



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Original article

Urban green spaces and stress during COVID-19 lockdown: A case study for the city of Madrid

Marcela Maury-Mora, María Teresa Gómez-Villarino*, Carmen Varela-Martínez

School of Agricultural, Food and Biosystems Engineering, Universidad Politécnica de Madrid, 28040, Madrid, Spain



ARTICLE INFO

Handling Editor: Wendy Chen

Keywords:

COVID-19
Indoor plants
Isolation
Mental health
Quarantine
Stress
Urban green spaces
Well-being

ABSTRACT

Due to the unexpected emergence of COVID-19, different cities improvised responses to prevent the virus from spreading and infecting the population. Madrid, capital of Spain and one of the most affected cities in Europe, confined everyone home and closed most public and private spaces, including public parks. The whole situation was surely to be responsible for stress-levels to peak. We developed an online survey to better understand the relationship between people and Urban Green Spaces prior to the COVID-19 pandemic, and the new bond that may have emerged from this interruption. We recruited participants, without gender or age preference, excluding underage children and teenagers, using a combination of convenience sample and a snowball approach. A total of 132 responses were logged. The study was limited to mental health inferences, specifically related to stress and its most frequent manifestations among the urban population. These indicators included physical, mood or behavioral changes and were studied on those participants who had access to UGS before and during confinement. Among the most important findings, we confirmed that when people are confronted with stressful situations, indoor plant interaction is not a substitute for different outdoor green experiences; those who interacted with green spaces in a daily manner managed stress levels better than people who didn't (but their effects might lose strength over time); and turning to green spaces for comfort during stressful times when you don't usually do so helps overcome difficult situations. This article contributes to the growing study of green spaces as a means towards improved mental well-being in urban areas.

1. Introduction

Currently, 55 % of the world's population live in cities. It's expected for this number to increase to 68 % by 2050 (United Nations, Department of Economic and Social Affairs, and Population Division., 2019) and for it to continually keep increasing with time. Although city dwellers are, on average, wealthier and receive improved sanitation, nutrition, and health care than their rural counterpart, urban living is also associated with augmented risk for chronic disorders, a more demanding and stressful social environment and greater social disparities (Adli et al., 2017; Lederbogen et al., 2011). This complex relationship between the urban and the human condition has long been a major concern that intensifies as the population of the world's cities rapidly expand (Pykett et al., 2020). In current explorations to identify how urban life affects citizens, stress has been shown as the potential channel through which the urban condition is embodied in the human experience affecting mood, anxiety and psychotic diagnoses

(Lederbogen et al., 2011; Manning, 2019). Due to the certainty of the devastating physical and mental health impacts derived from stress, the World Health Organization (WHO) has listed stress as the "Epidemic of the 21 st Century" (Fink, 2016).

Yet there is much disagreement over the definition, conceptualization, mechanisms and measurement of stress. According to the American Psychological Association stress is the physiological or psychological response to internal or external stressors and involves changes affecting nearly every system of the body, influencing how people feel and behave and causing these mind-body changes, stress contributes directly to psychological and physiological disorder and disease and affects mental and physical health, reducing quality of life.

Even though cities are human being's creation, people have a special connection with nature that needs to be nourished and contact with nature has many beneficial physiological effects related to relaxation or stress reduction (Menzel et al., 2020). Spending time outside in nature is essential to stimulate the immune system and it helps to improve

* Corresponding author at: Universidad Politécnica de Madrid, Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas, Departamento de Ingeniería Agroforestal, 28040, Madrid, Spain.

E-mail addresses: teresa.gomez.villarino@upm.es (M.T. Gómez-Villarino), carmen.varela@upm.es (C. Varela-Martínez).

<https://doi.org/10.1016/j.ufug.2022.127492>

Received 3 August 2021; Received in revised form 3 January 2022; Accepted 28 January 2022

Available online 8 February 2022

1618-8667/© 2022 The Author(s).

