

Article

Identification of Measures to Strengthen Resilience in Homes on the Basis of Lockdown Experience during COVID-19

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Abstract: The COVID-19 pandemic and the need to put populations into lockdown require a reflection on the capacity of homes to adjust to a specific function for which they are not designed: ensuring the health and wellbeing of people during lockdown periods. Thus, the government in the Comunitat Valenciana promoted a study to evaluate house fit in this Spanish region through the Valencia Institute of Building. The information was obtained by directly asking people affected through an online survey. On the basis of a series of indicators proposed in the study, the level of resilience and measures that favour house adaptation to such an extreme situation are analysed. The ultimate purpose is to offer solutions to enhance house behaviour against similar risks. The information obtained will be further useful for regional regulations of house design to be amended, currently under revision.

Keywords: resilience; house; COVID-19; lockdown; survey; refurbishment

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1. Introduction

It is a fact that the outbreak of the new SARS-CoV-2 coronavirus was declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO) on 30 January 2020 [1]. This happened a few days after the first cases of human-to-human coronavirus transmission were reported outside China. It was the sixth time the WHO had declared a PHEIC since the International Health Regulations (IHR) came into force in 2005. According to the aforementioned regulation, a PHEIC is an extraordinary event creating a risk to public health for other states due to the international spread of a disease and may require a coordinated international response [2].

On 24 January 2020, the first patient with the disease was diagnosed in Europe, specifically in France [3]. Just over a month later, and due to alarming levels of the spread of the virus as well as worrying levels of inaction, the WHO defined the infectious disease caused by the new coronavirus (COVID-19) as a pandemic [4]. Based on the aforementioned PHEIC statement, the WHO published the Strategic Preparedness and Response Plan of the international community [5] to help protect states with weak health systems through measures aimed at limiting human-to-human transmission. This plan already considered it crucial that the international community agree on priority areas to apply research and innovation and the most efficient ways to address the emergency.

On 16 April 2020, the WHO published guidance on public health and social measures within the COVID-19 framework, such as “lockdown” or “isolation” measures [6]. However, starting in January, the international community had already begun to react by ap-

plying these strict measurements. On 23 January, China ordered home quarantine for millions of people in Hubei province and the capital Wuhan [7]. This nationwide home quarantine was also forced in Asian countries, such as Iran, Malaysia and Bangladesh, as well as South American countries such as Peru, Venezuela and Ecuador, from mid-March 2020 to early April, while in Africa ordering mobile restrictions took some time [8]. Various containment policies were imposed in the United States, and California was the first state to establish an obligation to remain in lockdown on 19 March 2020 [9].

In Europe, the first country to order compulsory nationwide lockdown (Stay Home Order) was Italy, on 10 March 2020, followed by Greece and Spain. Other European states quickly implemented this severe measure during the second half of March, such as Austria, France, Luxembourg, Belgium and the United Kingdom. The first mandatory lockdown orders were extended until the second half of April or the first half of May. Thus, the countries in which people had to stay 50 days or more at home were Italy, France, Hungary, Ireland, and Spain [10,11].

In Spain, an alert state was declared on 14 March 2020, for managing the health crisis caused by COVID-19 [12]. Mobility on public roads or spaces was restricted to essential activities only. With successive extensions of this measure, the total lockdown time lasted 56 days until a de-escalation process began on 10 May 2020. Throughout this process, instructions issued by health authorities on people's mobility had to be complied with [13].

It is well established that this long and harsh period has had various effects on people's health. Mental health may have been seriously affected across Europe and the United States, especially with regard to feelings of loneliness, concern, sadness and boredom [14]. Negative psychological effects include symptoms such as post-traumatic stress disorder, confusion and anger [15]. The health of children of school or preschool age has also been impaired by social isolation. Socioemotional complications and insufficient physical activity have been highlighted as two of the main concerns [16]. Furthermore, a high percentage of adverse outcomes related to COVID-19 have been seen in elderly people with dementia staying at home in Italy [17]. Another consequence derived from the obligation to be locked down, as studied through a questionnaire in Spain, is sleep disorder. It has been found that the population in Spain experienced poor sleeping quality during this harsh experience. Some factors involved in this are: being female, having shift work, having had COVID-19 or having someone infected nearby, being unemployed or affected by a Record of Temporary Employment Regulation (RTER) and spending many hours in bed [18]. It is also noted that people with previous pathologies experienced aggravation and needed more care during home quarantine. This is the case for people with autism spectrum disorder [19], severe and complex obesity [20] and, in general, people with chronic diseases. All these people have faced a lack of exercise, routine checkups and daily medical care [21].

Before the COVID-19 pandemic, people would spend an average time of around 90% indoors [22] and 60% at home [23]. With the current restrictions, this percentage has reached 100%, so it is clear that the design of residential buildings plays a vital role in such an extreme situation. During the lockdown period, homes' occupants needed to change the use of their homes; that is, they "reinhabited" their own houses. The mere fact of relocating furniture in homes is a way to test their ability to change [24].

On the basis of an extensive study among students at a university institute in Milan during the lockdown period, it was concluded that poor quality of housing is strongly and directly linked to the risk of suffering from depressive symptoms. In particular, parameters such as the small size of houses and flats (<60 m²) and not having pleasant views are highlighted [25]. Regarding the latter feature, biophilia should be mentioned, that is, the need for people to be permanently attached to nature. According to Wilson, the human need for nature is not only linked to environmental exploitation but also to the influence of nature on emotional, aesthetic, cognitive and even spiritual growth [26]. Despite this need, cities and human settlements have turned into more and more artificial or built environments over the years. The loss of contact with nature that this involves has serious

consequences for health and wellbeing. Therefore, this contact should be encouraged to occur in the home itself, where, under normal circumstances, people spend more than half of their time [23]. Additionally, outdoor spaces favour relationships among neighbours, with safe distance between persons, and encourage physical exercise. Both aspects are necessary to preserve people's physical and mental health. With these spaces, socioemotional complications and insufficient physical activity could be avoided, aforementioned as two of the main concerns during this harsh period.

Moreover, according to a survey conducted by the Centre for Sociological Research (CIS), Ministry of the Presidency of the Spanish Government, during home quarantine there were changes in activities done at home. Most participants did activities more frequently, such as taking care of the family, supervising children's homework, contacting parents by phone and connecting with relatives or friends by video call [27]. Another opinion poll implemented during the compulsory lockdown in Spain, "A Mixed Approach on Resilience of Spanish Dwellings and Households during COVID-19 Lockdown" [28], based on a questionnaire and photographs and texts sent by participants, showed different results. The most frequent activity was working remotely, but the economic situation of respondents was ignored. In addition, less than 50% needed home spatial reorganization, but almost 50% would have opted for providing outdoor areas if possible. An assessment of the amplitude of space emerged from the analysis of photographs [28]. The increase in the time that people spent locked down has also influenced energy consumption in residential buildings. The importance of energy renovation in buildings is revealed because of these extreme circumstances [29].

Within this context, there has been an increase in the demand for moving homes, and even building certification systems have been put to the test.

According to the survey "Living in lockdown" conducted after home quarantine within the metropolitan area of Barcelona (a survey which studies the demand for moving homes and the main causes of it), more than a third of those surveyed were searching for housing, or they would have done so if they had been able to afford it. The lockdown effect has increased demand by around 18% [30].

A study on BREEAM, CASBEE, LEED and WELL certifications shows how they ensure better sustainability for residential buildings during and after pandemics. However, none of these standards could be regarded as "fully prepared for pandemics". Only WELL certification, focused on social comfort, responds better to people's health and safety [31].

In addition, concerning disease spread, there are influencing environmental factors. Some studies show that temperature and humidity seem to have a negative correlation with the number of COVID-19 cases, while others support the absence of this correlation or the fact that it is positive [32]. The airborne transmission of SARS-CoV-2 was initially thought to be unlikely, but growing evidence has highlighted that infectious droplets are small enough to remain in the air. There have been cases of transmission among people separated by a 2-m distance in indoor settings with poor ventilation [33]. The classic Wells–Riley model [34] is used to quantitatively assess the risk of airborne infections, since it relates risk of infection indoors with the number of people infected, amount of virus produced by an individual infected, duration of exposure and ventilation rate in a room. Therefore, ventilation and occupancy rates can play a vital role in reducing infection risks [35]. On the basis of a study on school buildings, it was found that the way of planning people's mobility indoors can be decisive in reducing infection risks. It was based on the assumption that a small exposure to a large number of people is similar to a large exposure to a few. Therefore, it was found necessary to minimize the time to go through a corridor from one class to another, and narrow corridors should be considered for one-directional passage, while wide corridors should be used for two-directional passage only [36]. Moreover, poor-quality housing led to a higher transmission of COVID-19, due to overcrowding, poor maintenance, discontinuous energy and water supply and unhealthy environments, among other elements. The pandemic has highlighted the most vulnerable resi-

dential conditions, even for people without access to adequate housing [37,38]. In Australia, the strict lockdown in a residential block due to an outbreak of infection revealed that residents in social housing often face a lack of inclusion in society [39]. In response to this, it should be noted that if an individual infected must go into home quarantine, the WHO recommends having a separate room with adequate ventilation and a separate bathroom [40].

There is scientific evidence showing that pandemics are becoming more prevalent, driven by a constant increase in underlying emerging diseases caused by animal microbes. These spread due to contact with wildlife, livestock and humans. Thus, the risk of pandemics is increasing rapidly, with more than five new diseases per year, any of them at the risk for spreading and becoming a new pandemic [41]. According to the WHO, there is an urgent need for sustainable preparedness for health emergencies to face the next pandemic [42].

For all the above, it is crucial to reconsider design and operation in residential buildings with a new perspective so as to provide greater resilience, which is seen as the sustained capacity of a community to resist and recover from adversity [43].

It should be added that the need to obtain a greater resilience and liveability in homes does not arise only from the pandemic situation, although it is clear that architectural obsolescence has become much more evident [24]. In Spain, there is a largely aged housing stock that requires renovation. In total, 55% of housing in Spain predates 1980, and more than one million homes are located in substandard buildings [44]. In the real estate and construction sector, the Law 8/2013 of June 26 [45] is committed to a model based on sustainable and inclusive development from environmental, social and economic perspectives. This requires that all efforts be concentrated on actions for urban renovation and regeneration. However, as Moya [46] states, one cannot lose sight of the fact that any intervention in an existing built-up area must give first priority to the improvement of its conditions and the permanence of inhabitants, since they are inseparable issues. Furthermore, it is difficult to achieve this goal without the participation of all the people involved, and users are a key factor.

Finally, although it exceeds the study addressed in this article, it should be mentioned that in consolidated cities, the renovation of residential compounds must include interventions at the level of the urban dimension as an opportunity to improve the quality of life and sustainability. A number of aspects concerning the liveability of homes, such as acoustics, thermal and light comfort, air quality, accessibility, views or bioclimatic suitability, are closely related to the urban environment itself. Likewise, proper waste management, the recovery of the natural water cycle, the promotion of renewable energies, the improvement of management of uses and the renaturalisation of spaces, as well as good connectivity and efficient mobility in urban areas, are key factors for sustainability. Various studies propose tools for urban space renovation. Regarding the obsolescence of the Spanish housing estates built during the 1960s and 1970s, it is worth highlighting the methodology developed by García-Pérez et al. with physical variables to detect urban quality [47]. In turn, the Special Plan for the improvement of the environmental quality of Moratalaz, in Madrid, is based on a new methodology of analysis, diagnosis and proposals for sustainable renovation of public spaces [48]. Over and above the aforementioned aspects, some others, such as mixed-use planning, proximity and space fairness to foster people's opportunities, as well as a proper good design and well-defined public spaces, are a challenge for urban regeneration.

Purpose of the Article

This article aims at presenting the results of a survey on the ability of houses in the Comunitat Valenciana to adapt to the needs of inhabitants in adverse circumstances, such as those that occurred during the COVID-19 pandemic and subsequent home quarantine. On the basis of the approach of a series of indicators, an assessment was obtained regarding the level of resilience offered by housing for people living in this Spanish region. The

results are very useful to provide solutions and improve houses' behaviour against similar risks.

2. Methodology

To collect information, an online survey was conducted among residents in the Comunitat Valenciana aged over 18, between 9 April and 26 April 2020, the year of the mandatory lockdown period. It was a random sample, with a total number of 2367 respondents, after filtering and refining results. Twenty-five questions were made aimed at characterising houses and identifying resilience against lockdown in terms of both habitat and occupants. A survey model was designed for an expected duration of 10 min.

2.1. Social and Housing Characterisation during Confinement

2.1.1. Sociodemographic Data

- Place of residence.
- Age and gender.
- Marital status.

2.1.2. Model of Coexistence

- Composition of cohabitation unit (CU).
- Working status.
- Economic situation.

2.1.3. Characteristics of Houses

- Tenure status of households.
- Useful area.
- Year of construction.
- Floor where house is located.
- Number of bedrooms.
- Number of bathrooms.

2.1.4. Impact of COVID-19

- Concern about COVID-19.
- Lockdown level.
- COVID-19 cases.

2.2. Questions Raised to Obtain Information on Resilience

2.2.1. Habitat Resilience

- Possibility of applying precautionary measures in houses.
- Adaptation of space.
- Size of municipality.
- Age of houses.

2.2.2. Resilience of Social Fabric

- Surface available per person.
- Impact of lockdown.
- Behaviour change.
- Performance of housework.
- Satisfaction with environment.
- Influence of age.
- Economic and employment vulnerability.

2.2.3. Innovation, Changes and Enhancements

- Missing features.
- Significant features.
- Influence of the most valued characteristics in houses.
- House shortcomings.
- Influence of shortcomings in houses.
- Requested enhancements in houses.
- Demand for refurbishment according to tenure.
- Demand for refurbishment according to economic situation.
- Demand for refurbishment according to work situation.

3. Results

Based on an analysis of the data collected, this section details results obtained regarding house characterisation and its occupants (Sections 3.1–3.4), as well as resilience (Sections 3.5–3.7). Likewise, at the end of this section, more information is provided on the conditions under which the survey was conducted and a summary of the sample and results obtained (Section 3.8).

