

Influence of landscape outside the window on the anxiety level of self-separation people during COVID-19

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Abstract

Windows are the communication medium between indoor and outdoor, but their influence and the corresponding landscape outside the window are often ignored due to the outdoor frequent activities of people. The coronavirus disease 2019 (COVID-19) has been a better choice to show the window performance, especially for the anxiety level alleviation of people isolated at home. A national survey was conducted on the anxiety of self-separation people and the window influence. The results showed that the average anxiety level was 1.54, between a little anxious and anxious, due to the COVID-19. The best satisfaction with the landscape outside the window was waterscape (2.98), followed by green plants (2.33) and buildings (0.83). During the COVID-19, the average number of overlook times increased by 1.49 times/day, which is higher 0.42 times/day than the normal condition. The landscape types had the certain influence on the overlook frequency, the window opening times and even the anxiety level. The average anxiety levels are 1.36 and 1.68 with natural landscapes and human landscapes, respectively. Optimizing the landscapes outside the window plays an important role in alleviating the anxiety of residents and improving their mental health.

Keywords: analysis of variance; overlook; the landscape outside the window; anxiety levels

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1 INTRODUCTION

People living in cities spent 80% of their time indoors [1, 2]. As the urban population has led to a higher density of buildings [3], people have less access to nature. In addition, the long-time lack of physical activities and direct contact with nature would increase the psychological pressure [4]. Moreover, it could lead to the increase of chronic stress [5, 6], which may result in anxiety, depression and coronary heart disease [7, 8]. Due to the coronavirus disease 2019 (COVID-19), people had to be

isolated indoors for a long time, making it more difficult to relieve psychological stress and heightened anxiety [9–11]. Exposure to the natural environment could contribute to the better recovery [12], such as adding green plants indoors and getting in touch with nature outdoors, which could effectively relieve people's anxiety and improve the quality of life [13]. Windows were very prominent in communication with outdoor natural environment, such as providing a certain natural proximity and bring sunlight and vision [14, 15]. Its role during the COVID-19 needs to be appreciated.

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People will gradually be adversely affected by the environment in the windowless space [16, 17], while the function of the windows for lighting and ventilation, introducing outdoor landscape and providing comfort [18, 19] could provide a positive psychological influence. Occupants could feel comfortable by looking out the window and observing the restorative landscape, and natural landscape could restore people's attention and calm people's stress response [20, 21]. Restorative landscape not only included natural landscape, but also the sky, street trees and greening in the city [22, 23]. Benfield *et al.* [24] compared the writing performance of students in two classrooms with the same design but different outdoor landscapes and found that students in classrooms with outdoor natural elements could get more positive thoughts and better grades. Ulrich *et al.* [25, 26] confirmed that the landscape outside the window was also restorative, when people viewed from inside to outside. People in restorative scenes paid more attention than those in non-restorative environments when watching outdoor scenes [27, 28]. This was because people had a certain preference for the form of natural landscape [29], and people paid more attention to the landscape with higher fractal dimension [30]. This confirmed the necessity of people's contact with nature in the process of urban life [31, 32].

Opening and closing the window reflected people's adjustment to the living environment and was the performance of the occupants' control over the indoor environment. Toftum [33] found that people were more satisfied with the space, which could control the indoor environment. Zhang *et al.* [34] confirmed that opening and closing the windows could mainly regulate indoor temperature and humidity. Meinke [35] investigated the behaviors adopted by residents to meet their own thermal comfort and found that most people would give priority to opening the window or undressing to adjust. Jones *et al.* [36] studied the behavior of opening and closing the windows of British houses when the indoor physical environment was subject to a series of variables and then obtained the behavior model of opening and closing the windows of British houses.

More attention was paid to the surrounding landscape and environment, and the landscape outside windows often was ignored subconsciously, although its influence is larger especially in alleviating anxiety and fatigue. This study explored the physical and mental effects of the windows as a medium of communication between occupants and the outside world under the pressures of the COVID-19, when people must be isolated at home. The influence of the landscape outside the window was discussed on alleviating the anxiety of the people in isolation by employing the questionnaire, and some suggestions were put forward on the view setting outside the windows.

