

## Research Paper

# The Psychological Effects of the Home Environment during Self-Quarantine: a Web-based Cross-Sectional Survey in Iran

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### Abstract

*During the COVID-19 outbreak in Iran, self-quarantine was a measure to slow the spread of this infection. We conducted this cross-sectional study to explore the psychological effects of the home environment while people had to stay at home for a long time. For the survey, 536 individuals took part. Collecting data was via an online questionnaire including three sections: (1) Demographic characteristics and general information, (2) Home environment features, and (3) Negative psychological experiences (NPE) considered as (a) feeling of sadness and depression, (b) feeling of stress and anxiety, and, (c) experiencing domestic violence during quarantine. For data analysis, first, some descriptive information about the participants was presented. Then, we used a logistic regression model, one of the classification algorithms in machine learning methods to investigate the association of home environment features and NPE during self-quarantine. The results indicate the home environment affects NPE differently among men and women. Generally, the individuals were more satisfied with their house performance during quarantine, and people considered the light quality of their house as appropriate. Besides, residents with less noise disturbance issues had a better mood during this period. Conversely, failure in the possibility of indoor exercising and the feeling of being in a crowded house increased the level of NPE.*

**Keywords:** Quarantine, Covid 19, Home environment, Psychological distress.

## 1. INTRODUCTION<sup>1</sup>

Since December 2019, Corona Virus (Covid19) has spread to nearly every country. In Iran, the first case of Covid19 disease diagnose was on the 19th of February 2020 (FarsNEWS, 2020). There are various strategies for controlling the expansion of the epidemics, the most non-pharmaceutical effective of them is quarantine, which means separating and restricting the movement of people exposed to a contagious disease to see if they become sick (CDC 2020). The method of implementing this strategy has been different in every country. For instance, China locked down whole cities, and Italy imposed restrictions throughout the country. In the United States, thousands of people have been subjected to

legally enforceable quarantines (Parmet & Sinha, 2020). In between, the Iranian government utilized the policy of social distancing and home quarantine without military measures (Abdi & Mirzaei, 2020). Iranians are sociable, so social interactions are critical for them (Safdar, Saba and Lay, Clarry and Struthers 2003). As a result, although adherence to quarantine helps maintain good physical health, it might potentially have negative psychological and social consequences (Ammar et al., 2020).

Due to being coerced to stay at home during the quarantine period, the home environment has gained even more importance in the quality of an individual's life. Most of the previous research on the effects of living conditions during Corona virus's pandemic has concentrated on the physical health of residents, which

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is impressed by the design and construction of the building (D'alessandro et al., 2020; Megahed & Ghoneim, 2020; Power, Rogers, & Kadi, 2020; Robillard et al., 2020). Since in this period, people are more exposed to psychological stresses (Song, 2020), studies focusing on the association between the home environment and psychological health should be prioritized (Ghimire et al., 2021; Hoisington et al., 2019; Serafini et al., 2020).

To enhance the quality of life in similar situations, it is essential to identify the most important items of the home environment, which may decrease NPE among residents. The research questions of this study are:

a) What is the association between the home environment characteristics and NPE during quarantine?

b) Which one of the home environment features are the most effective on NPE among residents in the quarantine period?

c) How are psychologically different men and women affected by the home environment features while coerced to stay home for a long time?

## **2. REVIEW OF THE LITERATURE**

Psychological health is a common concern in urban societies, especially during the Coronavirus pandemic (Chu et al., 2020). Following the outbreak of the Coronavirus, various psychological problems such as stress, anxiety, and depression started appearing (Brooks et al., 2020; Gianni et al., 2020; Molanouri Shamsi, Mahdih & Amani Shalamzari, 2020; Serafini et al., (n.d); Shirvani, Bazrafkan, & Afrooz, 2014). Some of these reactions can be just regulatory behaviour in the face of new situations and are not necessarily morbid (Mari et al., 2020). On the other hand, it seems that COVID-19 lockdowns have different effects on mental health for men and women (Vloo et al., 2021).