3.1. Sociodemographic Data

3.1.1. Place of Residence

The population that took part in the survey lives mainly in the metropolitan areas of Castellón, Valencia and Alicante. Other municipalities with a high level of participation were Benicarló, Sagunt, Xàtiva, Gandía, Alcoi and Elx. A decrease in participation within the Comunitat Valenciana was significant, especially in the northwest area of Castellón.

In different provinces, the number of responses was distributed in descending order as follows: 76% (1805) were obtained in the province of Valencia. Second, 15% (343) were obtained in the province of Alicante and, finally, 9% (219) in Castellón. In relation to the total population, Valencia had 0.7% of responses per 1000 inhabitants, Castellón 0.4% and Alicante 0.2% (Figure 1).

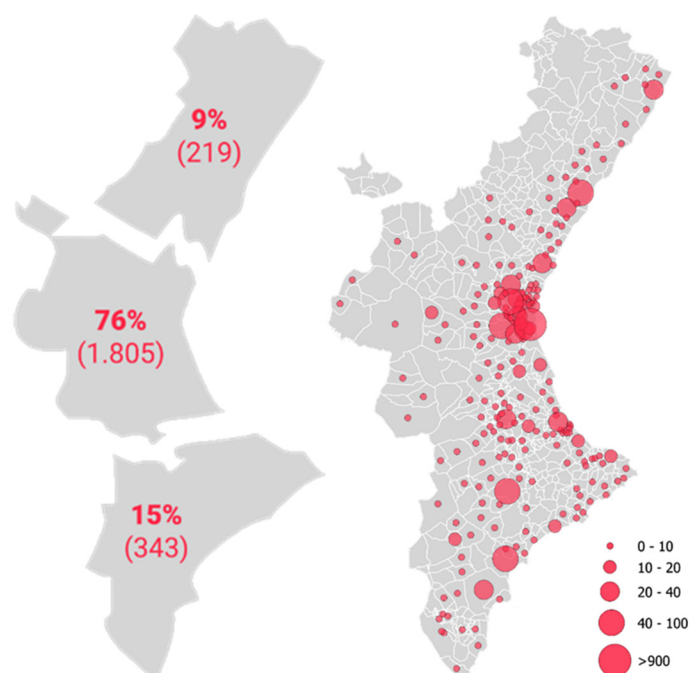


Figure 1. Population surveyed according to province and municipality.

3.1.2. Age and Gender

Most of the respondents were female aged between 35 and 49. This type of person was followed by females aged between 18 and 34, which together made up more than 45% of the total sample. Overall, a greater representation of females and a marginal representation of the population over 65 was meaningful. Both parameters are not representative of the sociodemographic reality in the Comunitat Valenciana (Figure 2).

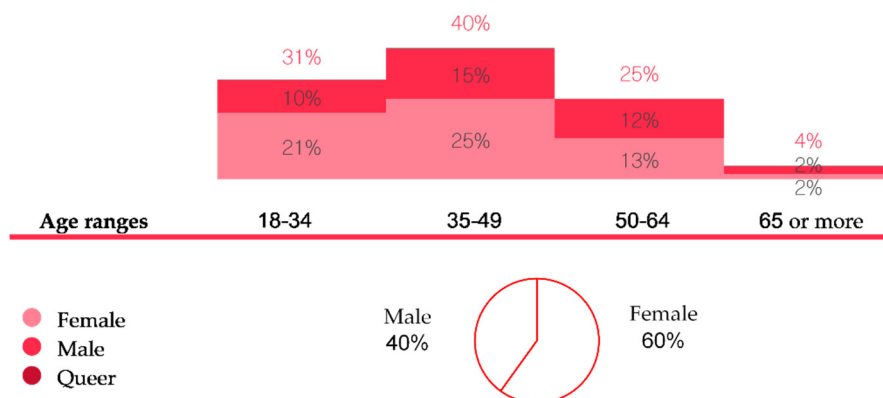


Figure 2. Percentage of population surveyed according to age and gender ranges.

3.1.3. Marital Status

More than half of the respondents (62%) were married or living with a partner, as indicated in the 2011 Census of the National Statistical Institute (INE) (63.1% of houses) [44] (Figure 3).

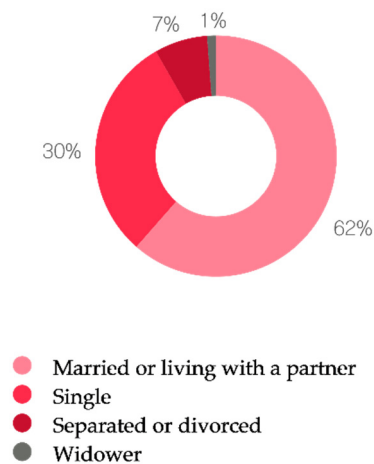


Figure 3. Percentage of surveyed population according to marital status.

3.2. Model of Coexistence

3.2.1. Composition of the Cohabitation Unit (CU)

A CU is a group of people living together in a house, intended to be permanent. In this case, the CU was considered strictly for the lockdown period.

According to the sample (Figure 4), 92% of CUs were made up of people who shared space with others while locked down. A total of 83% consisted of groups of 2, 3 or 4 members.

Almost 50% of CUs (44%) had one or more minors, and 33% admitted being a person at high risk of failing seriously ill with COVID-19 or living with someone in this category (pregnant women, people with diabetes, people with heart diseases, people with heart

and/or lung diseases or immunosuppressed people). Finally, only 1% of people surveyed presented functional diversity or lived with someone with functional disability.

The most common type of CU had 2–4 members without minors, individuals at risk or individuals with functional diversity.

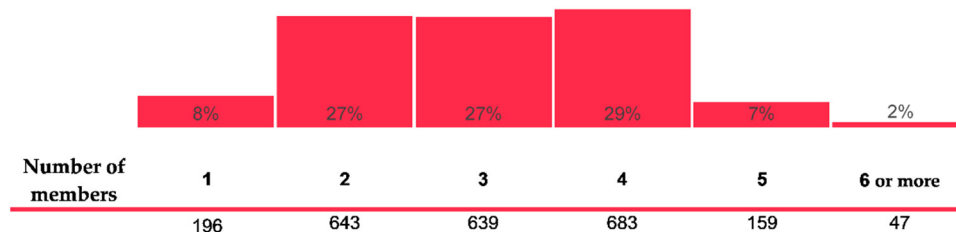


Figure 4. Number of CUs according to total number of members.

3.2.2. Working Status

This section analyses the working status of respondents during home quarantine. Among the possibilities indicated, there were some compatible, so several possible options were identified (Figure 5).

The most frequent type of person found was employed (23.6%) or self-employed (22.3%), regardless of the level of impact that the recession caused by COVID-19 had on their activity.

The percentage of people working remotely exceeded 25% (5.5% part time or 20.3% full time). Before the crisis, according to a Labour Force Survey by the National Statistical Institute (INE), only 4% of the labour force worked remotely for more than half of the work schedule.

People affected by RTER accounted for 6.7% of those surveyed, and 1.6% had retrievable paid leave.

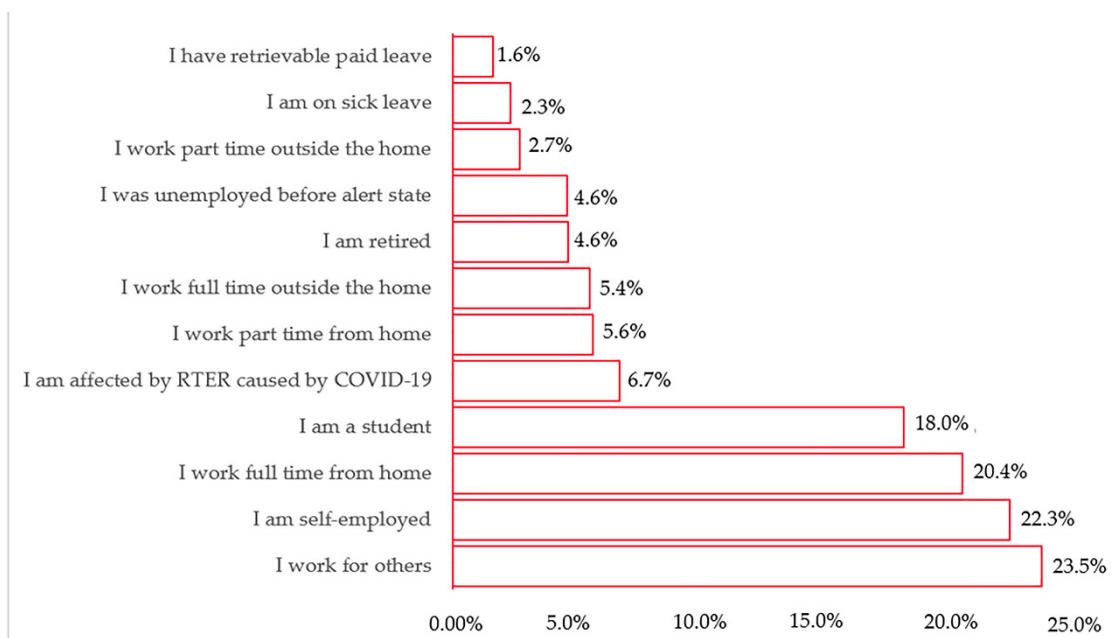


Figure 5. Occupation of people surveyed during lockdown period.

3.2.3. Economic Situation

A recession derived from health conditions affected 55% of participants. In 44% of cases, the level of impact was low. A total of 10% admitted being strongly affected, to the

point of finding it difficult or impossible to make ends meet. Only in 1% of cases did the economic situation improve during the lockdown period (Figure 6).

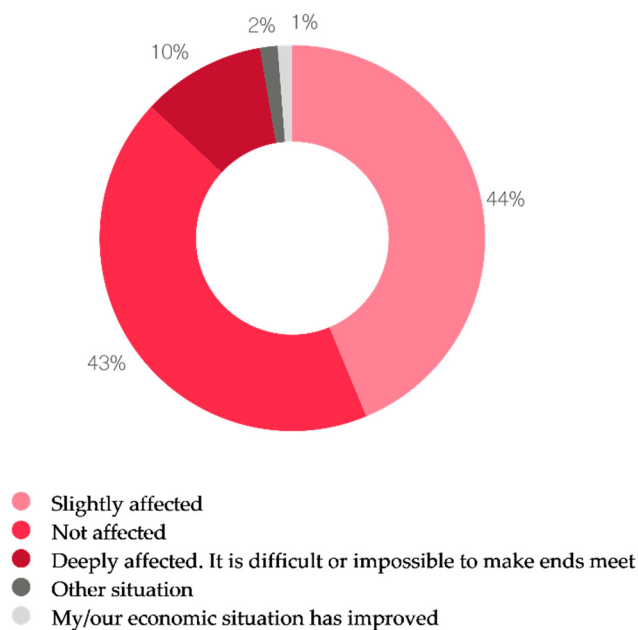


Figure 6. Level of impact of health crisis on economic situation.

3.3. Characteristics of Houses

3.3.1. House Tenure Status

Broadly speaking, the vast majority of participants, 91%, lived in their habitual residence while in lockdown.

More than 70% spent that period in a house of their own, while the INE's Living Conditions Survey for 2017 [49] and the Study on Housing Needs and Demand of the Generalitat Valenciana, 2017–2020 (ENDV.CV 2017–2020) [50] position house tenure status around 75%. Out of owned houses, there were only 25 publicly owned houses, either owned by the Generalitat Valenciana or another public entity, representing just over 1% (Figure 7).

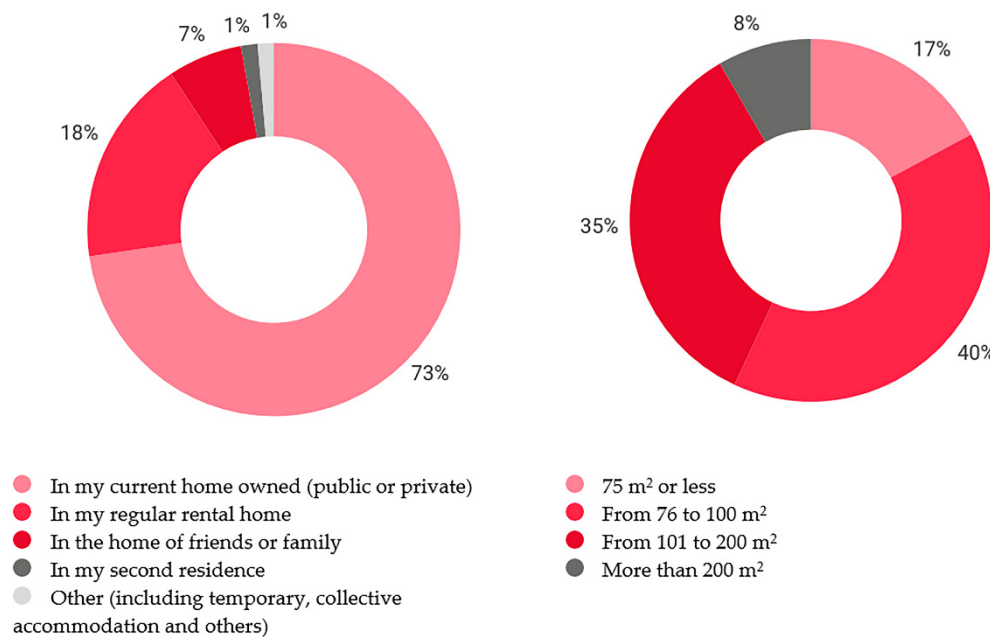


Figure 7. Percentage of households surveyed according to tenure model and useful area.

The percentage of CUs on a rental basis was just 18% of people surveyed, in line with the ENDV.CV 2017–2020.

3.3.2. Useful Area

In total, 57% of participants spent the quarantine period in houses and flats with less than 100 m² net space. In most cases, 83%, this exceeded 75 m² net space.

3.3.3. Year of Construction

Most respondents, 73%, spent the lockdown period in houses or flats less than 40 years old (Figure 8). This means that they were built in accordance with the Thermal Conditions in Buildings standard (NBE-CT-79) [51], which guarantees the minimum level of thermal insulation in openings, something that was nonexistent before this regulation.