2 MATERIALS AND METHODS

2.1 Questionnaire survey time and scope

The questionnaire used in this study was self-designed based on the Questionnaire Design Platform of Questionnaire Star, and the filling period was from March 8, 2020 to March 19, 2020

(Figure 1a). A total of 3516 WeChat answers were received from people in 34 provincial administrative regions (Figure 1b). There were 3401 valid questionnaires, with an effective rate of 96.73%. Up to the research time of this study, more than 2 months had passed since people were isolated at home, and the COVID-19 was still spreading, with the confirmation rate at its peak. Therefore, the data of the questionnaire survey could truly reflect people's reactions.

2.2 Questionnaire survey contents

As shown in the Figure 2, the survey of this questionnaire was mainly divided into three parts. The first part was about demographic factors such as age and gender of the participants. The second part was mainly the anxiety level during the COVID-19, the degree of the subjective evaluation of window in releasing anxiety, the main types of landscape outside the window, the satisfaction of the landscape outside the window and other issues. The third part was the behavioral factors of the participants before and during the COVID-19, including the times of overlooking and the times of opening windows. This questionnaire comprehensively investigated the anxiety of quarantined personnel and their interaction with windows before and during the COVID-19.

2.3 Research method

The data used in this study were questionnaires on anxiety and landscape factors of the population at home during the COVID-19. Analysis of variance was used to establish a model of the relationship between anxiety and its significant influence indicators in the population at home during the COVID-19, and the influence relationship was specifically studied.

3 RESULTS

Table 1 shows the gender, age, occupation distribution and proportion of the surveyed personnel. It could be seen that the participants were mainly aged between 18 and 35, and the proportion of males was 17.9% higher than females. The occupations of the participants were mainly students, teachers and civil servants.

3.1 Analysis of demographic factors

Figure 3 shows the probability density of anxiety levels and the anxiety levels of with anxiety levels, genders, ages and occupations. As seen in Figure 3a, due to the influence of the COVID-19, 74.92% of the participants were anxious, and 26.76% of the participants were extremely anxious. The overall anxiety level of participants was 1.54, between a little anxious and anxious, indicating that the COVID-19 has created the certain anxiety. From the variation of anxiety levels with gender in Figure 3b, the average anxiety level of women was 1.88, which was 0.58 higher than that of men of 1.30. It showed that women were more anxious than men when faced with the COVID-19. From

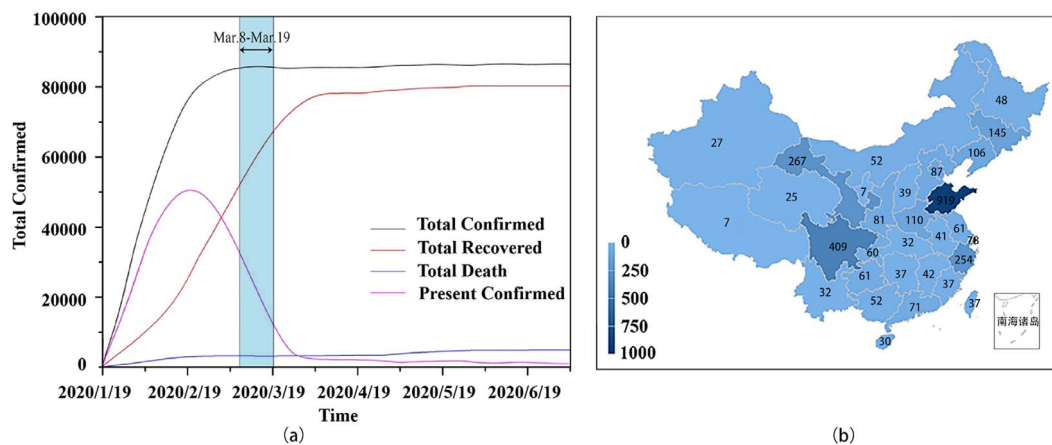


Figure 1. (a) The development trend of the COVID-19 and questionnaire survey time period. (b) Distribution of questionnaires in each province of China.

