



## ENVIRONMENTAL COMFORT AND THE PANDEMIC: DESIGN CHALLENGES FOR HOME OFFICE IN BRAZIL

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### Abstract

The article discusses the social distancing measures implemented by the World Health Organization in response to the global spread of the coronavirus pandemic, ranging from flexible measures to lockdowns and curfews in some countries. It highlights the significant shift towards remote work, accelerated by national and local containment policies, particularly in Brazil, where remote work was previously uncommon. The study emphasizes the importance of ergonomics in adapting home environments for remote work amidst the pandemic. Through an exploratory survey, the research identifies key needs for adapting home environments caused by COVID-19 and provides ergonomic recommendations to improve home office conditions. Results show that a majority of respondents worked from home during the pandemic, with about 48% of households needing better comfort conditions for remote work. Ergonomic recommendations cover physical, cognitive/emotional, and organizational aspects to enhance home office conditions and user well-being. The study concludes by highlighting the variability in perceptions of home office environments based on housing type and occupational profile, underscoring the need to consider individual needs for promoting comfort and well-being of residents.

**Keywords:** COVID-19; Ergonomics; Human Well-being; Home Office.

### 1. INTRODUCTION

The social distancing measures introduced by the World Health Organization in response to the exponentially global spread of the coronavirus have ranged from flexible or

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lesser social distancing measures to lockdowns or, in some countries, various types of curfews for defined periods of time (SALAMA, 2020). The new coronavirus (COVID-19 - severe acute respiratory syndrome - SARSCoV-2) is highly infectious and, as it is a relatively new and highly transmissible disease, practically all human activities have undergone transformations in order to reduce its transmissibility.

From this perspective, investigations from various fields are being carried out to understand the changes in the dynamics of societies during the pandemic period (MEGAHED, GHONEIM, 2020; SALAMA, 2020; ALRAOUF, 2021; MATURANA, SALAMA,

MCINNENY, 2021). Architecture, ergonomics and engineering, intended for studying the relationships between individuals and space, can understand the characteristics of built environments and their relationship with their users, addressing issues related to the domains of physical, cognitive and organizational ergonomics related to the activities they perform.

The pandemic caused drastic changes in work style and work environment, accelerating the recent trend of remote working from home (UMISHIO *et al.*, 2021), in response to national and local containment policies, companies, organizations and institutions encouraged their employees to work remotely at home in order to stay safe (XIAO *et al.*, 2021). According to the International Labour Organization (2020), it was estimated that before the COVID-19 pandemic, only 7.9% worked in the remote mode. As a result of blockades to movement of people, the practice of remote work ended up becoming more common around the world.

In addition to the term "work from home", it is possible to observe the use of the term "remote work" and "telework" (CUERDO-VILCHES; NAVAS-MARTÍN; OTEIZA, 2021). Apparently, the nuances of the use of each of these terms depends on the type of worker and the place where the task is performed, although they are inevitably related and may overlap (SOSTERO *et al.*, 2020). "Telework" usually refers to work that is performed away from the usual location, while "work from home" is related to work performed wholly or partially in the worker's home (ILO, 2020).

In Brazil, remote work has been a minority labour activity, of recent adoption, due to the COVID-19 pandemic. According to data from the Institute of Applied Economic Research, referring to the year 2020, 11% of workers worked remotely. Moreover, significant differences between Brazilian states were evidenced, such as the Federal District, with 23% of workers performing activities remotely, while in Pará, only 3.5%. The state with the highest number of remote workers was São Paulo, followed by Rio de Janeiro and Minas Gerais; the states with the lowest numbers were Amapá, Acre and Roraima. As to the profile of workers who worked



remotely in 2020 in Brazil, there was a higher percentage of women, people declared to be white, with complete higher education (IPEA, 2021).

The objective of this article is to highlight relevant risk factors, generate insights of potential use for architects and engineers, and emphasize the positive role that the field of ergonomics plays in the adequacy of “work from home” environments to the new reality experienced by the Brazilian population. For this purpose, this exploratory research seeks to identify the main needs for changes in the housing environment caused by COVID-19, from the perspective of Brazilian adults during the period of social isolation in 2020. Through this analysis, some ergonomic recommendations will be presented to improve working environment conditions for the health and well-being of users at home.

## 2. METHODOLOGY

The questionnaire was structured on the online platform Google Forms, aimed at the public aged over 18 years. The methodology of this work is based on the application of a dual-faceted virtual questionnaire. To prepare the questionnaire two main facets were defined: environmental and demographic data. Objective multiple-choice questions were designed to investigate the relationships of individuals (respondents) with the noise environment during the pandemic period, caused by COVID-19. The variables demographic data and sound perception were explored and published in the study of OLIVEIRA *et al.* (2021).