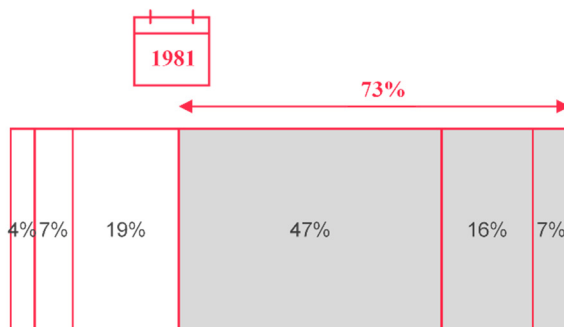


Figure 8. Percentage of households surveyed according to year of construction.

3.3.4. Floor Where Houses Are Located

Approximately 50% of houses, 49%, were located on the second or lower floor. Only 16% were on the sixth floor or higher.

A total of 8% did not have an elevator, and most of them, 5% of the total, were on the second floor or lower (Figure 9).

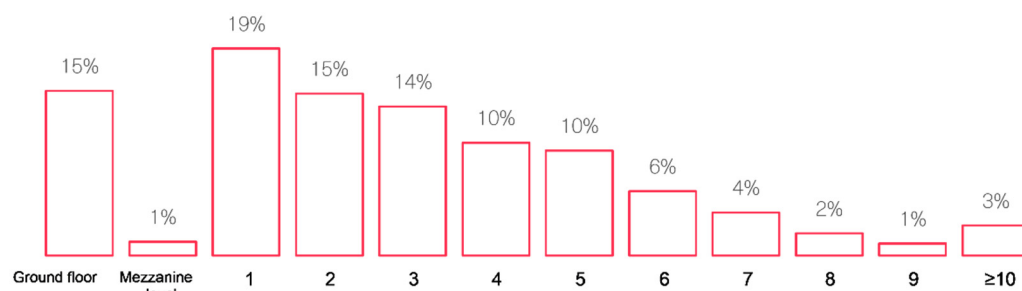


Figure 9. Percentage of households surveyed according to the floor where houses are located.

3.3.5. Number of Bedrooms

In total, 50% of the houses and flats in which respondents spent the home quarantine had three bedrooms, and 28% had more than three (Figure 10).

3.3.6. Number of Bathrooms

The vast majority of houses, 78%, had two or more bathrooms and/or toilets. In lockdown conditions, this could greatly ease living with an individual infected or suspected of being infected.

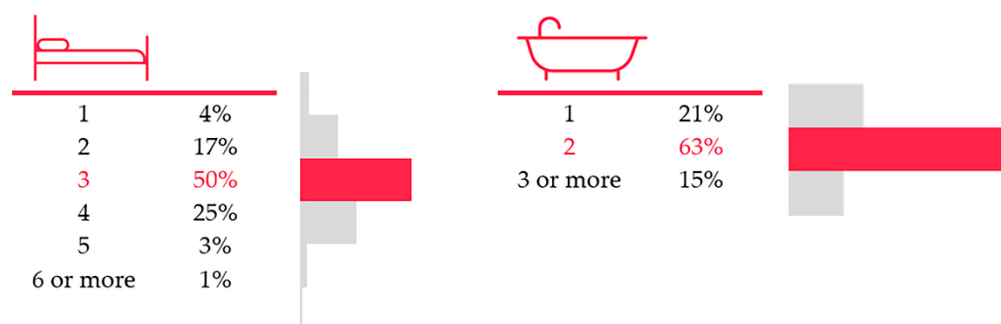


Figure 10. Number of bedrooms and bathrooms.

3.4. Impact of COVID-19

3.4.1. Concern about COVID-19

At the time the survey was conducted (the fourth, fifth and sixth weeks since the alert state was decreed), only 3% of participants were little or not at all concerned about the health crisis. A total of 82% were very or quite concerned (Figure 11).

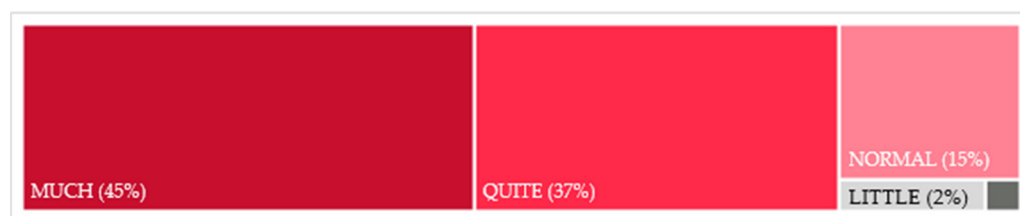


Figure 11. Concern about COVID-19.

3.4.2. Lockdown Level

Only 13% of CUs had a strict lockdown, that is, no member of the CU left the house. The vast majority, 86%, had a home quarantine with different levels of severity. Among them, the general trend in 67% of cases was a harsh period with limited outings to do grocery shopping.

People who were not locked down were hardly represented (Figure 12).

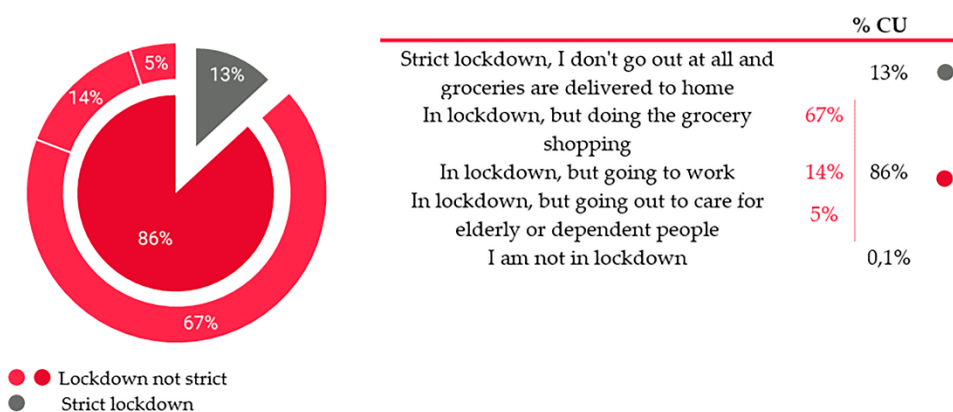


Figure 12. Lockdown level and outings, if any.

3.4.3. COVID-19 Cases

In almost all the cases, 90%, there was no COVID-19 infection in the CUs. Beginning with the remaining number, only 1% confirmed that they, indeed, had an infection case (Figure 13).

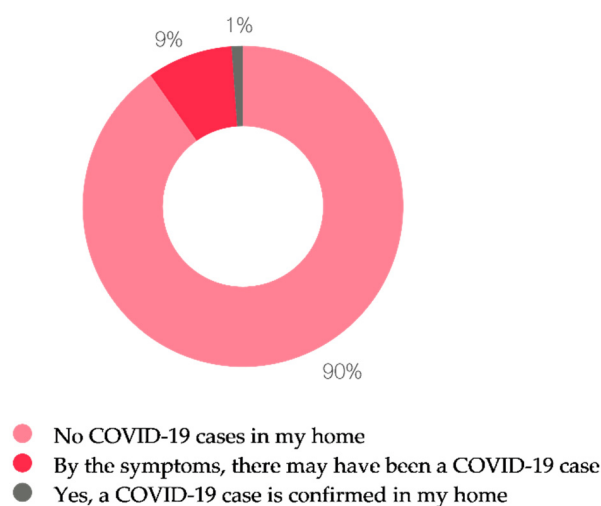


Figure 13. COVID-19 cases detected in CUs.

3.5. Habitat Resilience

On the basis of information obtained about habitat resilience, the following results should be highlighted.

In the absolute sense, the house resources available to people surveyed eased the application of precautionary measures in the event that someone in the CU became infected, as well as their ability to adapt to the new situation caused by the lockdown. Therefore, concerning habitat resilience, it is clear that houses provided sufficient conditions to face lockdown demands.

However, the behaviour of houses and flats was uneven. Certain factors significantly affected people’s satisfaction levels. For example, the age of houses themselves, especially with regard to compliance with the Basic Building Regulation on Thermal Conditions in buildings (NBE-CT-79), had a partial influence. However, indisputably, the available surface per person was the most representative factor of this unequal behaviour of houses when it came to people’s satisfaction.

The following subsections develop in detail different aspects considered in habitat resilience.

3.5.1. Possibility of Applying Precautionary Measures in Houses

In general, houses and flats would have responded adequately to apply precautionary measures in the event that someone in the CU had become infected (Figure 14). Without making any changes, houses had an isolated and ventilated room (51%), had a bathroom for exclusive use of individuals infected (57%) and could ensure a minimum 2-m distance between persons (53%).

By making some changes, more than 75% of houses could meet these demands. In fact, in just over 10%, it would have been impossible to guarantee such measures, with the exception of having a bathroom for exclusive use of persons infected, which was impossible in 25% of the total.

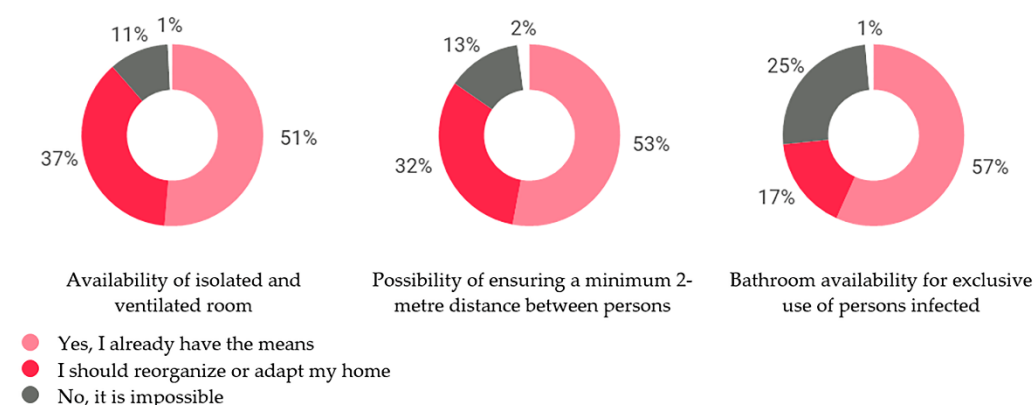


Figure 14. Possibility of applying precautionary measures in houses.

3.5.2. Adaptation of Space

Among participants, there were as many people who adapted spaces during lockdown period as those who did not (Figure 15). People who adapted spaces comprised 50%, and most of them, 42%, did so to be able to do new activities.

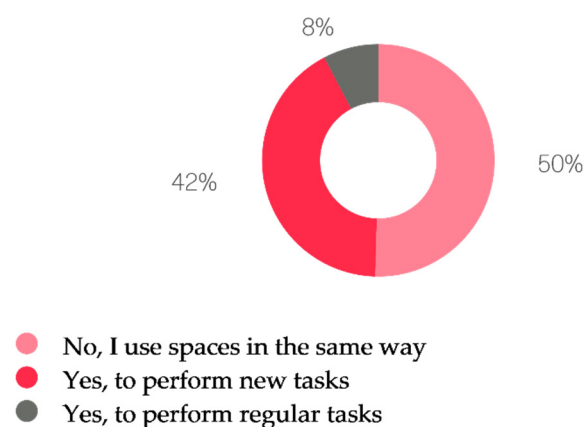


Figure 15. Adaptation of space during lockdown period.

3.5.3. Size of Municipality

No significant change was detected regarding the level of satisfaction with houses among people locked down within municipalities with over or less than 10,000 inhabitants. In both cases, the percentage of people who did not change their level of satisfaction with houses with respect to the situation of previous normality (68%) was similar (Figure 16). In the event that it had changed, the variation was minor. Therefore, the fact of living in an urban or rural environment was not significant.

3.5.4. Age of houses

The age of houses and flats had a slightly higher level of incidence rate, using the NBE-CT-79 standard as a reference. In houses built before the validity of this regulation, people’s satisfaction during home quarantine decreased 5% more than those in houses built according to the NBE-CT-79 standard.

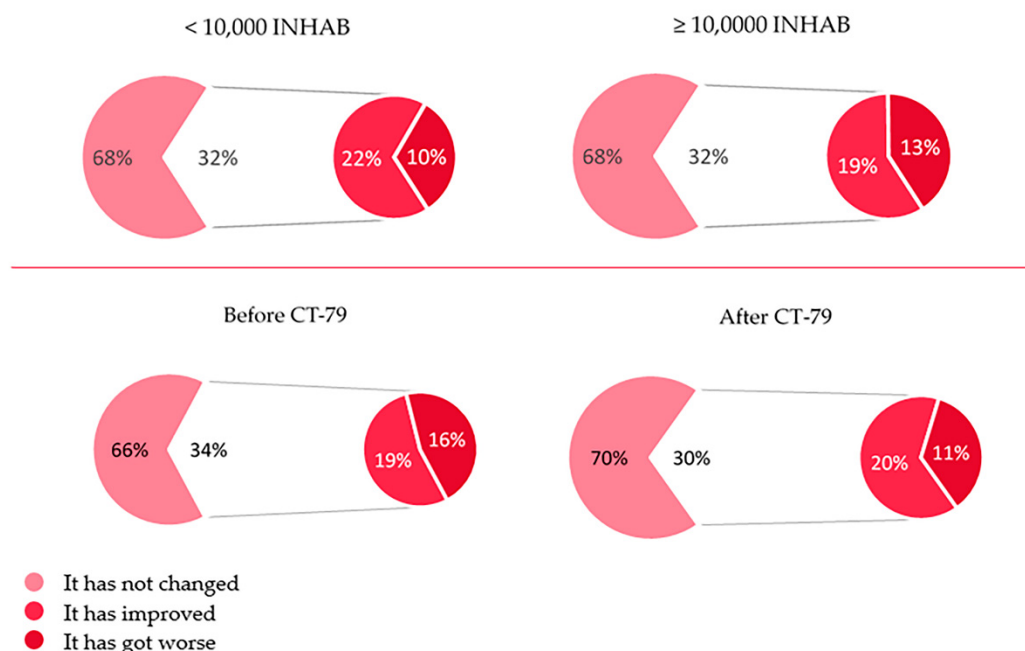


Figure 16. Relationship between level of satisfaction with houses, size of municipality and year of construction or renovation (before or after 1980).

3.5.5. Size of Houses

The size of houses and flats proved to be one of the most meaningful factors when it came to level of satisfaction (Figure 17). The larger the surface area, the lower the level of unsatisfied people was. Only 3% of people who were locked down in houses ≥ 200 m² net space had a lower level of satisfaction, compared to 62% of those in houses < 40 m² net space.