Table 1. The basic characteristics of the studied self-isolated population, N (%).

		Study population	
		Number	Percentage (%)
Gender	Male	1396	41.05
	Female	2005	58.95
Age	<18 years old	236	6.94
	18–25 years old	1019	29.96
	26–35 years old	1049	30.84
	36–45 years old	377	11.08
	46–60 years old	479	14.08
	>60 years old	241	7.09
Occupation	Students	1047	30.79
	Civil servants	376	11.06
	Teachers	710	20.88
	Doctors	274	8.06
	Freelancers	138	4.06
	General staffs	376	11.06
	Unemployed	241	7.09
	Retirees	239	7.03

variation of anxiety levels with ages in Figure 3c, the anxiety level of people of 26–35 years old and 36–45 years old were the highest with an average of 1.73, while the anxiety level of people under 18 years old and 18–25 years old were the lowest, with an average of 1.42. This phenomenon was due to that those aged lower than 25 years old were usually in the school or the college, while those aged between 26 and 45 years old were the main income source, which had been largely affected by the COVID-19. From the variation of anxiety levels with occupations in Figure 3d, doctors and the unemployed had a higher anxiety level among the participants, and their anxiety levels were 2.81 and 1.98, respectively. The anxiety level of general staffs and retirees were 1.73 and 1.71, respectively. The anxiety levels of teachers, freelancers, government employees and students were relatively low, which were 1.58, 1.49, 1.37 and 1.03, respectively. This indicated that doctors were under great work pressure and had serious anxiety due to the COVID-19. The unemployed had a higher level of anxiety due to economic problems such as loss of income sources and difficulty in maintaining household expenses. The teachers,

freelancers, government employees and students had a relatively stable occupation, and their anxiety was lower.

3.2 Analysis of landscape outside the window

Figure 4a shows the proportion of the actual and expected landscape outside the window during the COVID-19. As shown, the proportion of the landscapes outside the window were 37.4%, 30.61%, 18.91%, 6.73% and 6.35% for buildings, green plants, streets and squares, respectively. However, the expected landscapes are mainly green plants and waterscape, and their proportion were up to 50.22% and 41.69%. It showed that more than 50% of landscapes outside the window were not the same as expected. Figure 4b shows the landscape satisfaction outside the window during the COVID-19. The satisfaction level votes on the landscapes outside the window were 2.66 and 1.17 for natural and human landscapes, respectively, which indicated the isolated people were more satisfied with the natural landscapes than human landscapes. Figure 4c shows the anxiety level with landscapes

A questionnaire survey on the relationship between anxiety and the window indoor


Hello, thank you very much for participating in the questionnaire of anxiety and landscape factors during the epidemic. Your opinions are very important to our study, so please fill in this questionnaire according your feelings factually and carefully. We will keep your answers secret. Thank you for your support and cooperation.


SECTION ONE


Gender: Male / Female Age: ≤18 18-25 26-35 36-45 46-60 ≥60

Occupation: Civil servant Teacher Doctor Freelance General staff
 Unemployed Retiree Student

SECTION TWO

1. How anxious are you during the epidemic?

 As usual (0) A little anxious (1) Anxious (2) Very anxious (3)

2. Do you think the existence of windows can alleviate anxiety?

 No effect (0) A little effect (1) More important (2) Particularly important (3)

3. Are you satisfied with the view outside the window of your living room?

 Dissatisfied (0) A little dissatisfied (1) Moderate (2) Satisfied (3) Very satisfied (4)

4. What is the main landscape outside the window of your living room?
 Building Green plants Street Waterscape Square

5. Which landscape do you expect to see out of the window?
 Building Green plants Street Waterscape Square

SECTION THREE

6. Before the epidemic, how many times did you look far away every day?
 0 1 2 3 4 5 6 ≥7

7. During the epidemic, how many times did you look far away every day?
 0 1 2 3 4 5 6 ≥7

8. Before the epidemic, how many times did you open the windows every day?
 0 1 2 3 4 ≥5

9. Before the epidemic, how many times did you open the windows every day?
 0 1 2 3 4 ≥5

Figure 2. The questionnaire of survey on the relation between anxiety and window indoor.

outside the window. People had a lower average anxiety level of 1.37 for natural landscapes outside the window, while they had a higher average anxiety level of 1.67 for human landscapes outside the window. It showed that different landscapes outside the window had different effects on alleviating people’s anxiety, and natural landscapes made people’s anxiety levels lower.