A total of 1,769 responses were collected during the period from 08 May to 08 June 2020. It was distributed through social networks, by the Brazilian Council of Architecture and by ProAcústica - Brazilian Association for Acoustic Quality. Through the data analysis and statistics treatments, the study proposes ergonomic recommendations for housing design as guidelines for the comfort of users and improvement of working environment conditions at home.

## 3. RESULTS AND RECOMMENDATIONS

### 3.1. Home Office Activities

According to the total data collected (1,769 respondents), 77% of respondents performed their activities from home, 21% continued their work in the office or did not work, and only 2% partially at work or were retired. Distribution of the participants' profession areas are presented in Fig. 1. Teaching/Education professionals (600) and exact sciences (420) were the highest number of responses, focusing on professionals such as engineers and architects, as



well as teachers and students, respectively. Professionals from the trade and services (137), health (131), public service (81), and 83 unemployed also participated.

Regarding the environment or space to develop the home office activities, 36.3% of the participants considered it totally adequate, 34.4% partially adequate and 14% were not adequate. Also, 15.3% answered “not applicable” for not working from home. Therefore, approximately 48% of the housing requires better conditions of comfort and adjustments for work to be carried out at home. Subjectivity in relation to the perception of environmental conditions must be considered. People can react differently to the same environmental variables, causing discomfort or not, or requiring no adaptations to major environmental transformation for better performance work from home.

Figure 2 shows the relationship between the number of bedrooms per dwelling (house or apartment) and the condition of the space intended for home office activities. Around 40% of respondents who live in 2 and 3 bedrooms perceive the work environment as totally and partially adequate, 50% of respondents who live in a 1 bedroom apartment consider it partially appropriate and approximately 50% of respondents who live in housing with 4 bedrooms consider it to be totally suitable for home office activities. Correlation between number of bedrooms and perception of work environment from home demonstrated that as the number of bedrooms increases, from 1 to 4, the perception of suitability for carrying out activities in home office also increases, reaching a correlation coefficient of 96.4%.

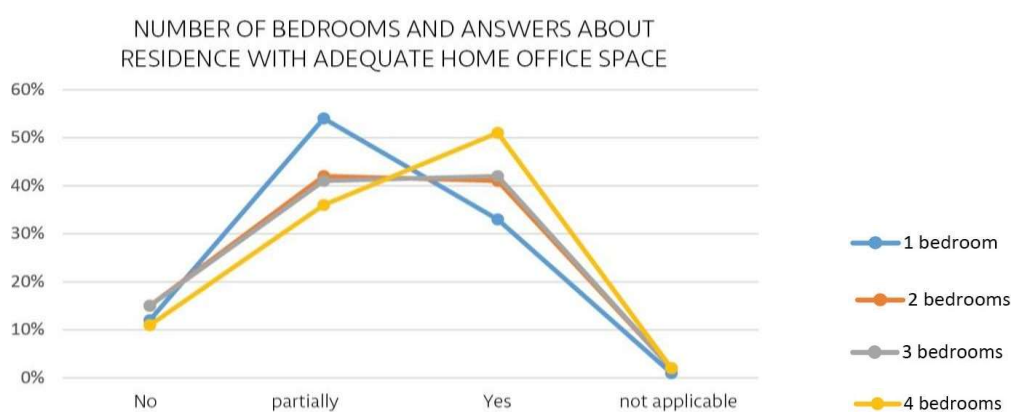


Figure 2. Correlation between number of bedrooms and perception of work environment from home.

### 3.2. Residence, Housing and Comfort

In relation to residence (Fig. 3a), most residents (39%) live in houses, followed by apartments with a balcony (33%) and apartments without a balcony (18%). Figure 3b presents the type of housing of the respondents and the number of people living there. More than half of



the respondents live at home with one or two people (54%), followed by four people at home (25%). According to the answers, there were no dwellings with more than five people. Most homes have more than two bedrooms, 43% of which are three bedrooms, 26% two bedrooms, 21% four bedrooms and 6% one bedroom.