However, houses < 40 m² net space can be deemed as an extreme case. In this regard, there was a great difference between level of satisfaction with them and those with 41 to 75 m² net space. In the latter, the level of satisfaction decreased 23%.

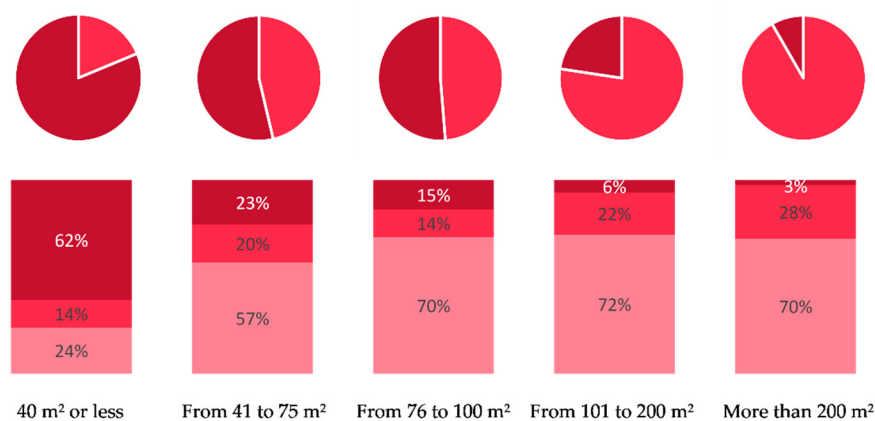


Figure 17. Relationship between level of satisfaction with houses and useful area.

3.5.6. Available Area per Person

Available area per person was also a reliable indicator of satisfaction with houses during the lockdown period (Figure 18).

A progressive fall in the level of satisfaction was revealed as available area per person was reduced. Among extreme cases, the level of satisfaction decreased 12% more in houses with $< 15 \text{ m}^2$ per person, compared to those with $\geq 50 \text{ m}^2$. This considerable variation occurred gradually in intermediate cases.

By contrast, since the available area per person was reduced, the percentage of people who improved their level of satisfaction decreased notably by almost 50%.

This gradation, although slowed down, was expressed among those people who did not change their level of satisfaction during this period.

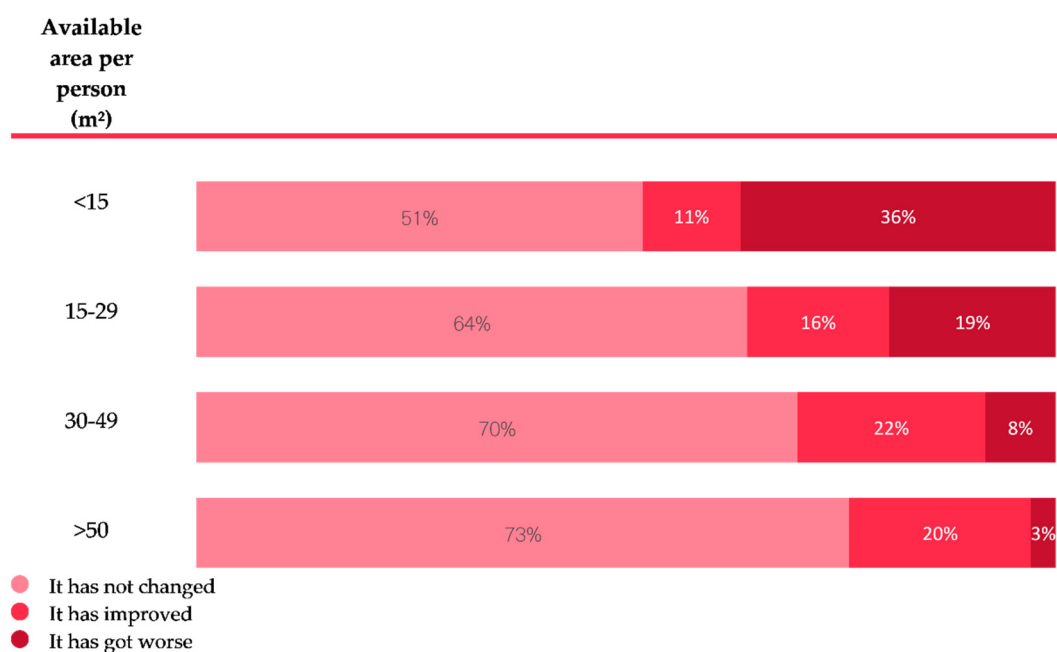


Figure 18. Relationship between level of satisfaction with houses and available area per person.

3.6. Resilience of Social Fabric

On the basis of the information obtained about resilience of social fabric, the following results should be stressed.

In an absolute sense, people surveyed were overwhelmingly satisfied with the houses and environment. They could assume significant changes in the intense use of living spaces, as well as modifications in housework, without this fact significantly influencing their satisfaction. Additionally, all this was done in the context of great concern about COVID-19 and its consequences, in a situation of strict lockdown. It can be stated, therefore, that the social fabric in the Comunitat Valenciana has a considerable resilient behaviour.

As a matter of fact, factors such as economic or work situations barely had an impact. However, this is not the case regarding the age of respondents. In general, in the case of younger people, the level of satisfaction became extreme, both in the case of rising or decreasing.

The different aspects seen in the resilience of the social fabric are developed in detail in the following subsections.

3.6.1. Impact of Lockdown

From the list of symptoms and disorders identified with home quarantine itself, the most frequent were sleep disorders, anxiety or restlessness; lack of motivation; sadness or

apathy; and a rise in the consumption of food, alcohol, tobacco, etc. In all cases, the incidence was over 10%.

The least frequent symptoms and disorders, below 5%, were: fatigue, carelessness in personal hygiene and care, obsessive or compulsive behaviours, and lack of appetite or upset stomach (Figure 19).

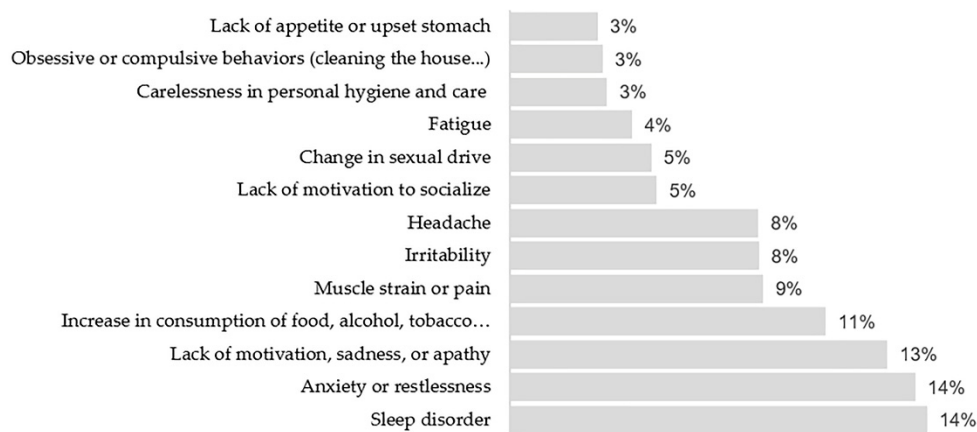


Figure 19. Symptoms and disorders identified with lockdown.

3.6.2. Change of Habits

There was a change in household habits as a result of the lockdown, which was expressed, as one would expect, in an intensive use of all rooms in the house, except for bedrooms (Figure 20).

This was revealed substantially for more than 40% of the cases, in a rise in the use of spaces for socialization, such as living rooms, kitchens or dining rooms, and workspaces (the studio), although the latter data was not applicable to elderly people. These were followed, in 35 and 38% of cases, by an increase in time spent in outdoor spaces (balcony, terrace and patio).

A total of 42% of respondents claimed to not have any outdoor space and 27% did not have a balcony.

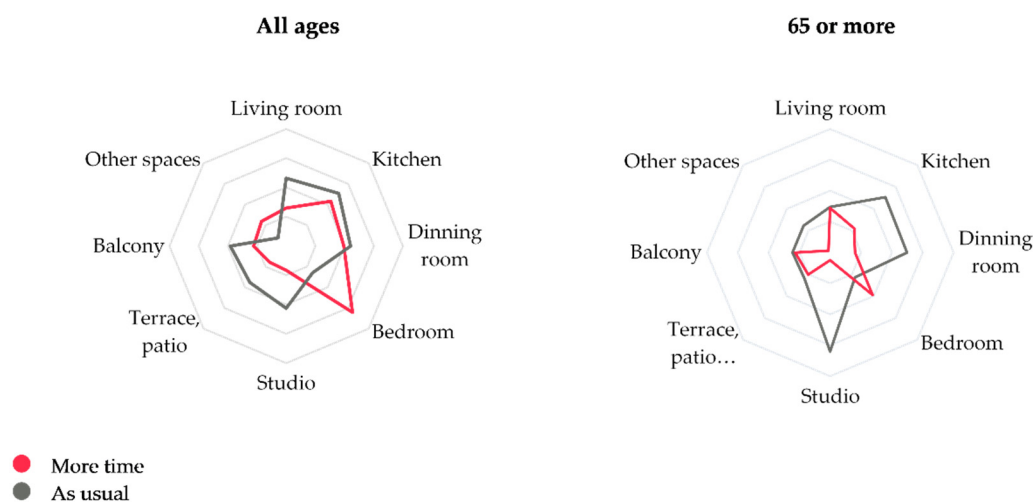


Figure 20. Time spent in rooms, terrace, patio or garden.

3.6.3. Performance of Housework

There was a significant rise in the time spent on housework as a result of home quarantine. This was the case with 62% of people surveyed. Unsurprisingly, only 4% spent less time on housework (Figure 21).

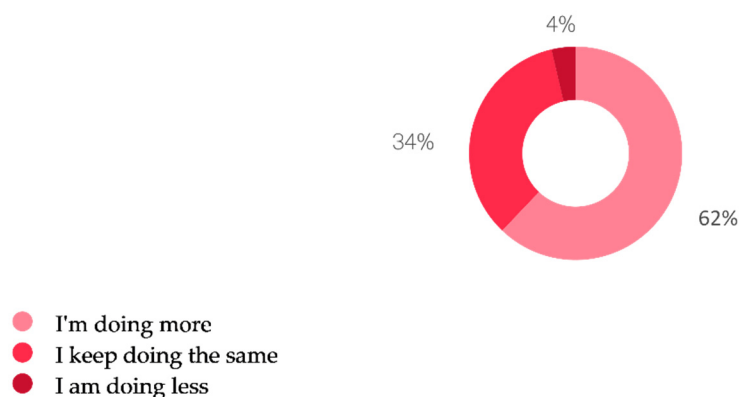


Figure 21. Frequency in performing housework.

In this regard, the gender gap remained. Females assumed more of the burden of household tasks during home quarantine. However, it should also be noted that, out of 86 people who spent less time on housework, three quarters were females (Figure 22).

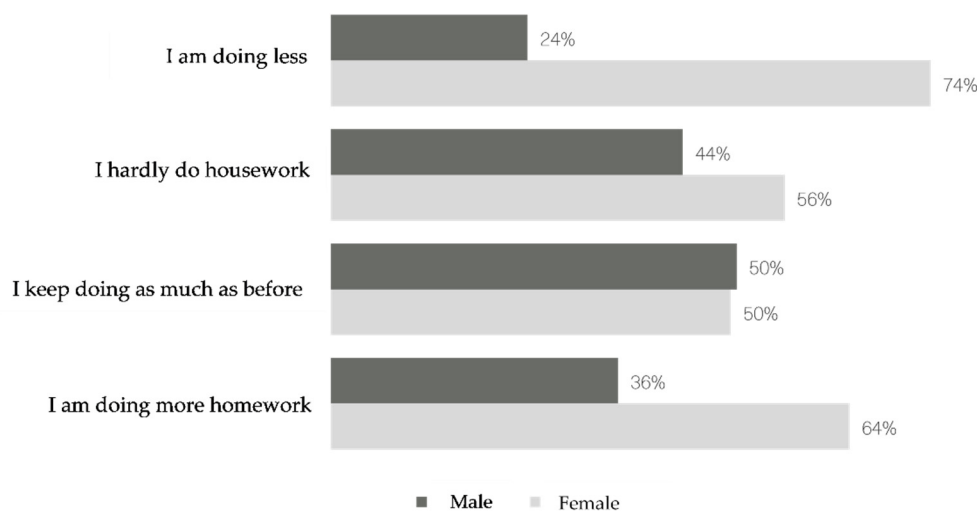


Figure 22. Frequency of housework according to gender.

3.6.4. Satisfaction with Environment

In general, the lockdown did not significantly impact opinion about the environment. With regard to CUs (66%), houses (68%), neighbours in the building (64%) and, especially, neighbourhood (73%), the people surveyed admitted not having changed their mind (Figure 23).

It was significant that more than 20–30% of people admitted improving their opinion about the environment around them as a result of the lockdown. Only 13% expressed a highly unfavourable opinion about their houses.

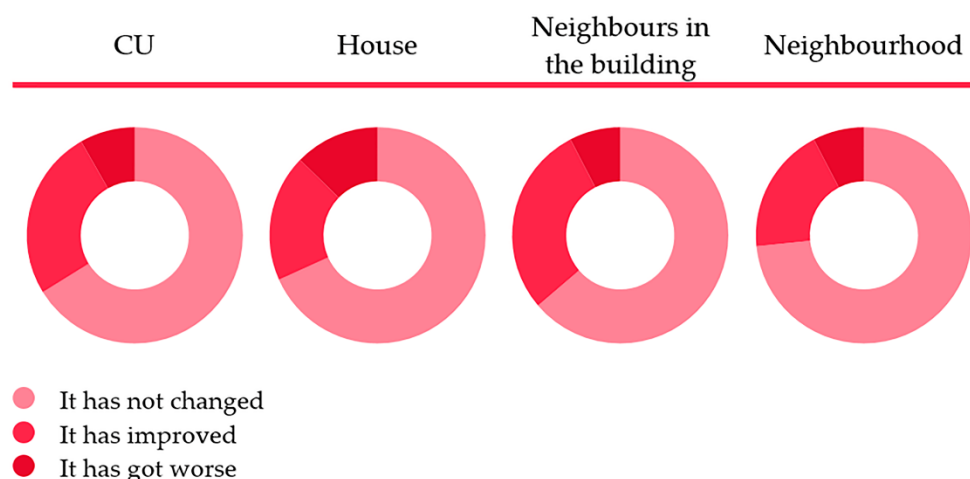


Figure 23. Level of satisfaction with environment.