Studies show that built environment characteristics could influence psychological health (Chu et al., 2020). Our buildings can considerably affect our mental well-being and health (Chu, Thorne, & Guite, 2004). Among the different built environments, residential environments have a central role in the life of people and communities (Moore, 2000). There is clear evidence of the impact of poor housing on the mental health of residents (Evans, Gary and Wells, Nancy M and Moch 2003; Pevalin et al., 2017; Serafini et al., 2020). Studies show that, during quarantine, the individuals forced to stay home were somewhat concerned about housing conditions (Duque-Calvache, Manuel Torrado, & Mesa-Pedrazas, 2020). Alongside that, during quarantine,

the home may become a dangerous place for victims of domestic violence (Mazza et al., 2020).

The size and area of the house are among the essential aspects of well-being and health (Cuerdo-Vilches, Ángel Navas-Martín, & Oteiza, 2021). Most of the families believed that their living space was not suitable for their children to play and study during the quarantine period (Aljunaidy & Adi, 2021). This emphasizes the importance of the area of the house and the number of bedrooms. Living in homes that provide more rooms for a given family is associated with better mental health (Keller et al., 2022). Interpersonal distances and spatial organization play an essential role in feeling comfortable or uncomfortable among residents in various situations (D'alessandro et al., 2020). Therefore, inhabitant crowding not only directly influences the disease outbreak but also might have an impact on the psychological health of the inhabitants (Moloughney, 2004). In some cases, lack of personal space and intrude on privacy made problems for inhabitants (Duque-Ceviche et al., 2020); During quarantine, privacy for all of the family members was one of the main requirements (Bettaieb & Alsabban, 2020). It is worth mentioning that privacy, crowding, and noise pollution can increase psychological distress, but they cannot create serious psychological disorders (Chu et al., 2004; Clark et al., 2007; Evans, Gary W and Wells, Nancy M and Moch 2003). Reducing physical activities besides social isolation are among the possible contributing factors to psychological distress (Araújo et al., 2020). Findings address that recreational and physical activities during long-term homestays have psychological, sociocultural, and physical benefits (Güzel et al., 2020).

Natural light, outside view, noise, and the quality of open and semi-open spaces are other contributors to psychological health (Zarrabi, Yazdanfar, & Hosseini, 2021). Studies indicate environmental factors such as view, daylight, acoustic quality, and green space more affect mental health compared to spaces and functions, and activities (Akbari et al., 2021). While people stay at home for a long time, the outside view becomes extremely important (Bettaieb & Alsabban, 2020; Spano et al., 2021). During this period, home gardening affects mental health (Dzhambov et al., 2021). Keeping plants at home leads to a decrease in self-reported anxiety and anger symptoms. Green views and access to private green spaces were both associated with a lower increase in each of the psychological health outcomes except for green view and recurrent thoughts and/or dreams (Spano et al., 2021); Access to semi-open and open spaces such as balcony or a garden also correlates with a decrease in mental well-being (Groot et al., 2022).

It seems that, during quarantine, people who lived in private houses had better mental health compared to residents of multi-dwelling units, and satisfaction with the kitchen, green space, and exercising (indoor) was important (Akbari et al., 2021). The amount of sunlight in the home was another affecting factor on anger, moodiness, boredom, and irritability (Spano et al., 2021). The dominant colour of space is an important feature as well (Zarrabi et al., 2021). A study revealed that colour diversity directly affected psychological health, and inhabitants with bright walls were associated with fewer reports of child mental problems compared to inhabitants with neutral wall colours (Aljunaidy & Adi, 2021).