3.3 Correlation analysis of interaction factors with window and landscape outside the window

Figure 5 shows the alleviation benefits of landscapes outside the window on the anxiety level during the COVID-19. As showed, the average alleviation level to the isolated person was 1.83, which was between ‘a little effect’ and ‘effect’, but more inclined to ‘effect’. At the same time, 90.94% of the participants believed that the windows had the alleviation benefit on anxiety. Among them, 30.96% thought windows played an important role, 26.99% thought windows played a relatively important role and 30.4% thought windows had little effect on relieving anxiety. Only 11.64% of the participants believed that the windows had no role in alleviating anxiety. It could be seen that during the COVID-19, windows

played an important role in alleviating people’s anxiety as a medium connecting indoor and outdoor space when people could not go out.

Figure 6 shows the overlook frequency and the overlook frequency with landscapes outside the window before and during the COVID-19. As shown in Figure 6a, the average overlook frequency was 2.41 times a day before the COVID-19, while that was 3.90 times a day during the COVID-19, increasing 1.49 times a day. This showed that the overlook frequency significantly increased during the COVID-19 as people sought to interact with the outside world in prolonged isolation. Figure 6b shows the overlook frequency of different landscapes outside the window before and during the COVID-19. Before the COVID-19, there were significant differences in the overlook frequency of the different landscapes outside the windows. The daily average overlook frequency of waterscape was the highest of 3.12 times. It was followed by green plants of 2.71 times. The daily average overlook frequency of buildings and streets were 2.26 and 2.13 times, respectively. Moreover, the squares had the lowest overlook frequency of 1.95 times. During the COVID-19, the overlook frequency of all landscapes increased significantly. The overlook frequency was 4.46, 4.37, 4.01, 3.63 and 3.33 times per day for green plants, waterscape, squares, buildings and street, respectively. The waterscape had the highest overlook frequency. It showed that people preferred to overlook natural landscapes such as green plants and waterscape, compared with the human landscapes such as streets, buildings and squares outside the window.

Figure 7a shows the comparative analysis of the window opening times before and during the COVID-19. The window opening frequency increased during the COVID-19 compared with that before. The average window opening frequency was 1.76 times per day before the COVID-19 and 2.18 times per day during the COVID-19, with an increase of 0.42 times per day. The main function of opening windows was to increase indoor air flow and fresh air and regulate indoor thermal environment. This indicated that during the COVID-19, the awareness of ventilation was enhanced. Figure 7b shows the comparison of window opening frequency among different landscapes outside the window. Before the COVID-19, the window opening frequency of waterscape was the highest of 2.87 times a day, followed by green plants (1.94 times a day); the window opening frequency of other landscapes (1.59 times a day on average) outside the window was about the same. During the COVID-19, the window opening frequency among different landscapes increased significantly. It was 3.37 times for waterscape and 2.46 times for green plants, increasing by 0.51 times a day on average; the window opening frequency of other landscapes (1.20 times a day on average) were roughly the same. The result showed that different landscapes outside the window affected people’s window opening behavior. When the landscape outside the window was natural landscapes such as waterscape and green plants, the frequency of window opening was higher than that of human landscapes such as buildings, streets and squares.