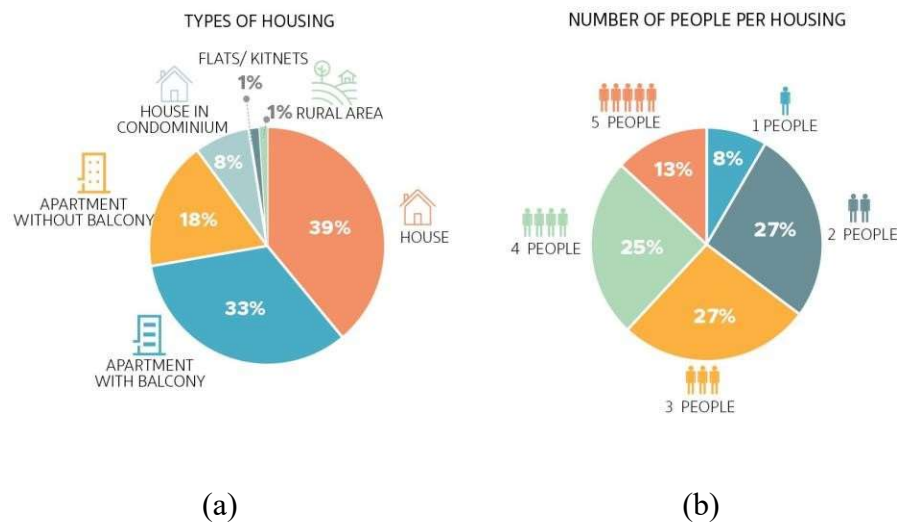


Figure 3. Type of housing of the respondents and the number of people living there.

Regarding the perception of comfort, the percentages related that cause the most discomfort according to the respondents and to the type of housing are shown in Fig. 4. In housing such as houses, condominiums and rural areas, the temperature was pointed out as the one that caused the most discomfort. It is important to emphasize that the temperature is a very variable aspect of comfort and depends on the time of year and the region of Brazil. In flats/kitnets and apartments (with and without balcony), noise was the most pointed annoyance aspect, which may indicate that houses with reduced spaces, which share internal partitions, are more susceptible to the passage of noise between houses. Noise, in addition to being annoying, can interfere with cognitive performance of the work activity.

According to the data collected from the respondents that work from home, 64% made or intended to make changes at home during the pandemic, 17% did not change anything, while 19% did not respond. When comparing with the data referring to the respondents who were not working from home, the percentage was lower but also quite expressive, 47% made or intended to make changes at home during the pandemic.

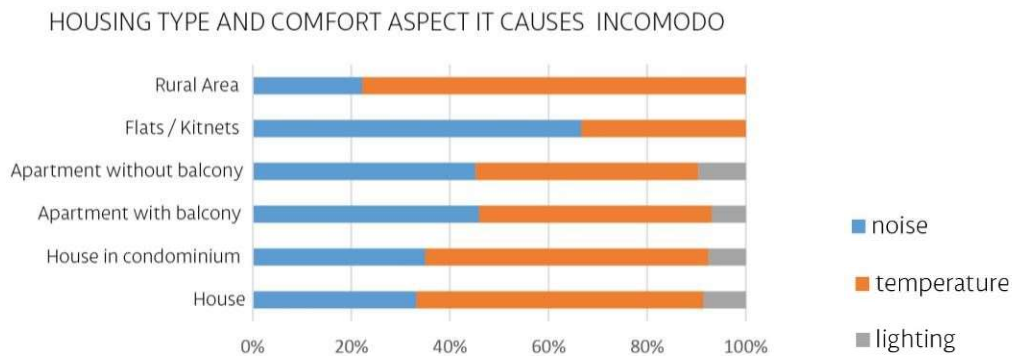


Figure 4. Percentages related to the perception of comfort considering the type of housing.

Housing changes reported by the participants in the work from home environments are diverse, covering aspects related to the workstation, as well as other more general aspects such as changes in the bedrooms, kitchen, living room, painting/cladding, layout changes, improvements in the gardens and balconies (Fig. 5). In relation to working environment conditions at home, changes were pointed out with the need to adapt the environment/space of home office activities. From transforming a bedroom or living room into a home office, or even changing the layout to favor spatial flow, to acquiring ergonomic accessories to adapt furniture to their needs, e.g., footrest, chair/table to work, shelves to organize the workspace. In addition, it was pointed out the need to improve lighting and thermal conditions of the workstation for home office. Concern with the design and organization of the work environment also was highlighted by the respondents, a reason for certain dissatisfaction and even stress that is accentuated due to the pandemic situation. environmental variables, causing discomfort or not, or requiring no adaptations to major environmental transformation for better performance work from home.