According to the literature review, the characteristics of the house are associated with the psychological health of residents during quarantine. Some of these factors are the type of residential building, house size, number of bedrooms, outside views, satisfaction with general lighting quality, amount of colour variety, dominant colour, characteristics of the terrace, possibility of aloneness and solitude, possibility of exercising in the house, noise pollution, and residential satisfaction. The current research will investigate the impacts of the mentioned factors, besides subjective density, and communal areas, on the negative psychological experiences of residents during quarantine. Data analysis will be via AI algorithms. The extent of influence of home environment factors on NPE will be separately discussed for groups of men and women.

### **3. MATERIALS AND METHODS**

A cross-sectional survey was carried out from August 24 to September 5, 2020. Data collection was via an online questionnaire, which was published by free Google Forms software, and the invitation link was disseminated through one of the social media platforms in Iran. At the beginning of the questionnaire, it required only urban inhabitants to participate. The survey was anonymous, and confidentiality was ensured. Participants were allowed to terminate the survey at any time they desired, and non-monetary rewards were given for completing the questionnaire. This online questionnaire collected data in three sections as follows:

Section 1) Demographic characteristics including gender, age, family structure, and general information about the duration of social distancing in the home and the most frequent activities among participants while self-quarantine;

Section 2) Home environment and living conditions during self-quarantine;

Section 3) Negative psychological experiences (NPE) among inhabitants while self-quarantine.

After the distribution of about 30 questionnaires, preliminary investigations were carried out to increase the reliability of the instrument, some questions were eliminated or edited, and the distribution was restarted. Cronbach's alpha from the questionnaire is 0.76, so the reliability of the questionnaire is at an acceptable level.

#### *3.1. Study Participants*

Initially, 831 individuals took part in the survey. Among them, 246 people who lived in villas, as well as 17 people who did not fill the NPE section of the questionnaire besides 32 people who did not adhere to quarantine according to their self-reports, were excluded. Finally, 536 individuals participated in this survey, which seemed enough because descriptive statistics did not change much after adding 100 later samples.

#### *3.2. Data Analysis*

For data analysis, first, some descriptive information is presented. Then, a logistic regression model, as one of the classification algorithms in machine learning has been applied to investigate the association between home environment features and NPE during self-quarantine. The logistic regression model can produce multinomial outputs containing more than two classes; besides that, the predictors can be quantitative or nominal of both types (AbuElgasim Abbas Abow 2022).

The dataset was divided into training and testing datasets with a 70:30 split. During each training section of models, a 30% test dataset was used to experiment with the performance of the models.

This model was trained by predicting three groups or classes of NPE. In the third part of the questionnaire, the amount of (a) feeling sadness, and depression, (b) feeling stress and anxiety, and (c) experiencing domestic violence during the quarantine were asked. The score based on an answer was: not at all = 1, somewhat = 2, and very much = 3. In this research, the mean score of these items is considered an indicator of NPE (Table 1).

For selecting hyperparameters of the logistic regression model, C (100, 10, 1.0, 0.1, 0.01), penalty (none, 11, 12, elasticnet), and solvers (newton-cg, lbfgs, liblinear) were tested, and by each hyperparameter set, the capability of the classifiers to distinguish between classes were compared by accuracy, precision, recall, specificity, f-score, and the

area under the receiver operating characteristic curve (AUROC) (Fawcett, 2006).

#### 4. RESULTS

One hundred twenty-five (23.3%) males and 411(76.6%) females in age ranges below 20 years (9.1%), between 20 and 40 years (72.0%), between 40 and 60 years (16.0%), and above 60 years (2.8%) participated in this study. Among them, just 18 people (3.4%) have spent the quarantine alone, 109 people (20.3%) spent it with one, 140 people (26.1%) with