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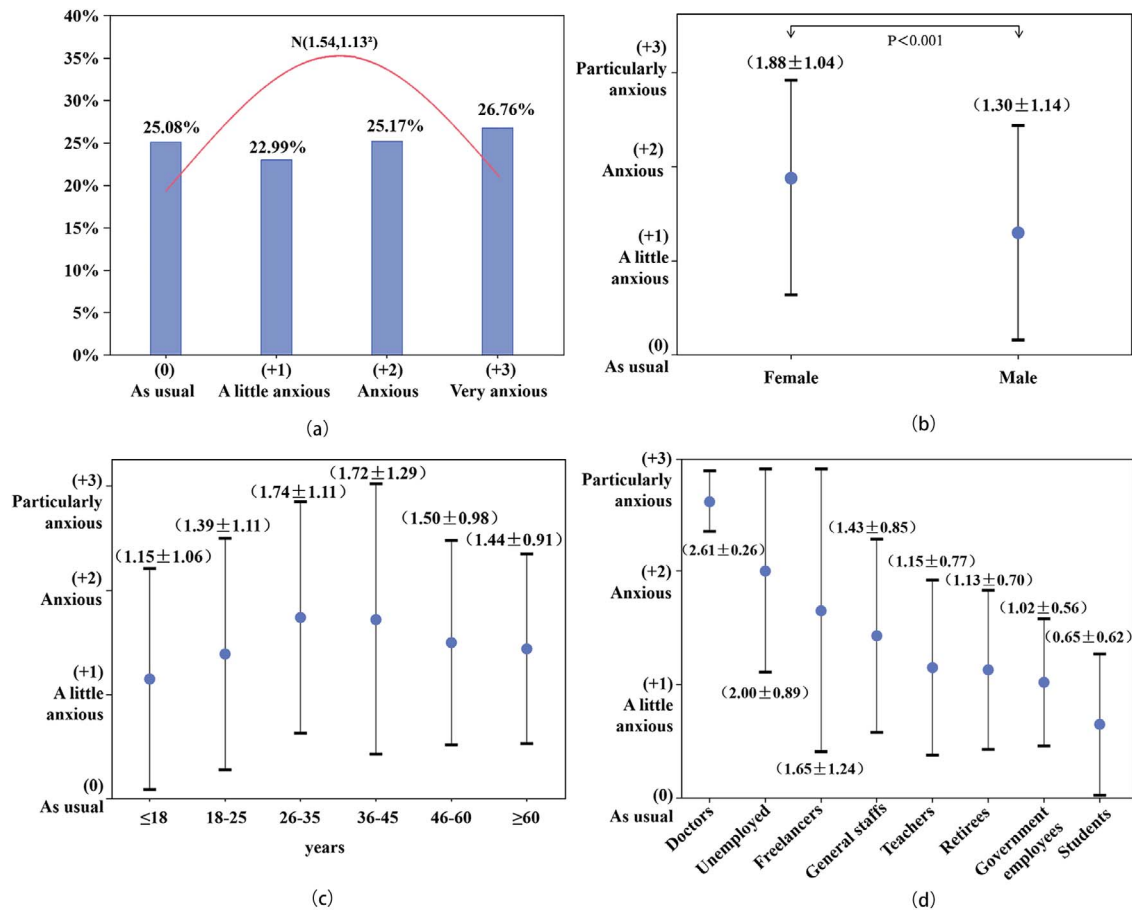


Figure 3. (a) Probability density of anxiety levels and the anxiety levels of with (b) genders, (c) ages and (d) occupations.

4 DISCUSSION

Our findings indicated that 74.92% of the participants were anxious due to the influence of the COVID-19, which was consistent with previous studies [37–39]. In terms of gender, women were more anxious than men when faced with the COVID-19. This may be influenced by hormones, such as progesterone, which is associated with anxiety [40]. In terms of anxiety levels and age, Gambin *et al.* [41] found that the anxiety level of the youth of 18–29 years old was significantly higher than that of middle-aged people of 45–59 years old and the elderly of 60–85 years old, which was slightly different from our findings. We found that the anxiety levels were highest among the young groups aged 26–35 years old and 36–45 years old and lowest among the youth groups aged under 18 years old and 18–25 years old. Moreover, we predict the causes of emotional distress in different age groups. Young people under 25 years old usually study at school and face only singular anxieties, such as the burden of schoolwork or the restrictions of public life imposed by the COVID-19. Young people aged of 26–45 years old face the most stress because their work income was affected severely by the COVID-19, and they have to juggle work and life (including child caring) at the same time. The middle-aged and the elderly aged over 46 years old have more stable family

