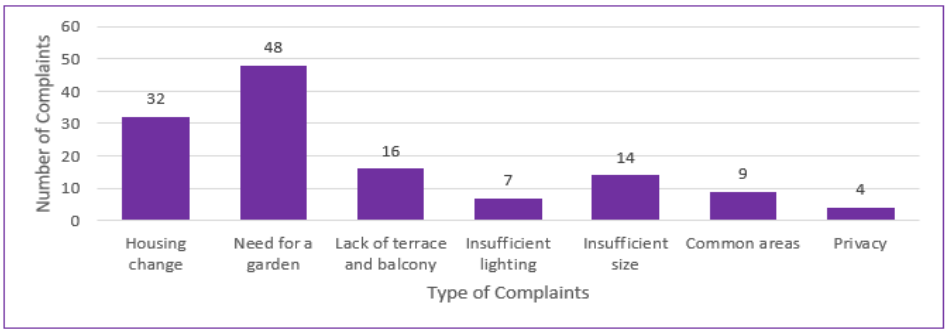

Figure 10 Numbers and types of complaints by the users

The comments gathered under the title of housing change were made by users residing in multi-storey houses and they expressed their desire to switch from the houses they live, in to detached houses. However, the most common complaint is the need for garden, open space, and closeness to nature. Many participants complain about the lack of gardens and open spaces near or integrated into their houses, the weak relationship of their houses with the natural environment and the distance of these houses to these environments. Many participants complain about the inadequacy of their interiors and open and semi-open spaces such as balconies and terraces. While the participants say that spaces such as balconies and terraces should be larger, when looking at the complaints under the title of insufficient size, it is said that the number of rooms and bathrooms is insufficient for individual isolation during quarantine periods, in addition to discourses such as the small size of the interior spaces. Some participants stated that there should be a bathroom, especially at the entrance of their houses, for cleaning and ventilating the objects coming from outside. In the complaints under the title of insufficient lighting, the participants complain about the facade their houses are oriented and the interior spaces not getting enough daylight. Complaints stated under the title of common areas generally consist of insufficient cleaning, lighting, and ventilation of areas such as stairs and corridors in multi-storey houses. Under the title of privacy, complaints were made about the inadequacy of sound insulation and the fact that the houses and their balconies were too close to each other since many people spent time in their houses during the closure period Figure 10

Looking at the results of the survey, it is seen that user satisfaction can be achieved at a rate of approximately 2/3 in many areas. To increase this rate, it is necessary to examine and evaluate the identified deficiencies and the complaints submitted by the participants. When looked at comparatively, it can be said that in many areas, detached house users are more satisfied than those living in multi-storey houses. In the questions asked about the common areas, the satisfaction level cannot exceed 50%.

3. CONCLUSION

History has revealed epidemics that have caused many changes in our lifestyles, in the natural and built environment, and in our lives in general, in various periods. Although, we want to continue our lives before the epidemic, unfortunately, it can be said at any time that we are at risk of encountering new diseases in the near or distant future. Spending the whole day in the places we live helps us to see the shortcomings of these places, while giving us ideas about how we can improve these places with a critical perspective. It is seen that the ongoing Covid-19 pandemic can cause various changes in our structures.

For the houses to be healthier, safer, and more comfortable within the scope of the Covid-19 pandemic, it is necessary to investigate the deficiencies noticed and determined by the users and to suggest what changes can occur in the houses. To better understand these deficiencies, within the scope of the survey conducted in Bolu Province, it has been found that there are some factors affecting the peace and health of the participants during the closure processes.

If it is necessary to gather the suggestions under certain titles within the scope of the research and survey findings, these are natural lighting and ventilation, flexible space design and biophilic design. For healthy spaces to be designed and for these spaces to be sufficient in terms of user comfort, various conditions must be met. The fact that the environment is at a certain temperature and humidity positively affects the health of the user, while reducing the risk of transmission of the coronavirus. Natural ventilation methods should be used not only inside the houses, but also in the common areas of the houses where there is a collective life, so that these spaces are safer and cleaner. While the necessary user comfort is provided without energy consumption, it can pave the way for designing healthier and more sustainable spaces.

Flexible space design is of great importance not only for closure and quarantine processes, but also for designing sustainable residences. While it is difficult to change the dimensions of the existing houses today, there is always the possibility that the sizes of the houses to be designed soon will not be fully compatible with these changes due to the variating needs and conditions. In addition, the individual characteristics and thoughts of the users also play an important role in defining the dimensions of the space and vary greatly from person to person. For this reason, instead of changing the dimensions, flexible and adapting to various conditions, prefabricated construction systems and modular structural systems are recommended for flexible space designs. In this way, the dimensions of the space can be changed when desired in various periods and the spaces with the desired functions can be integrated with the residence.

Today, the harmony and relationship of many cities and the buildings designed in these cities with the natural environment is quite weak. Although this situation is not felt much under normal conditions, it has largely manifested itself during the closure and quarantine periods. Research shows that taking care of plants, having a view overlooking the natural environment and living together with the natural environment have positive effects on human psychology. For this reason, it is necessary to design houses and spaces in relation to the natural environment and plants, considering the health of the user. At this point, it is recommended to apply biophilic design methods integrated with interior spaces, building materials and open and semi-open spaces, since it will be difficult to maintain or renew the natural environment relationship of existing houses. In addition to being unpredictable when the Covid-19 pandemic will end, unfortunately, there is no guarantee that we

will not encounter new pandemics. For this reason, the design of spaces that can be adapted to various conditions, considering human health and comfort, is timelessly important for the users and the architectural environment.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Anomaly, J. (2014). What Is an Epidemic ? Currents in Contemporary Bioethics, Journal of Law, Medicine and Ethics, 42(3), 389-391. https://doi.org/10.1111/jlme.12155

Anttonen, N. (2015). "Revıew Of Wood-Based Constructıon And Archıtecture-Technology", Status And Trends, Dasos Capital, Kasım 2015, Finlandiya.