3.6.5. Influence of Age

The age of respondents certainly affected the level of satisfaction with houses and flats (Figure 24). The younger the person, the more satisfaction differed, both for better and for worse. This variation became very significant. Compared to 88% of people aged 65 or older who did not change their level of satisfaction during the health crisis, in the case of the youngest, aged between 18 and 34, this figure was reduced by 28 points. On the other hand, the variation in the level of satisfaction among young people was almost fivefold more than that of the elderly, regardless of whether this was a change for better (5% to 23%) or for worse (4% to 18%).

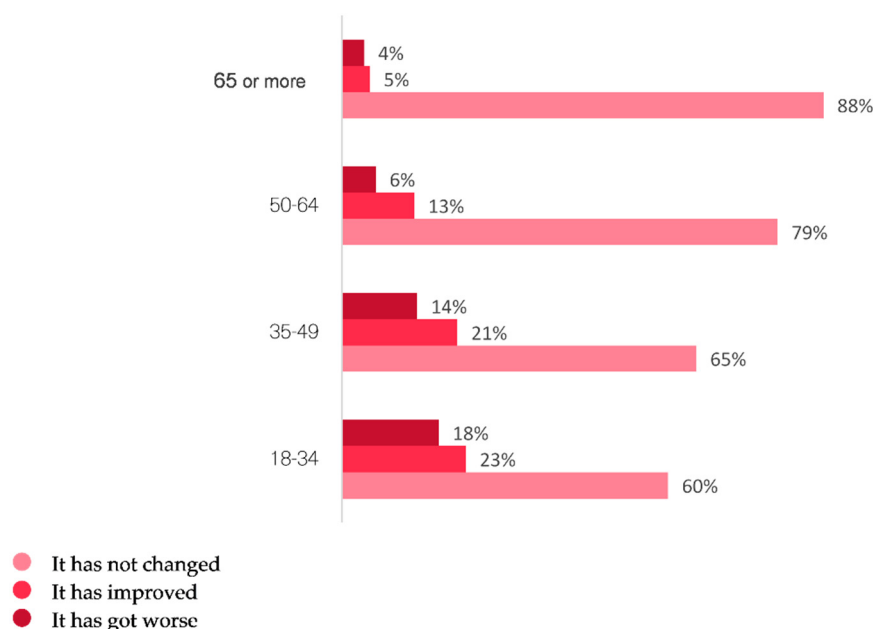


Figure 24. Relationship between level of satisfaction with houses and age of occupants.

3.6.6. Economic and Employment Vulnerability

No direct relationship was detected between economic situation and level of satisfaction with houses (Figure 25). There were hardly any slight variations in satisfaction with houses whether the health crisis had a financial impact or not. This variation moved in ranges from 0 to 6 points.

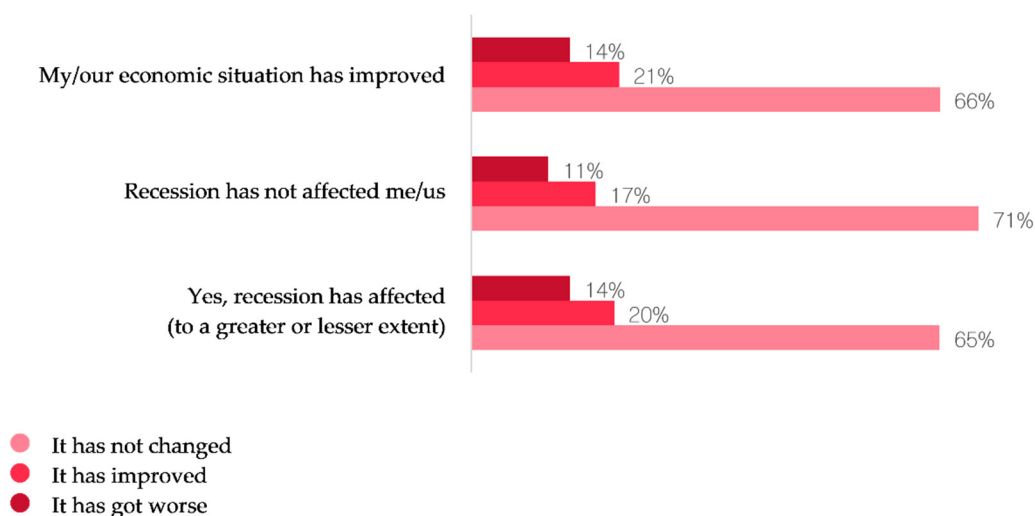


Figure 25. Relationship between level of satisfaction with houses and economic situation.

In terms of the work situation, more significant variations were noted (Figure 26). Most people working from home did not change their level of satisfaction with houses, while those affected by an RTER had polarized views. Variation ranges were between 1 and 12 points.

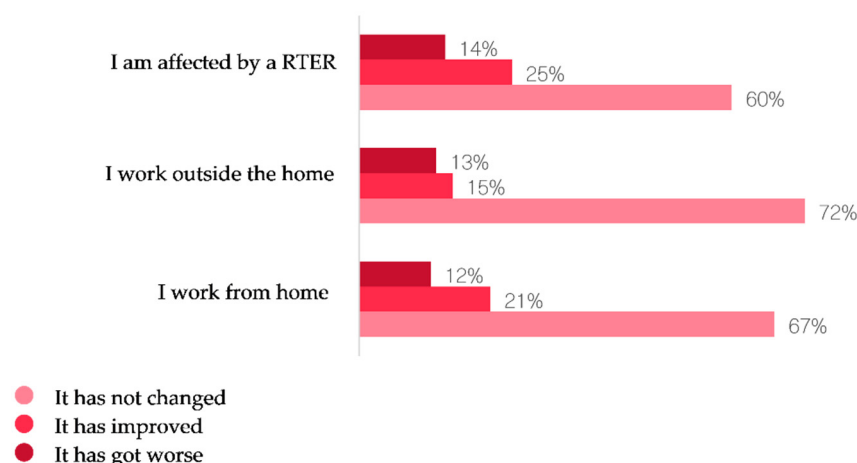


Figure 26. Relationship between level of satisfaction with houses and work situation.

3.7. Refurbishment: Changes and Enhancement

Based on information obtained about refurbishment in houses, the following results should be highlighted.

In line with the high habitat resilience indicated in Section 3.5, in general, people surveyed showed little interest in refurbishing or adapting spaces in homes as a result of the lockdown experience. As a matter of fact, practically half of them, 46%, did not consider it.

However, when asked about shortcomings in homes, they clearly lacked some relevant features. For example, almost 75% admitted that the houses were not adapted for people with reduced mobility, but most people rated it as a substantial detail. Having adequate thermal and acoustic insulation was one of the most relevant factors. Additionally, this was also the most common shortcoming: a third of houses had thermal or acoustic insulation problems, and almost 50% of those surveyed admitted not having any insulation.

Therefore, in general, a low demand for house refurbishment was combined with the identification of aspects to improve. In this regard, it should be noted that the response to

a demand for refurbishment was uneven among respondents. Such inequality was strongly conditioned by tenure status (owned or rented) or the work situation of participants.

Different aspects concerning refurbishment are described in detail in the following subsections.

3.7.1. Important Features

In general, the most important features in homes as a result of the lockdown were those related to comfort and Internet connectivity. In the first case, good thermal and acoustic insulation (89%), outdoor spaces (92%) and good orientation (93%) featured most prominently. In the second case, 92% of people surveyed regarded it essential to have an Internet connection. In this sense, according to the countrywide survey conducted by the CIS [27], 81% of respondents stated to have contacted family or friends by video call more often than usual during the lockdown, and 28% worked remotely (Figure 27).

The characteristics considered less relevant were those related to home automation (only 19% found it essential), the possibility of living outside the city (33%) or the fact of living with others (41%).

In relation to home layout, flexibility of spaces (69%) and the possibility of adaptation to several uses were highly valued (having space for working remotely, 77% of people, or independent spaces, 64%).

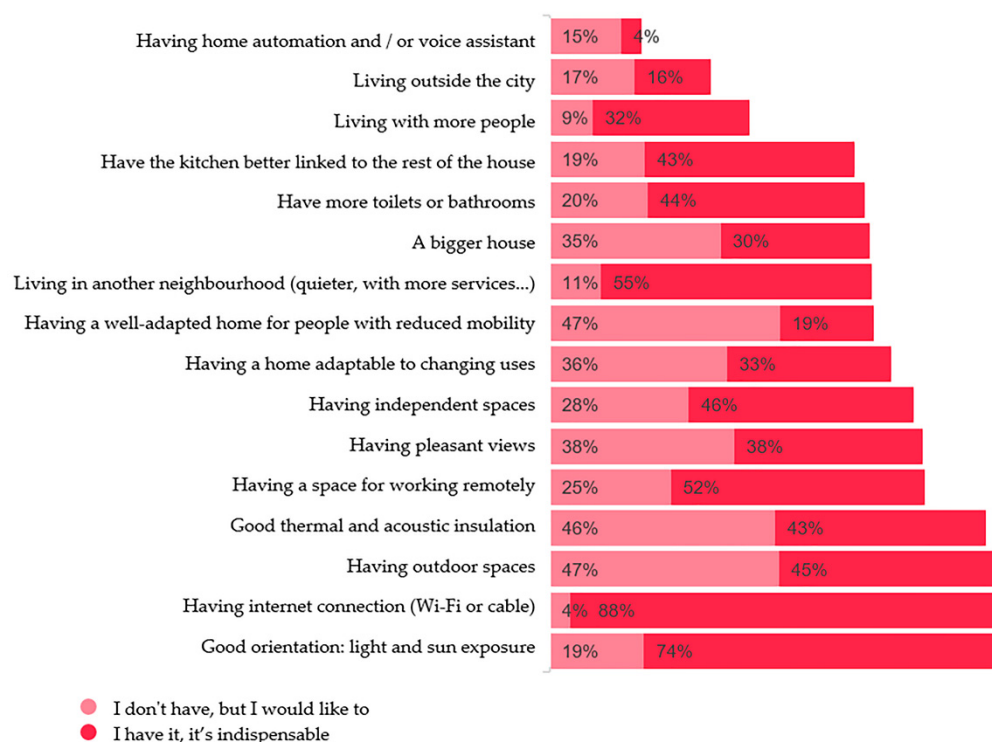


Figure 27. Assessment of features of environment and houses.

3.7.2. Missing Features

In the group of home characteristics highly valued and analysed above, it is appropriate to look at those that did not exist in houses but that people were interested in having (Figure 28). The comparison between both groups of characteristics provided evidence on the potential level of dissatisfaction with specific issues.

It is noteworthy that 72% of participants (1712) admitted their houses not being adapted for people with reduced mobility, but most of them regarded it as a substantial feature (1113, 47%).

In almost 50% of the cases, houses and flats did not have good thermal and acoustic insulation or outdoor spaces, despite the fact that these were considered important.

A total of 87% of houses did not have home automation systems, although only 15% of people regarded it important.

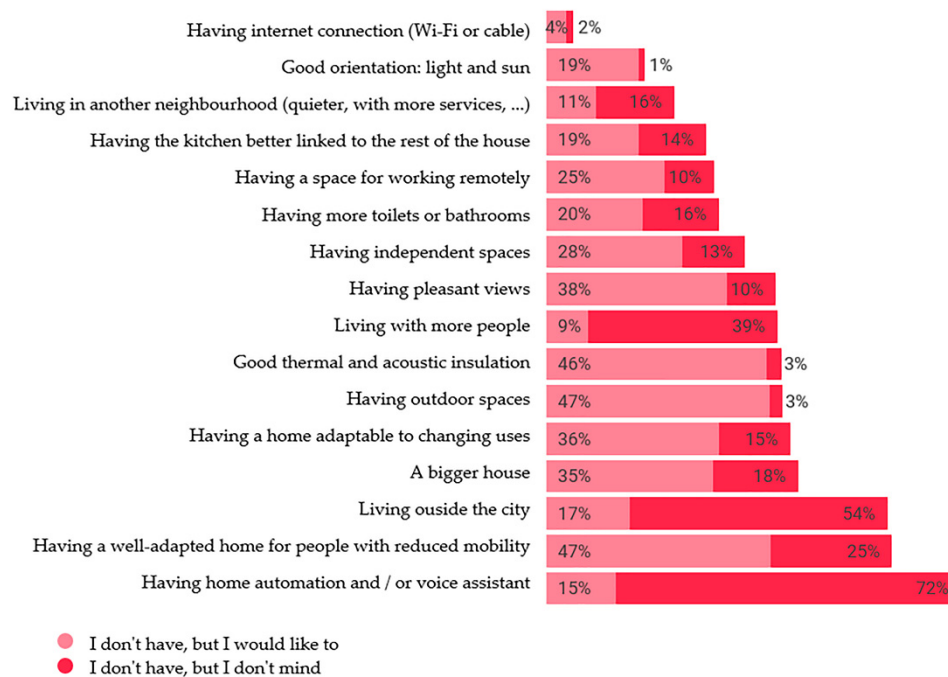


Figure 28. Missing features in homes by occupants.

The results of the missing features regarded as highly substantial by users could be compared with those of a countrywide survey conducted in Spain during the lockdown period [28] on improvements or changes that respondents would make in their homes.

In the survey referred to in this article, concerning the missing features, the fact of having outdoor spaces and a house adapted for people with reduced mobility ranked first and second (47% of respondents), and having good thermal and acoustic insulation ranked third (46% of respondents). Respondents also valued having a larger house adaptable to space-use changes (over 35% of respondents).

According to the countrywide survey, the major improvement that respondents would introduce is having an outdoor space: terrace, patio or balcony (almost 42% of respondents), followed by having overall thermal and acoustic insulation (36% of respondents) and having a bigger house (27%).

Therefore, there are three overlapping aspects that stand out as a priority in both surveys following the lockdown: having outdoor areas, good insulation and a bigger house.

The fourth aspect highly valued in this survey is that of having rooms with a view. In total, 38% of people surveyed stated not having a good view and that they would like one. The need for changes in this respect was reduced to 18% in the national survey [28]; however, it highly stood out above the 16 aspects considered.