relationships, occupational status and daily life, so they have less anxiety. However, it is worth noting that while the levels of anxiety varied significantly between particular age groups, there are many other physiological and psychosocial factors contributing to anxiety, such as people’s occupations. Study by Deng *et al.* [42] showed that healthcare workers suffered from higher rates of depression disorder and anxiety disorder compared to the general public. In addition to medical workers, we found that the unemployed also have high levels of anxiety, mainly due to financial problems. The exact cause of the anxiety needs further investigation.

To alleviate the anxiety caused by prolonged isolation during the COVID-19, people try to interact with the outside world through the windows. The reasons are as follows. For one thing, windows can help people shift their attention from psychological worries about the COVID-19 to visual stimulation of the landscape outside the window, so that the interaction between visual and other senses reduce the psychological anxiety [43]. For another, the window triggers the compensation effect of indoor environmental factors [44]. High-quality factors (such as a window) can compensate for the negative impact of low quality factors (such as poor indoor thermal environment) to a certain extent, and the improvement of comfort alleviates people’s anxiety.

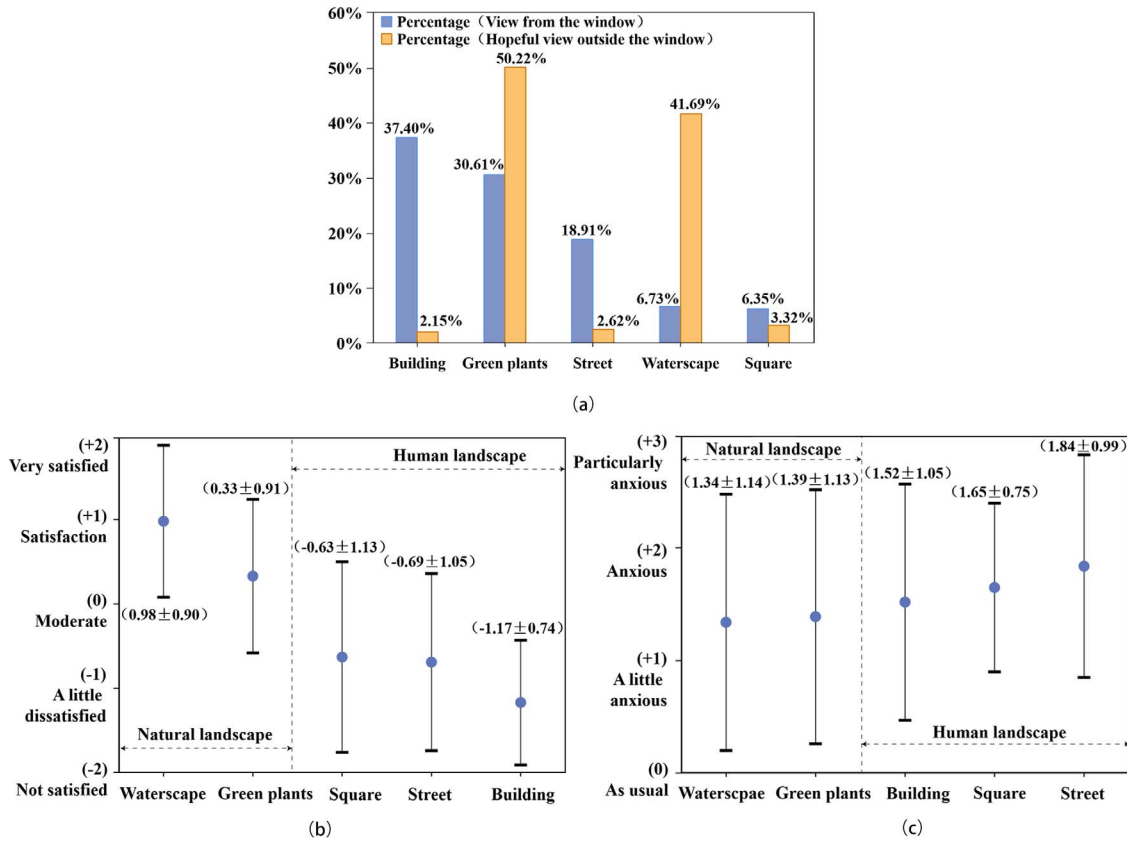


Figure 4. (a) Proportion of the actual and expected landscapes outside the window, (b) the satisfaction level with landscapes outside the window and (c) the anxious level with landscapes outside the window.

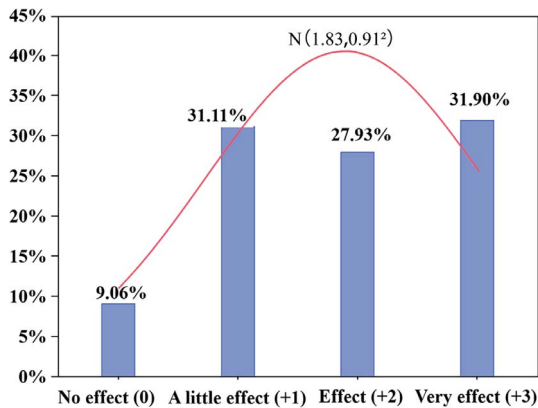


Figure 5. The alleviation benefits of landscape outside the window on the anxiety level during the COVID-19.