Bolu, (2022). Bolu Municipality Archive, Bolu.

Browning, W. D. Ryan, C. O. & Clancy, J. O. (2014). "Patterns of biophilic design", New York, Terrapin Bright Green.

Büyüköztürk, Ş. Kılıç Çakmak, E. Akgün, E. A. Karadeniz, Ş. Demirel, F. (2014). Bilimsel Araştırma Yöntemleri, ISBN 978-9944-919-28-9, Pegem Akademi, 18.

Çınar, M. (2020). A Historical Perspective on Epidemics and New Beginning after COVID-19.

EPA, (2001). 402-K-01-003, Healthy Buildings, Healthy People : A Vision for the 21st Century.

Isha, S. N. Ahmad, A. Kabir, R. Apu, E.H. (2020). "Dental Clinic Architecture Prevents COVID-19-Like Infectious Diseases", Health Environments Research & Design Journal 2020, 13(4), 240-241. https://doi.org/10.1177/1937586720943992

Işık, M. E. Kuruşcu, A. O. (2018). "Yapısal Titreşimlerin Kullanıcı Konforuna Etkisinin İncelenmesi", Harran Üniversitesi Mühendislik Dergisi.

Karasar, N. (2010). "Bilimsel Araştırma Yöntemleri", Nobel Yayın No : 68, Eğitim Bilimleri ; 36.

Kazanasmas, Z. T. (2009). "Binaların Doğal Aydınlatma Performanslarının Değerlendirilmesi", V. Ulusal Aydınlatma Sempozyumu, 07-09.

Kellert, S. R. (2014). Biophilia and biomimicry : Evolutionary adaptation of human versus nonhuman natüre, Intelligent Buildings International, 8(2), 51-56. https://doi.org/10.1080/17508975.2014.902802

Klepeis, N. E. Nelson, W.C. Ott, W. E. Robinson, J. P. Tsang, A. M. Switzer, P. Behar, J. V. Hern, S. C. Engellmann, W. H. (2001). The National Human Activity Pattern Survey (NHAPS) : a resource for assessing exposure to environmental pollutants, Journal of Exposure Science & Environmental Epidemiology 11, 231-252. https://doi.org/10.1038/sj.jea.7500165

Muilu-Mäkelä, R. Haavisto, M. Uusitalo, J. (2014). Puumateriaalien terveysvaikutukset sisäkäytössä-Kirjallisuuskatsaus.

Neufert, E. Neufert, P. Baiche, B. & Walliman, N. (2000). Yapı Tasarım Temel Bilgisi, Oxford : Blackwell Science.

Okay, A. I. Kaşlılar-Özcan, A. İmren, C. Boztepe-Güney, A. Demirbağ, E. Kuşçu, I. (2000). Active faults and evolving strike-slip basins in the Marmara Sea, northwest Turkey : a multichannel seismic reflection study, Tectonophysics, 321(2), 189-218. https://doi.org/10.1016/S0040-1951(00)00046-9

Önel, H. Akbulut, M. T. (2002). Deprem Bölgelerinde Yapı Üretimi Sempozyumu, Yıldız Teknik Üniversitesi Oditoryumu, İstanbul.

Öztürk, A. Bayrak, D. (2017). Anaokullarındaki Doğal Mekan ve Materyallerin Çocuk Gelişimindeki Yeri, Social Sciences, 12, 25-36. ISSN: 1308 7444 (NWSASOS) https://doi.org/10.12739/NWSA.2017.12.1.3C0155

Parsons, K. (2002). Human Thermal Environments, The Effects of Hot Moderate and Cold Environments On Human Health, Comfort, and Performance, Third Edition, CRC Press, Taylor&Francis Group.257-268s.

Scheuer, C. Gregory, A. Reppe, P. (2003). Life cycle energy and environmental performance of a new university building : modeling challenges and design implictions, Enerji and Building, 35(10), 2003, 1049-1064. https://doi.org/10.1016/S0378-7788(03)00066-5

Söğüt, A. (2020). Covid-19 Pandemisi Sonrası Normalleşme Sürecinin Sürdürülebilirliğe Etkisi, Mühendislik ve Mimarlık Bilimlerinde Güncel Araştırmalar, 55-67.

TSEN (2008). Binaların enerji performansının tasarımı ve değerlendirilmesi için iç ortam parametreleri - Bina içi hava kalitesi, ısıl ortam, , aydınlatma ve akustik", Ref. No. EN 15251:2007: E.

Tatlı, B. (2008). Esneklik Ve Değişebilirliğin Çelik İskeletli Çok Katlı Konut Yapılarında İrdelenmesi, Dokuz Eylül Üniversitesi, Fen Bilimleri Enstitüsü, İzmir.

Uzel N. (2001). Esnek ve Adapte Olabilir Konutlar İçin Değerlendirme Rehberi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

Yüksek, İ. Esin, T. (2011). Yapılarda Enerji Etkinliği Bağlamında Doğal Havalandırma Yöntemlerinin Önemi, X. Ulusal Tesisat Mühendisliği Kongresi, 13/16 Nisan, 2011/İzmir

INTERNET REFERENCES

https://www.muntes.net/havalandirma-sistemleri, (Access: 17.03.2022).

http://www.bolu.gov.tr/nufus-yapisi (Access: 17.03.2022).

https://www.science.org/content/article/how-today-s-cholera-pandemic-was-born, (Access: 17.03.2022).

https://seismo.berkeley.edu/blog/2020/01/26/quake-in-turkey-highlights-the-hazard-in-the-east-bay.html (Access: 31.03.2022)