3.7.3. Influence of Most Valued Features in Homes

The availability or not of home features highly valued by respondents affected their level of satisfaction considerably (Figure 29).

The fact of not having an adapted home or good thermal and acoustic insulation compared to those that had it doubled the percentage of people who experienced de-

creased satisfaction during home quarantine. In the case of thermal insulation, this number was 15% compared to 8%. In the case of acoustic insulation, this number was 17% compared to 8%.

Additionally, this decrease in level of satisfaction became more noticeable, tripling the percentage in the event that homes did not have outdoor spaces.

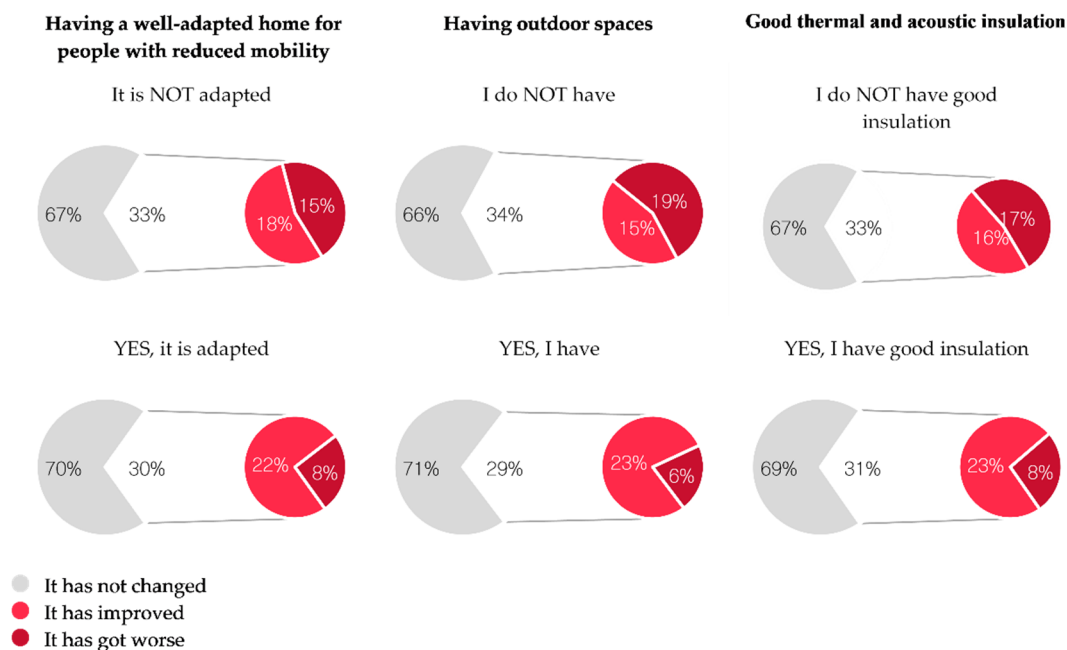


Figure 29. Relationship between level of satisfaction with houses and features highly valued.

3.7.4. House Shortcomings

Moreover, 34% of homes had thermal or acoustic insulation problems. This was the most frequent shortcoming expressed by participants. This data contrasted with the percentage of people that admitted to not having it, 46%, as indicated in the previous section.

A total of 17% of homes had leaks or dampness a percentage similar to that shown by the ENDV.CV 2017–2020. Around 10% of houses lacked enough natural light, had wall and ceiling cracking, poor ventilation or no elevator.

In a minority of cases, less than 5%, there were houses with heating, cooling or other supply problems.

From the data analysed in the countrywide survey conducted in Spain during lockdown [28], it is possible to compare the data regarding ventilation, air quality and lighting in homes.

In the survey referred to in this article, 8% of respondents considered that ventilation was poor. The other aforementioned survey brought about a similar result regarding air quality: 2% of respondents regarded it as poor, and 11% considered it to be fair.

In terms of natural lighting, as seen in Figure 30, 11% of people surveyed considered that it was insufficient. This result is similar to that obtained in the countrywide survey, in which 12% of the respondents stated that they would like to make changes in this regard.

In this survey, 34% of those surveyed claimed that their homes had thermal or acoustic shortcomings. Similarly, in the nationwide survey, 32% of respondents stated that their homes had poor acoustic insulation.

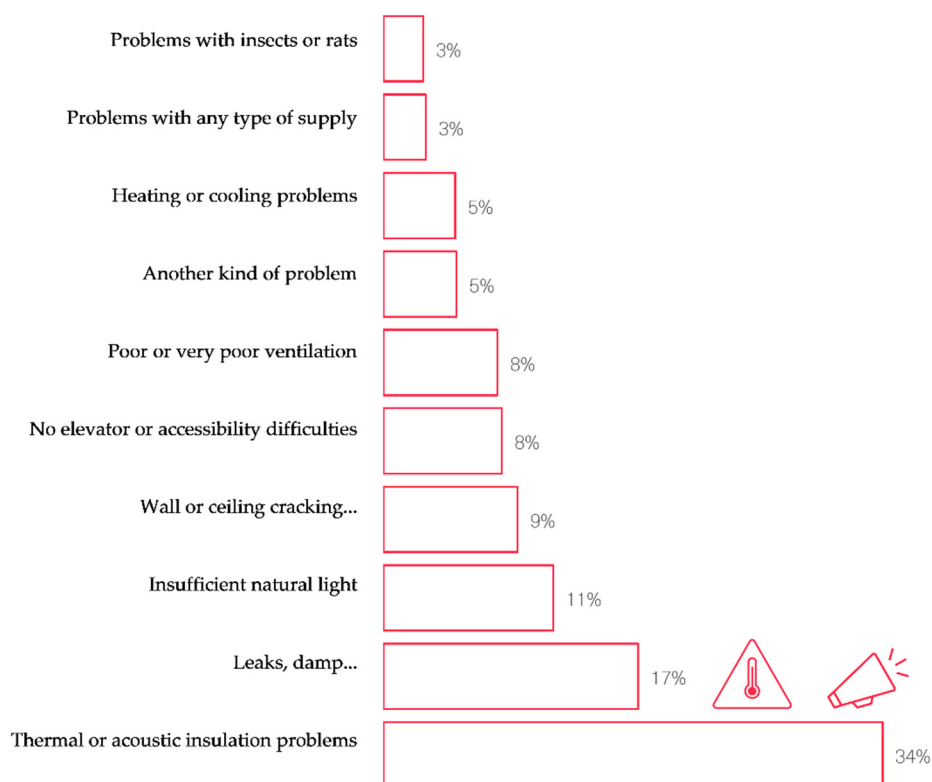


Figure 30. Presence of shortcomings in houses.

3.7.5. Influence of Shortcomings in Houses

The level of satisfaction with houses was affected when household problems arose. Generally speaking, the percentage of people less satisfied increased to 18% when home shortcomings arose, compared to 6%, a third of the previous percentage, when none was detected (Figure 31).

Additionally, a decrease in the level of satisfaction in houses regarding poor ventilation was particularly remarkable: 48% of cases. To a lesser extent, but also far from the 6% of people who did not admit having problems in their houses, there were homes with insufficient natural light, as well as supply, heating or cooling problems.

The shortcomings that least influenced the low level of satisfaction corresponded to houses without an elevator or with accessibility problems (Figure 32).

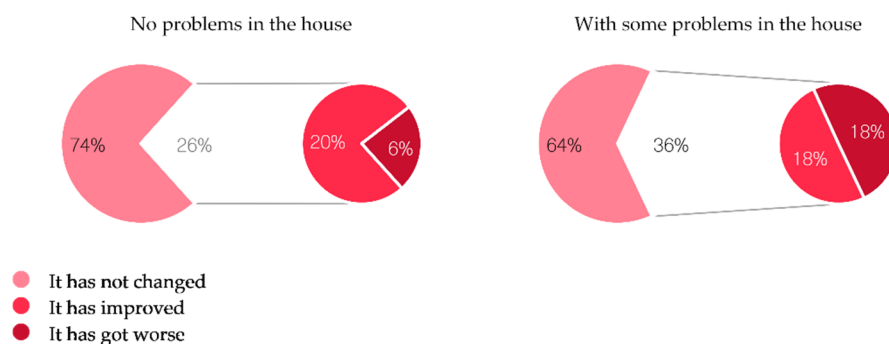


Figure 31. Relationship between level of satisfaction and having or not having household problems.

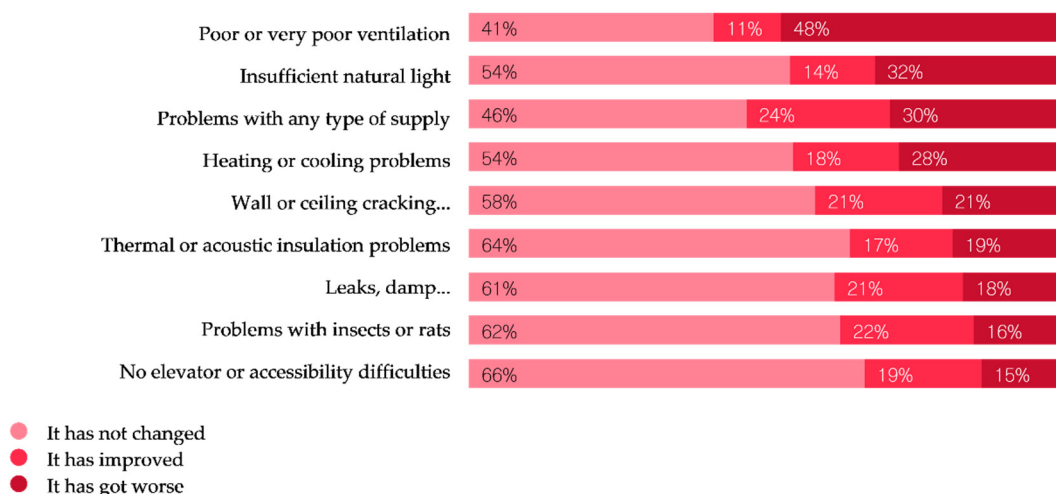


Figure 32. Relationship between level of satisfaction with houses and each household problem.

3.7.6. Enhancement Demand in Homes

Only a quarter of people surveyed expressed an intention to refurbish or adapt some spaces as a result of lockdown experience. In fact, nearly half, 46%, did not consider it.

It is remarkable that the most demanded improvement, in 23% of cases, was having more flexible spaces adaptable to different uses. This percentage contrasted with that of individuals who admitted to not having flexible spaces, despite considering it a major feature (36%).

On the opposite side, and in addition, only 4% of people would have divided some spaces of the house (Figure 33).

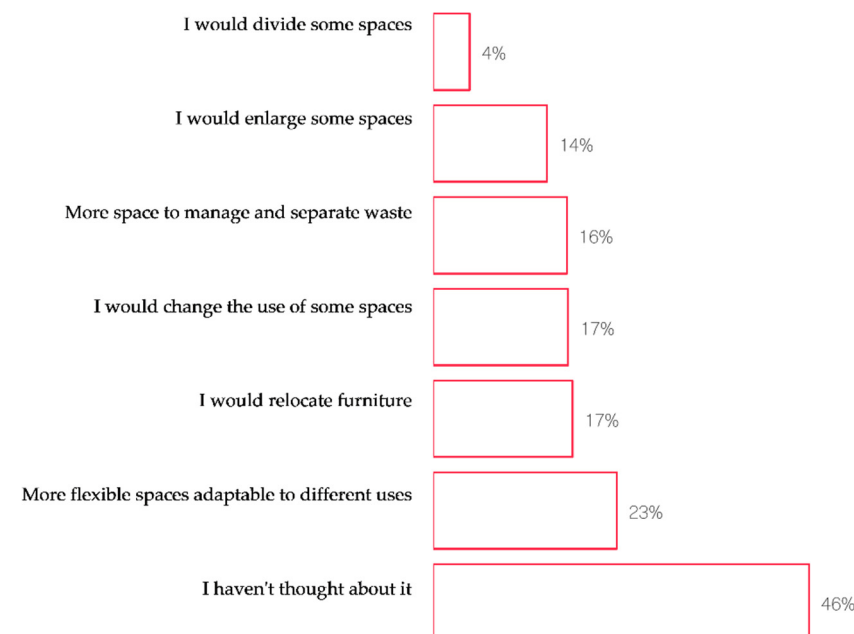


Figure 33. Refurbishment and/or adaptations most demanded to improve comfort during lockdown period.

Concerning furniture, the survey in this article showed that 17% of people surveyed would rearrange it, a percentage similar to that found in the countrywide survey conducted in Spain during lockdown [28], in which 14% of respondents would rearrange it.

It is also possible to compare the result regarding changes in spatial distribution; whereas in the present survey, 4% of people surveyed would divide home spaces, and 14% would enlarge them, in the countrywide survey, a similar percentage, 15%, would change spatial distribution.

3.7.7. Demand for Refurbishment According to Tenure Status

Demand differences for refurbishment were noticeable according to the specific type of persons surveyed (Figure 34).

For example, it was clear that refurbishment demand would be influenced by tenure status (owned or rental). In all cases, those living in a rental house demanded refurbishment more frequently than those in owned houses.

In this regard, it was especially meaningful that demand for flexible spaces adaptable to different uses reached 50%, corresponding to the sum of 20% in the case of ownership and 30% in the case of rental houses. This proportion according to tenure status was the same in the case of demand for space partition, although this type of refurbishment had a significantly lower relative weight.