For the visual stimulation of the landscape outside the window, people were more satisfied with the natural landscapes than the human landscapes. Some studies also support this conclusion that people generally prefer to immerse themselves in nature rather than in the city [45, 46], possibly because different landscapes have

different physiological and psychological effects on people. Compared with urban space view, viewing green space through window resulted in a significant increase in parasympathetic activity and a significant improvement in subjective emotional states [47]. Studies have proved that green spaces and blue spaces (including water features such as oceans, lakes and rivers) have a positive impact on stress relief, quality of life and well-being [48, 49]. In addition, we further refined the specific classification of natural landscape and human landscape and found that people liked green plants the most and squares the least. Moreover, the increase of the frequency of opening the window varied with different landscape outside the window.

Our study had some advantages. It was based on a large number of samples from different provinces in China, with different genders, ages and occupations, so the sample range was convincing. Moreover, we conducted comparative analysis and correlation analysis of the results. However, our study also had some limitations. The survey was conducted during isolation based on an online questionnaire, so it only analyzed the psychological effects of different landscapes outside the window and did not recruit volunteers to measure the physiological effects. This limited the applicability of the findings.

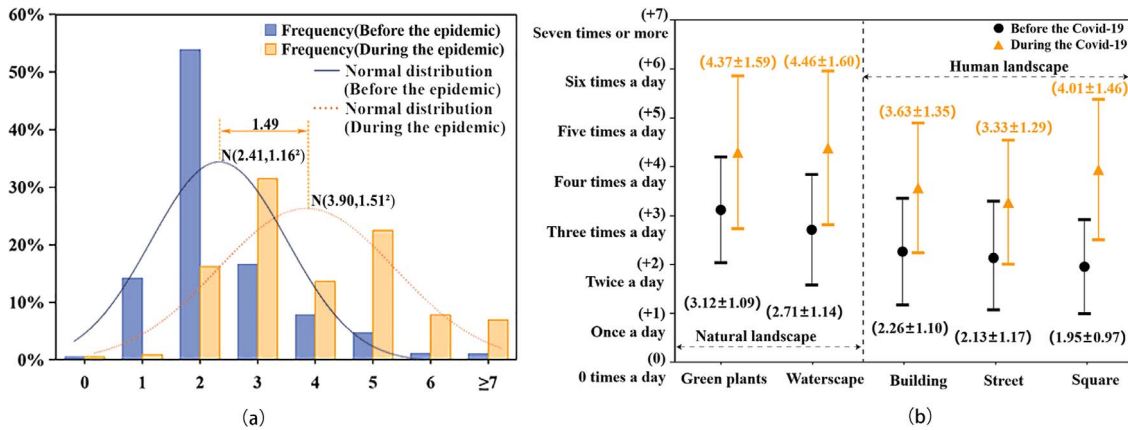


Figure 6. (a) Comparative analysis of the overlook frequency and (b) the overlook frequency with landscape outside the window before and during the COVID-19.