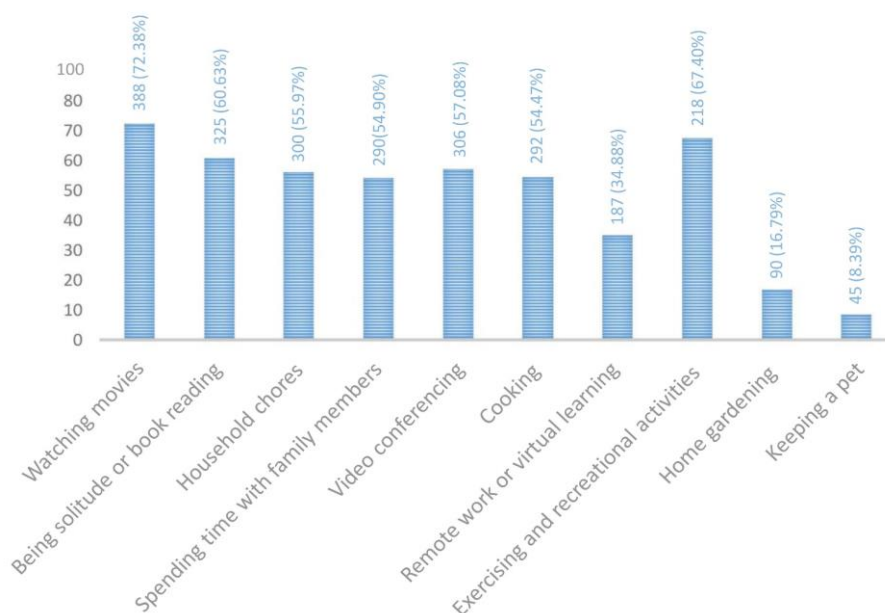
two, 199 people (37.1%) with three, and 70 people (13.1%) with more than three companion shared house during quarantine. Moreover, 36.0% of the participants spent their quarantine in houses between 50 and 100 m<sup>2</sup> with two bedrooms, 20.5% in houses between 100 and 150 m<sup>2</sup> with three bedrooms, and 15.7% in houses between 100 and 150 m<sup>2</sup> with two bedrooms (Table 2). The most common activities that inhabitants have done during the quarantine were watching movies, exercising, and recreational activities, as well as being in solitude or reading books (Figure 1).

**Table 1.** Definition of NPE Classes

Class 1	$1 \leq \text{NPE-score} \leq 1.33$	Inhabitants with the least negative psychological experiences during quarantine
Class 2	$1.66 \leq \text{NPE-score} \leq 2.33$	People who somewhat suffered from negative psychological experiences during quarantine
Class 3	$2.33 \leq \text{NPE-score} \leq 3$	people with very much negative psychological experiences during quarantine

**Table 2.** The Characteristics of the Houses Participants Spent Their Quarantine

		Number of bedrooms				Total
		1 Bedroom N (%)	2 Bedrooms N (%)	3 Bedroom N (%)	More than 3 Bedroom N (%)	
House size	$\geq 150 \text{ m}^2$	1 (0.2%)	8(1.5%)	54(10.1%)	9 (1.7%)	72(13.4%)
	100-150 m <sup>2</sup>	1(0.2%)	84(15.7%)	110(20.5%)	1 (0.2%)	196(36.6%)
	50-100 m <sup>2</sup>	44(8.2%)	195(40.0%)	4(0.7%)	0(0.0%)	243(49.0%)
	$\leq 50 \text{ m}^2$	21(3.9%)	1(0.2%)	0(0.0%)	0(0.0%)	23(4.3%)
Total		67(12.5%)	288(53.7%)	167(31.5%)	10(1.9%)	536(100.0%)