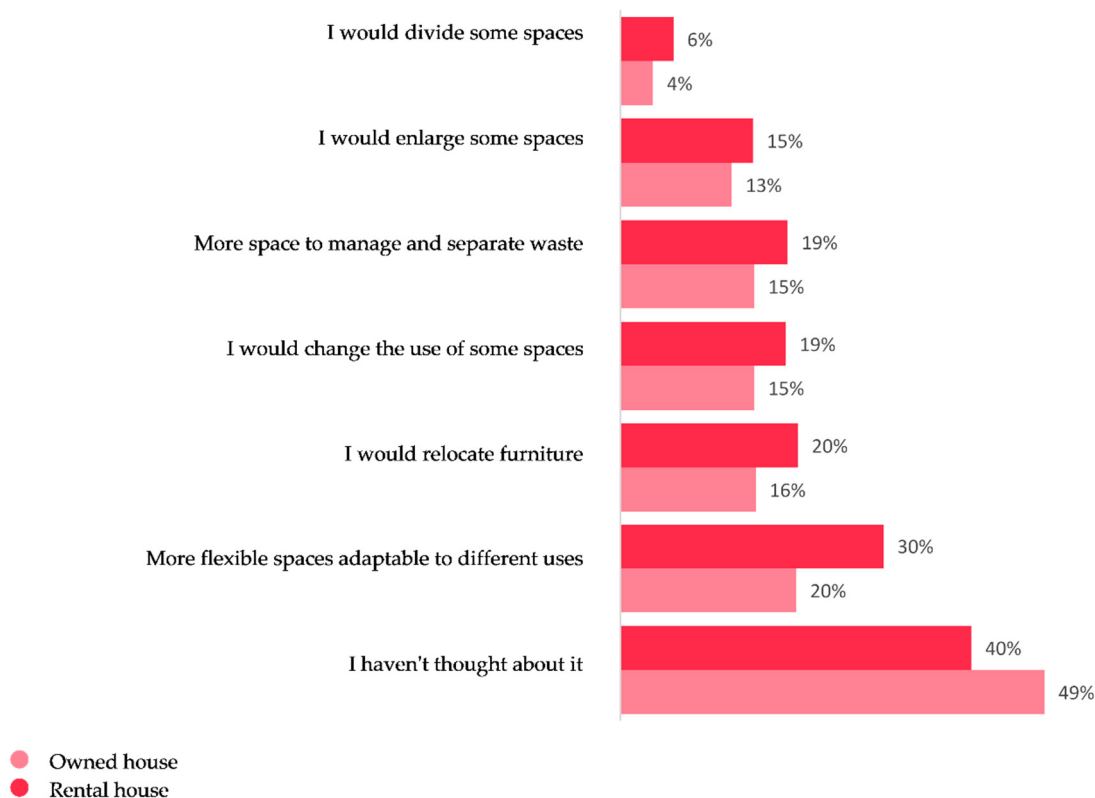


Figure 34. Refurbishment and/or adaptations most demanded according to tenure status.

3.7.8. Demand for Refurbishment According to Economic Situation

Furthermore, the economic situation during home quarantine did not significantly affect house refurbishment demand (Figure 35).

However, those people whose economic situation had improved demanded enlarging some spaces, relocating furniture or having more flexible spaces.

On the other hand, people whose economic situation worsened stated to need more space to manage and separate waste and modify some space uses. However, in general, this group demanded the lowest level of refurbishment: 44% compared to 55% of those whose economic situation had improved and had not proposed any refurbishment.

People not affected economically by the health crisis ranked last when it came to three specific demands: enlargement of some spaces, relocating furniture and having flexible spaces.

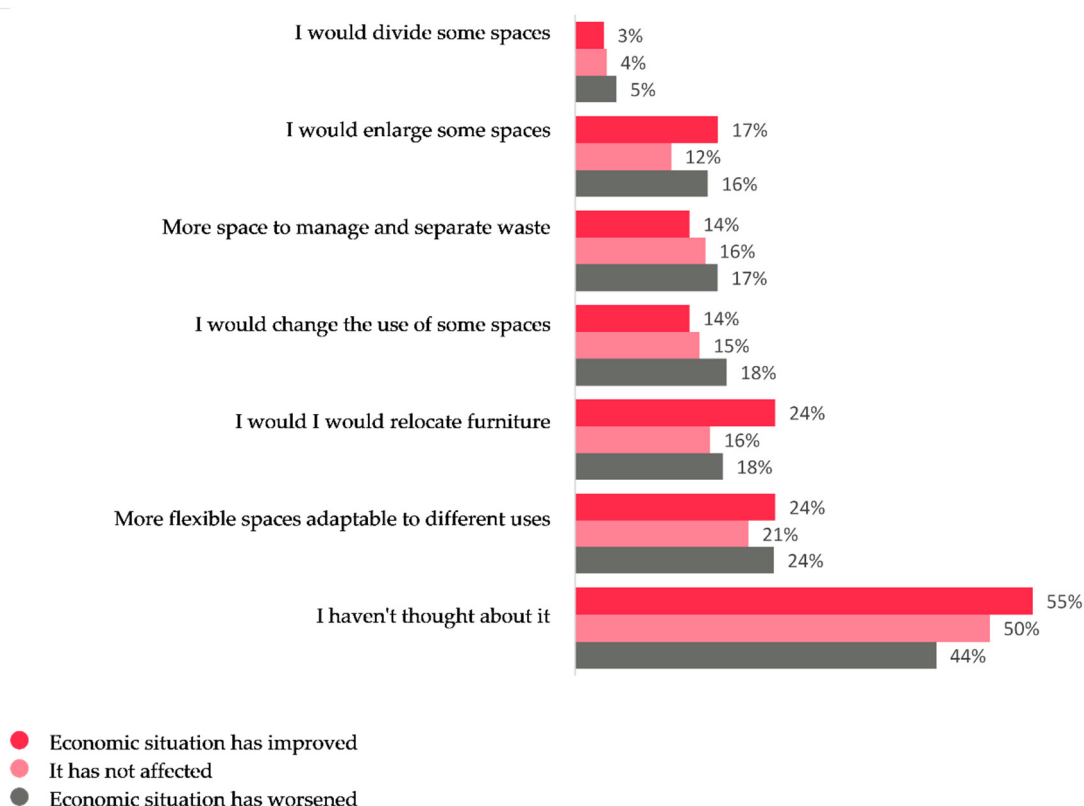


Figure 35. Refurbishment and/or adaptations most demanded according to the economic situation.

3.7.9. Demand for Refurbishment According to Work Situation

On the other hand, the work situation of respondents had a decisive influence on house refurbishment demand (Figure 36).

People working from home expressed a demand for refurbishment six and three times higher than those who worked outside home in all proposed refurbishment options.

The types of refurbishment with marked differences were: partition of some spaces, modifying the use of some spaces and relocating furniture.

Furthermore, a quarter of people working from home did not consider any refurbishment, while those working outside home who did not consider refurbishment barely reached one tenth of all participants.

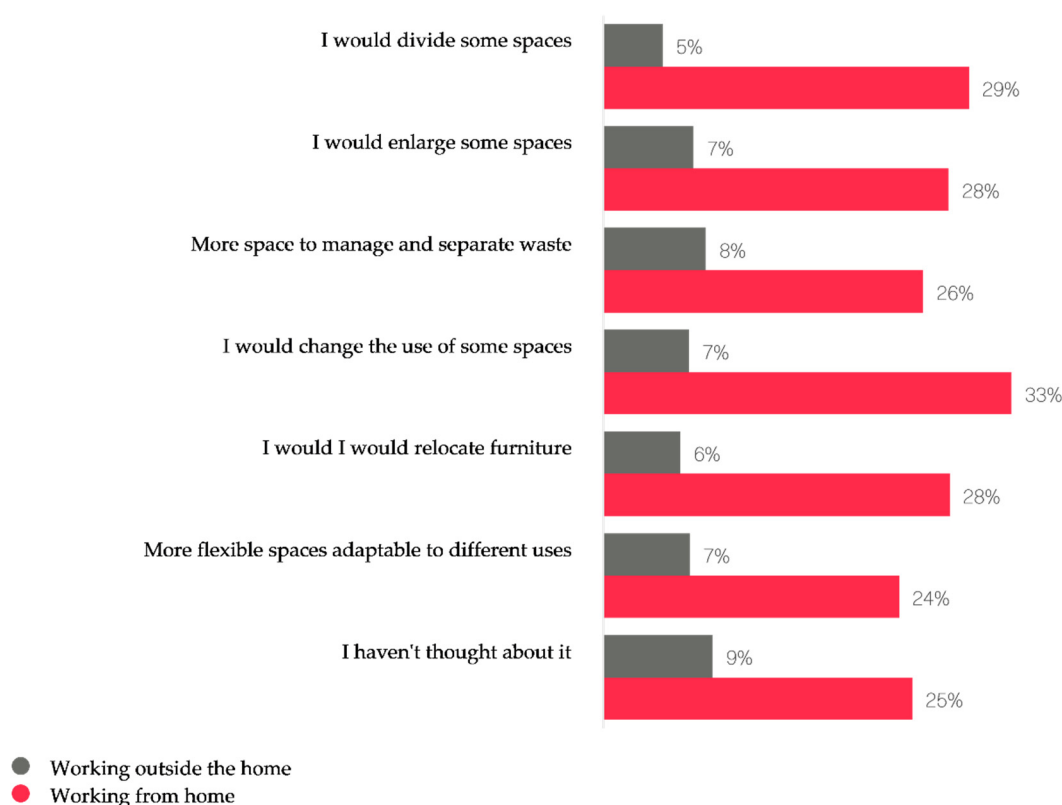


Figure 36. Refurbishment and/or adaptations most demanded according to work situation.

3.8. Observations on the Results

This survey was conducted during the fourth, fifth and sixth weeks in lockdown, that is, the strictest period since the beginning of the health crisis. In total, 99% of individuals had to comply with restrictions at different levels. Therefore, they were forced to make intensive and unforeseen use of their homes. All this also took place within the context of high concern about COVID-19 and its subsequent consequences.

The sample obtained was of remarkable urban character, especially within the three metropolitan areas of the Comunitat Valenciana, and had a very high relative weight in the capital, Valencia. Most of the opinions collected corresponded to females aged between 18 and 49, married or living with a partner. About half were employed and 50% were working remotely and financially affected by the health crisis. As a whole, the average house where the people surveyed spent this period was over 75 m², built or renovated in the last 40 years, owned and the regular residence of participants.

It should be noted that, due to the survey details, the specific types of persons could not be reflected. For example, this was the case for those with difficulties accessing communication networks, either not having a connection or not being properly trained for correct use. This was also the case for people far from the communication channels normally used, most of them with marked vulnerability.

The survey released two resilience structures with different and interwoven behaviours that provided support to the different CUs surveyed, so as to face the health crisis: “habitat resilience” and “social fabric resilience”. Regarding the latter, in general terms, people learned how to overcome the difficulties caused by the crisis.

4. Discussion

During home quarantine, an awareness of exceptionality was imposed, which led people surveyed to express being mostly satisfied with their habitat. However, home features proved to be decisive in socially overcoming the health crisis.

Accordingly, public administrations play a vital role in house design. Through the approval of building regulations, drafting of quality guidebooks, innovation in public buildings or development of financial incentives, it can be demanded, recommended or encouraged for homes to meet specific requirements related to safety, liveability, sustainability, etc., so that they can offer greater resilience in the face of adverse situations.

4.1. Most Valued Features

Based on the lockdown experience and survey conducted, the four issues of great importance for almost 90% of participants regarding houses and flats are presented below. In addition, the ways in which public administrations could respond to issues raised are analysed.

4.1.1. Light and Sun Exposure

In the first place, the feature most valued by participants was “having a good orientation: light and sun exposure”. It is significant that 74% claimed to have this feature and deemed it as highly essential. A total of 19% of participants stated a lack of good orientation and desired it. Current liveability regulations in the Comunitat Valenciana set minimum conditions on the size of openings and inner courtyards to provide enough natural lighting to rooms. However, this does not adjust the orientation of openings so that rooms receive sunlight. This aspect is subject to the orientation of the plot itself, environment and building design.

Stressing the latter, from the view of liveability regulations, it could be established that in those cases where it is possible, houses should have a good orientation and design that, considering the shadows cast by buildings or other obstacles, would allow sunlight indoors. Likewise, building orientation should be foreseen in urban planning. For example, the draft Decree to regulate the liveability and design conditions of housing in the País Vasco [52] proposes sunlight requirements in residential buildings to be incorporated into urban planning tools. These must comply with the detailed arrangement of areas or plots with buildings for residential use. It is proposed that these tools include a justification in the project, showing that the design allows sunlight in at least one room, in living or private areas. In the case of total or partial impossibility on urban land, it is suggested to provide proper justification.

4.1.2. Internet Connection

Secondly, the fact of “having internet connection, Wi-Fi or cable” was highly valued by 88% of participants as an essential aspect. A total of 4% claimed not to have it and would have liked to.

It is a fact that the need for the Internet in our technological society is undeniable, but in lockdown circumstances, it has become much more important. The pandemic has even been a great spur to transfer face-to-face activities to digital media. This has affected almost all areas, from educational, work, health, administrative, commercial and cultural to religious, social or family, the latter being decisive to avoid isolation and loneliness. However, it is exactly having these options that has made the lack of Internet have a negative impact on the most vulnerable CUs. Thus, the lack of digital media has affected school-age children who, during the pandemic, have interrupted learning and were put at a disadvantage, compared to others with more resources [53]. In addition, having this tool allows children to improve social relationships by reducing such marked isolation during the pandemic.

Therefore, it can be concluded that administrations, through legislation and other means at their disposal, could demand Internet connection in all newly built housing. Furthermore, they should promote a reduction in the digital divide within existing households [54,55]. Currently, the Government of Spain grants direct aid so that users can con-

tract access to fixed broadband. However, only service-registration-related costs are covered in locations without availability of access to fixed broadband that provide a downstream data rate of 10 MB per second with a delay time under 100 milliseconds [56]. According to the 2025 Digital Agenda by the Government of Spain [57], the COVID-19 pandemic has shown the need for digital connectivity in all aspects of life and economic activity. Therefore, one of its goals is the possibility of issuing social connectivity vouchers for highly vulnerable groups linked to other programs aimed at closing social gaps and favouring integration.

4.1.3. Outdoor Spaces

The third feature highest rated item by participants was “having outdoor space”. A total of 45% claimed to have it and deemed it as an essential element. A total of 47% claimed not to have it and would have liked to.

It should be noted that in the Comunitat Valenciana, people’s tendency to have terraces glazed to gain interior living space is highly frequent. However, the lockdown has made it clear that outdoor spaces have become essential elements.

The explanation can be found in biophilia, which describes the human need for connection with nature on an ongoing basis.

Urban legislation in different Spanish regions regulates a provision of green spaces in new developments [58], but liveability regulations do not require it for buildings. Through standards, provision of outdoor spaces should be promoted through regulation. Landscaped terraces and patios, green roofs, etc., are solutions that help naturalise buildings and improve quality of life.