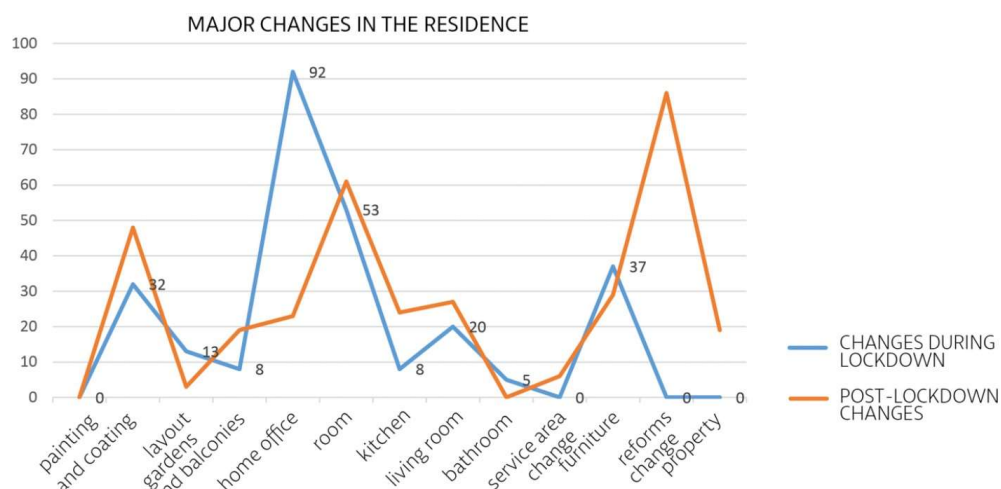


Figure 5. Residential changes during and after pandemic.





### 3.3. Residence Housing and Comfort

From the results of the questionnaire applied to identifying the main problems or discomfort experienced by users during the period of social isolation, this study also proposes some design ergonomic recommendations for the comfort and safety of users at home, to improve working environment conditions and to respond to dwellers' expectations for wellbeing.

According to the International Ergonomics Association, there are three broad domains of ergonomics: physical, cognitive, and organizational, that are the basis for proposing improvements to safety, health and working conditions (ILO, 2010). Design ergonomic recommendations for housing are described in this article by physical, cognitive/emotional and organizational domains. Table 1 presents parameters and recommendations that can be applied for the comfort of users and improvement of the work conditions at home.

Table 1. Propose of Design Ergonomic Recommendations for Housing

Ergonomic Domains	Parameters	Recommendations
Physical	Functionality	(a) Design an accessible layout; (b) Choose functional furniture, easy to reach, adjustable; (c) Ensure the usability of products and work processes
	Acoustic comfort	(a) Increase the sound insulation of doors and windows; (b) Move away from louder noise sources; (c) Use of headphones; (d) Use of furniture and more sound-absorbing elements
	Thermal comfort	(a) Ensure good thermal conditions for the workplace; (b) Provide cross ventilation and shields (heat barriers); (c) Improve energy efficiency and sustainability
	Visual comfort	(a) Provide sufficient lighting for the workstation; (b) Prioritize natural lighting; (c) Design glare-free workstation
	Workload	(a) Design flexible workplace; (b) Consider dwellers' anthropometric measurements; (c) Use ergonomic chairs for workplace
	Installations safety	(a) Provide secure facilities and easy maintenance; (b) Updates technologies to ensure quality communication; (c) Maintain light fixtures
Cognitive/ Emotional	Workload	(a) Avoid work overload; (b) Balance moment of concentration and distraction; (c) Enjoy physical activities
	Socializing	(a) Keep socializing even if distant; (b) Use communication technology for social interaction
	Leisure	(a) Provide planned leisure time; (b) Look for new leisure alternatives; (c) Enjoy family life
	Aesthetics	(a) Customize your home environment; (b) Make appropriate use of colors in the living environment
Organizational	Routine	(a) Provide breaks during work; (b) Separate work and family time; (c) Maintain a suitable working and living environment
	Time	(a) Organize the workstation for time optimization; (b) Control work and rest time
	Spatial flow	(a) Design an accessible work environment; (b) Organize the flow of daily activities properly



	Furniture change	(a) Adapt furniture to your needs; (b) Choose functional and flexible furniture
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#### 4. CONCLUSIONS

The research questions presented in this article cover some ergonomic foundations as a contribution to the process of developing healthier housing environments, considering the new demands arising from the pandemic caused by COVID-19. Adherence to the home office can directly interfere with the perception of the environment, especially in cases of using inappropriate environments to develop such functions. This fact shows that the perception of the environment depends on interrelated perceptual understandings, such as hearing, vision and touch, in addition to social, psychological and economic factors.

In general, the virtual questionnaire applied in this study allowed us an overview of the pandemic situation of the Brazilian populations. The results showed differences between types of housing, professional occupations and mainly, as highlighted above, different perceptions and preferences related to the housing environment for work conditions at home. As recommended by ergonomics should be considered the individual characteristics and necessities to respond to dwellers' expectations for comfort and well-being. On the other hand, the results may generate new questions related to the evaluation of architectural problems and environmental comfort of housing and improvement initiatives for dwellers' quality of life and health, as well as the elaboration of design ergonomic recommendations, how indicated in this study, for this new world in the home office at the present time. improve working environment conditions and to respond to dwellers' expectations for well-being.

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