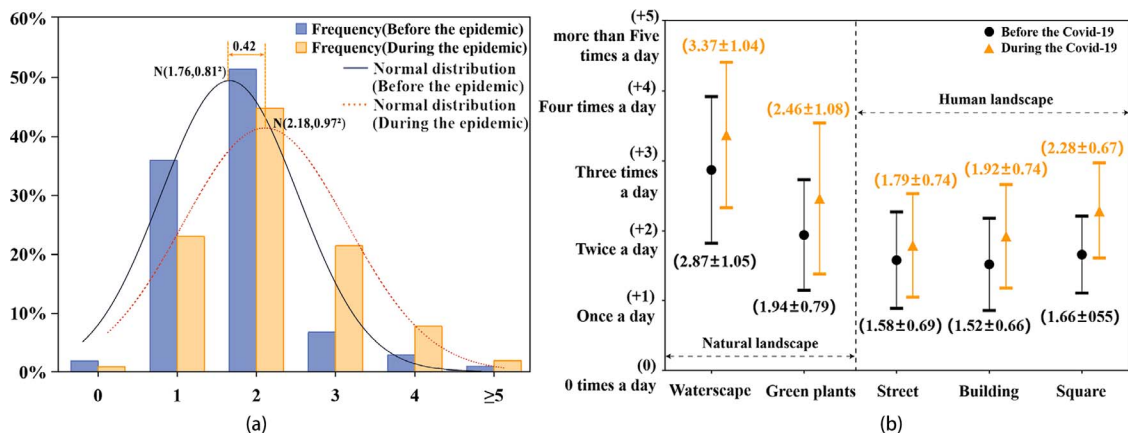


Figure 7. (a) Comparative analysis of the window opening times and (b) the window opening times with landscape outside the window before and during the COVID-19.

5 CONCLUSIONS

The anxiety level was impacted largely by the gender, age and occupations, and the landscapes outside the window had a certain effect on alleviating anxiety. The specific conclusions were as follows:

(1) Owing to the COVID-19, 74.92% of the participants had anxiety, and the overall anxiety level was 1.54, between ‘a little anxious (1)’ and ‘anxious (2)’. Women reported an average of 0.44 more anxiety than men.

(2) The anxiety level in the age group of 26–45 years old was the highest, and its average level was above 1.70, while the anxiety level of the doctors and unemployed people were up to 2.81 and 1.98 respectively, which was very high.

(3) A total of 90.94% of the participants supported that window played a certain role in alleviating anxiety. The average alleviation level of isolated persons from windows was 1.54, between ‘a little effect (1)’ and ‘effect (2)’.

(4) The anxiety level with natural landscapes outside the window was lower 21.9% than that with human landscape, indicating that natural landscape, such as waterscape and green plants, was more conducive to alleviating people’s anxiety.

(5) During the COVID-19, the overlook frequency and window opening times were increased by 61.8% and 23.9%, respectively, which showed that long-term isolated residents had an urgent need for outdoor environment, especially for natural landscape such as green plants and waterscape.

The above study showed that the landscapes outside the window not only affected people’s behaviors such as window opening and overlooking, but also had a certain alleviating effect on anxiety of people who isolated at home for a long time. However, this study was based on a cross-sectional survey in a short period of time on the internet. Further analysis would be done to explore the influence of different outside landscapes on people’s psychological and physiological effects by measuring human blood pressure, heart rate, EMG and EEG, so as to provide reference and basis for people to create comfortable outside landscapes.

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