4.1.4. Thermal and Acoustic Insulation

Finally, the fourth feature in order of importance according to participants was having “good thermal and acoustic insulation”. A total of 43% claimed to have it and rated it as an essential facility. A total of 46% claimed not to have it and would have liked to.

This is an aspect fully regulated by the Technical Building Code (CTE), a national standard with a high level of requirements [59,60]. However, it is clear that existing buildings prior to the CTE, although meeting the requirements of the NBE-CT-79 standard, present clear insufficiency of thermal and acoustic insulation, which is detected by users. Furthermore, it should not be forgotten that in Spain, 56.3% of residential buildings were built before 1980, that is, before the NBE-CT-79 standard was approved [44]. Therefore, such buildings lack thermal insulation.

In general, insulation enhancement in a home is a complex issue, since it may require a major intervention, with high economic costs, and may affect common elements of the building.

To increasingly improve decarbonisation in building stock, administrations have developed various strategies, some of them included in the “Long-term strategy for energy renovation within the building sector in Spain” (ERESEE 2020) from the Ministry of Transport, Mobility and Urban Agenda [61]. However, despite the fact that part of the population is unsatisfied with house insulation, there is not such a high concern about it socially as that detected in the face of other shortcomings, such as lack of accessibility, perhaps due to the fact that the latter is more disabling for people. This can be seen in the difference between applications for financial aid set in the State Housing Plan 2018–2021 [62]. In the 2019 call of the Comunitat Valenciana [63], financial support for improving energy efficiency and sustainability was granted only to 38 buildings, and 860 buildings received support for accessibility and conservation.

That is why administrations should continue to grant aid and management in this field: for example, through detailed monitoring plans. These would facilitate the detection of factors that hinder strategy application, and incentives to make them effective could be adjusted. As pointed out in the ERESEE 2020, one of the aspects that can enhance the energy renovation of housing (and acoustics in the same way) is an implementation based

on an integrated approach of actions (global improvement of liveability and quality in buildings), rather than a partial or sectoral approach.

The Renovation Wave Strategy of the European Commission [64] aims to improve the energy efficiency in buildings (by doubling at least renewal fees in ten years' time) and thereby enhance the quality of life of occupants. Additionally, it would be desirable that European and Spanish financing for residential building renovation consider liveability in general and not just promote energy savings and accessibility, as mentioned above.

One example is the Aid Plan for renovation of buildings and housing in the País Vasco [65]. In addition to accessibility works and energy efficiency measures, support is also included for some other renovation and rehabilitation works in housing to enhance liveability. These works can even cover the renovation of finishes (painting, tiling); adaptation of core facilities (electricity, plumbing, heating); renovation of carpentry, bathroom and kitchen fitting; building or expansion of balconies and terraces/outdoor patios in buildings prior to 1980 [66].

In this sense, home users were questioned through the "Housing Barometer of 2018". This was an opinion poll conducted by the CIS [67], and users highly valued further actions that administrations could undertake: first, offering direct support to cover part of the work costs (62%); second, providing affordable credit (38%); third, promoting renovation directly (33%); and fourth, setting tax deductions (30%).

4.2. Assessment of Missing Features

Regarding the exclusively missing features in houses collected in Section 3.7.2, the three rated as most important by more than 45% of participants are listed below.

4.2.1. Accessibility

First of all, it is worth highlighting the feature related to "having a well-adapted home for people with reduced mobility". Despite the fact that 92% of the survey was answered by people under 65, 47% of participants claimed not to have a house adapted and highly rated this feature.

The problem of the ageing of population, largely associated with disability, is present in Spanish society and particularly in the Comunitat Valenciana. According to the forecast of the population projection aged over 65 in this region, for the period from 2018 to 2033, ageing will increasingly grow. Thus, the group aged 65 and over would represent 25% with regard to the Comunitat Valenciana as a whole [68].

Through the CTE and regulations of the Comunitat Valenciana, a greater requirement has been set so that buildings are increasingly accessible [69,70]. However, there are still many of them that are not, and in addition, the needs of disabled people and the rest of the population as a whole evolve over time. For this reason, administrations should significantly speed up the process of removing architectural barriers in existing buildings to the furthest extent possible. This could be achieved by strengthening renovation support plans and the demand and promotion of universal design as a process of continuous and transversal enhancement in each initiative. It is meaningful that, for a long time, in this area, annual aid has been granted until the budget was exhausted. Thus, for example, in 2019 within the Comunitat Valenciana, 920 support applications for the conservation and improvement of accessibility were denied, due to lack of funding [63]. On the other hand, due to the recession caused by COVID-19, some administrations had to reduce budget issues for this purpose [71].

4.2.2. Open Spaces and Insulation

Likewise, taking second and third place among the most valued missing features are those referring to "having open spaces" and "good thermal and acoustic insulation", rated as essential aspects by 47% and 46% of participants, respectively.

Although these characteristics have been addressed in Section 4.1, it should be mentioned that, since they are among the most valued ones of those missing, they provide evidence of the problem in many existing buildings. These require renovation or refurbishment to meet basic liveability needs and the connection to outdoors.

4.3. Does It Make Sense to Introduce the Needs of a Pandemic Situation into the Homes of the Future?

Given the exceptional situation that this pandemic has led to, there are undoubtedly grounds for thinking that it makes no sense to adapt homes to a situation that will not happen again. However, as mentioned in the introduction, according to the WHO, this situation is prone to recur. Therefore, the aspects addressed in previous sections should be considered in house design to provide greater resilience in the face of similar episodes. An example of this scenario can be found in modern communal housing. In them, it is interesting to check architects' forecasts so that works would be ahead of their time when designed. However, in some buildings the test of time has shown that the key to success lies in their ability to evolve and change according to the way of life of their occupants [72].

Additionally, before the pandemic, some aspects highlighted in the opinion poll were already identified. According to the survey "Housing Barometer of 2018" [67], half of respondents were already little or not satisfied with accessibility in buildings for people with reduced mobility, and around 35% stated to be little or not satisfied with thermal insulation and noise level.

Listed below are other aspects derived from the survey directly linked to the pandemic, both with the disease itself and some household behavioural changes due to it, which should be also taken into account in house design.

4.3.1. Precautionary Measures in Case of Developing Disease and Prevention Measures

On the basis of the features in the survey that have favoured homes to be resilient against COVID-19, the following stand out: "bathroom for exclusive use of persons infected" (57%), "space to ensure minimum 2-metre distance between persons" (53%), and "having an isolated and ventilated room" (51%).

These features strengthen the WHO recommendation for homes to have a separate room with adequate ventilation, as well as a separate bathroom if an individual infected must undergo home quarantine.

Thus, it would be of utmost importance that houses with two or more users were spacious enough to ensure physical distance between persons and had at least one bathroom and one bedroom independent of the rest of the house, with sufficient ventilation. As the latest research has shown, proper ventilation and occupancy rates can play a vital role in reducing the risk of infection. Thus, natural cross ventilation is an effective and economical strategy, since it is based on the pressure difference created by the wind on opposite facades of buildings [73].

4.3.2. Size of Houses

Regarding satisfaction with houses during lockdown, a decisive factor is size and the available area per person. The larger the size of the home, the higher the satisfaction is, but two key values of useful area can be noted: in houses ≤ 40 m², the satisfaction with the home decreases significantly (62%), and in houses with ≥ 75 m², the satisfaction increases (from 3% to 15%).

Likewise, satisfaction according to available space per occupant gradually rises up to ≥ 50 m² per person. However, it is meaningful that the greatest variation occurs in intervals under 15, and intervals from 15 to 29 m² per person. With an area < 15 m² per person, the level of satisfaction decreases 36%, while this value drops to 19% in homes with an area

between 15 and 29 m² per person. Between 30 and 49 m² per person, the level of satisfaction drops to 8%, and with 50 m² per person or more, the level only decreases 3%.

Therefore, since the level of satisfaction with houses does not significantly drop in a lockdown situation, there should not be a useful area of < 40 m² in total, or < 15 m² per person. It would be advisable to increase the minimum size to others closer to 75 m² in total and 30 m² per person.

In the same vein, as mentioned in the introduction, other studies have confirmed that there is a strong association between poor quality of houses and the risk of suffering depressive symptoms, emphasizing parameters such as small size of houses and unpleasant views.

On the other hand, with regard to home size, 35% of those surveyed would like to have a larger home. This turned out to be the second cause of demand for housing, after the need for a home that meets family needs according to the survey “Living in lockdown, the demand for housing in the metropolitan area of Barcelona” [30].

4.3.3. The Views from the House

Views are rated as a major factor by 76% of participants; it is placed sixth out of sixteen characteristics valued, and half of people surveyed stated to have pleasant views.

In order to improve the views from buildings, in addition to the vital role that architects play in building design, public administrations should pay special attention to urban planning. Volumes and distances among buildings should be properly regulated, and there should be an increasing naturalisation of the surroundings, ensuring general aesthetic conditions through municipal regulations, etc.

For example, there are municipal regulations governing the urban inclusion of buildings; harmonization with the environment; the design of ground floors and exposed dividing walls; the proper placement of technical installations and advertising elements, fencing and cleaning plots and the preservation and adequate maintenance of buildings. These are some aspects that, deemed substantial for the visual appearance of cities and the sense of belonging to a place on a daily basis, have special relevance for health during home quarantine.

As mentioned in the introduction, improving the quality of housing is closely linked to the regeneration of urban space. Notably, providing better views depends on the landscape quality of the urban environment.

In this connection, the survey “Living in lockdown, the demand for housing in the metropolitan area of Barcelona”, referenced above [30], shows that, among people searching for a home, 45% chose a neighbourhood with core services around, and 40% preferred a more rural environment.

4.3.4. Household Behavioural Changes: Spaces for Work and Learning

Moreover, as a result of the pandemic, there have been household behavioural changes affected by new activities inevitably done at home. This is the case of remote work or distance learning, which even partially “are here to stay”, as explained in Section 4.1 concerning Internet connection.

For example, this circumstance has led many sectors of the economy to discover a greater ability for remote work than estimated before [74]. Prior to the pandemic, only 4% of the workforce worked remotely for more than half of their work schedule. During lockdown, the percentage of people working from home exceeded 25% according to the survey. Furthermore, as seen in various studies [74], more than 30% of all employees in Spain could work remotely.

People who worked from home expressed a remarkable need for refurbishment, three to six times higher than those who worked outside home. Among the types of refurbishment, change of space use (33%), compartmentalization of spaces (29%), space enlargement (28%), furniture relocation (28%) and having more flexible spaces (24%) stand out. Through the amount of time spent in the rooms, it can be inferred that, although time

spent in all rooms increased (mainly in socialization rooms), in houses with a studio, the rise was remarkable, 46%.

In addition, having a space for working remotely and independent spaces were deemed important by 77% and 64% of individuals, respectively, ranking fifth and seventh among the features valued.

When the home suddenly becomes a workplace, spaces previously used for other family uses are occupied, and this can have consequences on home and personal life [75]. According to research studies, having an adequate space improves worker productivity and satisfaction. The latter, along with a reduction in communication time with coworkers, are shown to be aspects greatly influencing the results of working remotely [76,77].

Space for working from home should meet the recommended conditions (temperature, ventilation, lighting, acoustics, facility provision, etc.) [78]. When necessary, it should also allow distance from other members of the household to ease concentration, allow for online meetings and avoid interruptions or added stress.

Matching up with the conclusions of another study in Spain during the pandemic through an opinion poll [28], flexible spaces allowing remote work, learning or studying, etc., could be required in regulations as part of the basic housing program, in addition to the rest of the functions already assumed in homes.

For all these reasons, the aspects and issues addressed in this section are acknowledged as positive elements for the health and wellbeing of users, and their implementation would provide a better quality of life and social resilience. Public administrations, for their role and especially due to their regulatory work, must assume and play a driving role in implementing, apart from environmental measures [79], resilience features in the promotion of public and private housing. All this is regardless of whether the lockdown situation recurs or not and whether the option of remote work or other household habits continue or not.

5. Conclusions

As the WHO points out, “COVID-19 is not the last health emergency the world will suffer, so there is an urgent need for sustainable preparedness for health emergencies to face the next pandemic. It is necessary to break the cycle of panic and forgetfulness”. For this sustainable preparation, it is crucial to increase home resilience.

Based on the survey conducted throughout the home quarantine, whose results are analysed in this study, the four home features better rated by participants were: light and sun exposure, internet connection, outdoor spaces and insulation (thermal and acoustic). Among missing features, the last two were regarded as important, as was having a house adapted to people with reduced mobility.

Other characteristics in the survey increasing home resilience against the disease itself were: having a bathroom and a ventilated room for exclusive use of affected persons and having space to ensure a minimum 2-m distance between persons. In addition, having an adequate space, pleasant views, flexibility of spaces and rooms for working increased the level of satisfaction with homes during quarantine time.

Within this context, public administrations, due to their role, could include all these aspects in regulations, guidebooks, economic incentives, etc., so that houses can be adjusted to the needs of users in different circumstances of life.

For this, regulations governing the design and quality features of homes are a key factor. The inclusion of the social key performance indicator analysed in these standards would make it possible to provide all homes with a higher quality level and resilience for all groups of people, including those especially vulnerable. These conditions should be introduced in newly built housing and especially in the case of renovating existing houses, setting minimum conditions to avoid substandard housing.

There is therefore a clear need to address regeneration of urban space, as it is closely linked to quality of housing.

Likewise, it would be appropriate to continue research work on some characteristics outlined in this study, such as remote work, the possibility of adapting spaces to different uses, etc. It would also be very useful to include the correlation of characteristics with different age groups, genders, etc. In addition, it would be interesting to be able to compare the results of this survey with those conducted over some other period of time. On the other hand, due to the limited number of responses obtained in relation to territorial extent, the conducting of this survey could be repeated within a smaller area, which would allow for an increase in the percentage of responses in relation to the geographical area.

An opportunity of future studies to obtain more information on the ability for adaptation and resilience is the possibility of expanding the relationships between the variables analysed and the types of buildings, their location (historic centre, urban expansion, housing estates, single-family housing, etc.) or the location of flats in the building: for example, according to floor height.

Finally, it should be advisable to conduct new surveys on the basis of home quarantine experience, focusing on other groups. It should also be mentioned that specific types of persons could not be represented in the opinion poll due to its digital format, which prevented the participation of people without access to communication networks or with marked vulnerability.

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