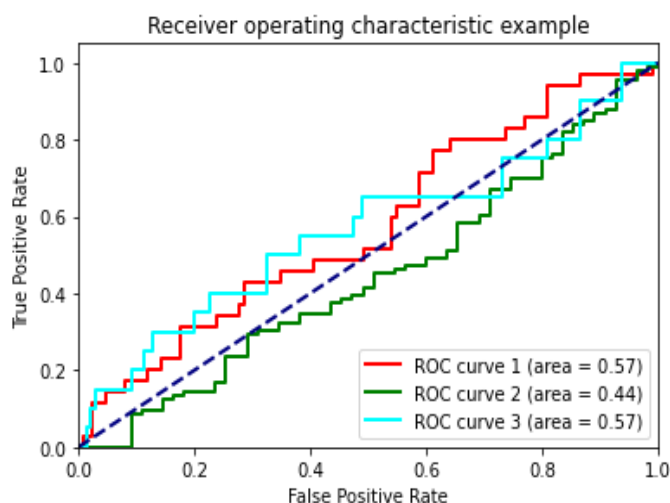
**Fig 1.** Common Activities during Quarantine

#### 4.1. The Logistic Regression Model

For pre-processing data, missing (NaN) values were replaced by particular means. After that, with 70% of the dataset (376 individuals) and 16 input features, the logistic regression model was trained to predict and divide people into three classes based on NPE. Selected hyperparameters for this model were: C = 0.1, penalty = l2, and solve r= newton-cg. Considering a 30% test dataset (160 individuals) to experiment with the performance of the model, this logistic regression model achieved 73% accuracy, 64% precision, 73% sensitivity, and 69% specificity.

The F-score of the model is 0.66; the AUROC as presented in Fig. 1 is around 0.53 (Figure 2).

Feature importance (FI) report of the logistic regression model, as presented in Table 3, helps compare the impacts of different input features on NPE during the quarantine period. According to column (All), gender is one of the most important features (FI= 0.34), and it seems that women are at higher risk of NPE compared to men. Due to this difference, the model trained separately for men and women as well, and FI of the features have shown in two separate columns (men and women) (Table 3).



**Fig 2.** AUROC in Logistic Regression Algorithm for Predicting NPE Amount

**Table 3.** Data Feature Importance Table

Input feature		Feature Importance (FI) Score		
		All	Male	Female
1	Gender	0.34		
2	Residential Satisfaction	Male		
		Female		
3	Appropriateness of general interior lighting quality	Not at all	-0.43	-0.14
		Somewhat		
		Very much	-0.42	-0.12
4	Noise pollution	Not at all	0.12	0.01
		Somewhat		
		Very much	0.14	0.14
5	Possibility of exercising at home	Not at all	-0.11	-0.24
		Somewhat		
		Very much	-0.03	-0.03
6	subjective density in the house (feelings of being crowded)	House was crowded (annoying)		
		House was crowded (not annoying)	-0.10	-0.30
		Not crowded	-0.08	-0.08
7	Number of bedrooms	one bedroom		
		two bedrooms		
		three bedrooms	-0.09	-0.08
		more than three bedrooms	-0.07	-0.07

Input feature	Feature Importance (FI) Score			
	All	Male	Female	
8 Type of residential building	Apartment Residential complex Tower	0.07	-0.15	0.14
9 Number of people shared the house	1 household 2 households 3 households 4 households More than 4 household	0.06	0.11	0.05
10 Outside views	Towards a cityscape Toward a natural landscape Towards a private space (such as the yard) Facing other buildings Closed and limited view	0.04	0.09	0.06
11 Amount of interior colour diversity	Not at all Somewhat Very much	-0.04	-0.02	-0.04
12 Characteristics of the terrace/balcony	With a place to sit With pots and plants With a disturbing view from other units With a good view.	-0.03	0.06	-0.07
13 The possibility of aloneness and solitude	Possibility to be alone in a private room. Possibility to be alone without a private room Not possible to be alone	0.03	0.05	-0.03
14 Dominant colours	Neutral colours (white-cream-gray) Cold colours (blue, green, lilac) Warm colours (red, yellow, and orange)	-0.03	-0.05	-0.02
15 (Communal) area been used during quarantine	Corridor and lobby areas Clubhouse (gym, swimming pools) Meeting room (party room) Roof Green spaces Private yard	0.02	0.04	-0.01
16 House size	≥150 m2 100-150 m2 50-100 m2 ≤ 50 m2	-0.01	-0.01	-0.05

## 5. DISCUSSION

According to the results, the home environment affects NPE. It seems that the level of residential satisfaction during the quarantine has been the most important factor (FI= - 0.43), especially for women (FI= - 0.42) compared to men (FI= - 0.14). A more critical role in taking care of the family and doing household chores may be the reason. Another study also confirms that if the level of residential satisfaction is higher, the residents will have better mental health (Akbari et al., 2021). General interior lighting quality

(FI= - 0.20) is the second most important feature affecting NPE; it affects men (FI = - 0.25) more than women (FI = - 0.12). Another research conducted in Iran has also emphasized the significance of daylight on mental health during quarantine (Zarrabi et al., 2021).

The possibility of exercising at home (FI = - 0.11), just among men (FI = - 0.24), is another important factor affecting NPE. This result aligns with previous similar research (Akbari et al., 2021). The probable reason is that exercise has reduced depression and anxiety levels during the pandemic and has made

people happy (Ai et al., 2021). On the contrary, this factor has not been very effective among Iranian women (FI = - 0.03).

Noise pollution such as household sounds, and from the television set to music playing on the stereo or computer, vacuum cleaners, fans and coolers, washing machines, dishwashers, etc. has been annoying for most individuals during the quarantine (FI = - 0.12). Women (FI = - 0.14) have been more sensitive in this respect, and it has not been a significant factor for men (FI = - 0.01). Generally, the more the residents perceived their homes to be annoyingly crowded, the more they were exposed to NPE (FI = - 0.01). During the quarantine, the effect of the subjective density was much higher in men (FI = - 0.30) than in women (FI = - 0.08). According to similar studies, the simultaneous presence of all family members caused the feeling of being overcrowded among residents. Therefore, they experienced a higher level of anxiety, and the possibility of solitude overshadowed them (Groot et al., 2022; Keller et al., 2022; Mohareb, 2020).

It is noteworthy that, based on the findings of this research, house size, household density (the ratio of family members to bedrooms in the home), and the possibility of solitude were not among the most effective factors on NPE. Probably the living conditions of the participants, who often lived in houses with two or more than two bedroom, has decreased the effectiveness of this feature.

The type of residential building had a different effect on the level of NPE among men (FI = - 0.15) and women (FI = - 0.14). Seemingly, men, living in a tower and women, living in single-unit apartments, had better psychological status during the quarantine.

As shown in Table 3, other characteristics of the home environment include the amount of interior colour diversity, the dominant colours of the house, number of people shared the house, house size, the number of bedrooms, the possibility of solitude, outside views, the characteristics of the terrace/balcony, and (Communal) areas been used during the quarantine have also associated with the amount of NPE. However, their impacts were less than the discussed features.

## 6. CONCLUSION

Quarantine, a measure to slow the spread of Coronavirus, has changed the life routine of people. The most common activities during the quarantine were watching movies, exercising, and recreational activities, as well as being in solitude and reading books. On the other hand, long-term staying at home has made residents at risk of different psychological

distress. The results of this research confirm that the home environment affects NPE, especially among women, during quarantine.

Generally, the individuals who were more satisfied with their house performance during quarantine, people who considered the light quality of their house as appropriate, and residents with less noise disturbance issues had a better mood during this period. Conversely, failure in the possibility of indoor exercising and the feeling of being in an overcrowded house increased the level of NPE.

The feeling of being overcrowded, general interior lighting quality, the possibility of exercising at home, the type of residential building, and residential satisfaction are the most important factors affecting men's NPE. While for women, residential satisfaction, the type of the residential building, being exposed to noise pollution, and general interior lighting quality are the most effective features of NPE.

Future research can focus on exploring the association between the housing characteristics and psychological disorders of different age groups during quarantine. Studying the psychological effects of the home environment in long-term homestays helps on improving the quality of residential unit design concerning boosting the mental health of residents.

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