Published by Elsevier GmbH. This is an open access article under the CC BY license

(<http://creativecommons.org/licenses/by/4.0/>).

cognitive functions and increase resilience (Bratman et al., 2019; Kuo, 2015; Lawton et al., 2017). Furthermore, restorative influences of nature encompass an alteration towards a more positive emotional state and positive changes in physiological activity levels. The exposure to natural vs human-made assets is decisive in accounting for the differences in recuperation and perceptual intake (Ulrich et al., 1991). In times of stress, the chance to contact more large-scale natural areas further away from home may be just as (or even more) important to manage to stay healthy. When people are faced with major negative life events, such as a loved-one's death or divorce, they need time to reflect on their life, their actions and priorities. Nature can be a means to cope with these difficult events (Kaplan and Kaplan, 1989).

For this reason, there must be a balance between hardscape spaces and green spaces in cities (Russo and Cirella, 2018). One of the most common ways to battle urban stress is to take refuge in urban green spaces (UGS) (Cox et al., 2017). There is an important generalization and association between green spaces and mental health: people are happier, healthier and enjoy greater longevity in spaces with nature, and this includes UGS (Hartig et al., 2014a; Markevych et al., 2017; Qiao et al., 2021). The psychological well-being and the social connection that green spaces provide, especially urban ones, transform them into some sort of shelter (Felappi et al., 2020). The WHO's definition of UGS stands as "all urban land covered by vegetation of any kind. This includes vegetation on private and public grounds, regardless of size and function, and can also include small water bodies such as ponds, lakes or streams (Blue Spaces)" (World Health Organization - Europe, 2017).

The links between UGS and general health have been reviewed in many publications (Dadvand et al., 2016; Gruebner et al., 2017; Markevych et al., 2017; van den Berg et al., 2016). 'Greening' could be a low-cost, high-return investment used by urban and regional planners to positively influence population's mental health (Zhu and Xu, 2021). Stress, anxiety, and depression are known to be associated with a myriad of other adverse health conditions that lead to lost work days and low productivity (Beyer et al., 2014; von Lindern et al., 2016v). Urban parks, forests and natural areas are restorative environments for urban dwellers, and people who have green spaces at their disposal are considered healthier (Tsai et al., 2018; van den Berg et al., 2016; Wood et al., 2017). Those who live beyond a 1 km radius from green space are more likely to experience stress than others who live inside a 300 m radius, however, green spaces further away from home (3 km or more) are particularly important in helping people cope with negative health impacts of stressful life events (Dadvand et al., 2016; Fagerholm et al., 2021; Triguero-Mas et al., 2015; Venter et al., 2021; von Lindern et al., 2016v). It's particularly important to pay attention to low-income or socio-economically vulnerable people and the spaces they live in, as they can have more difficulties accessing green spaces (van den Berg et al., 2016).

When a new pathogen confines the population to their homes, abruptly altering urban human beings' routines and causing new stress levels, UGS that could provide relief become inaccessible. Being confined in closed spaces in an urban context and maintaining little contact with natural environments can negatively affect health and well-being (Brooks et al., 2020; Samuelsson et al., 2020). The global coronavirus pandemic (COVID-19 for this article) of 2020–2021 has a limited public and everyday life.

The Spanish Government, in order to face the health emergency situation caused by COVID-19, approved on March 14, 2020 the declaration of the State of Alarm throughout the Spanish territory. During the established period, the restriction of citizen movement was decreed, remote work was prioritized, face-to-face educational activity was suspended and the temporal closing of different places like parks, restaurants or hotels where cultural, artistic, sport and similar activities was carried out. The main objective of these measures was to protect residents' health, contain the progression of the disease and strengthen the public health system (<https://www.lamoncloa.gob.es/covid-19/Paginas/estado-de-alarma.aspx>). During this period, the population

suffered from sleep and appetite disturbances, anxiety attacks, frustration and anger, pessimism, and even provoking the fear (or even the desire) of dying in sick people (Amerio et al., 2020; Direk Tecirli et al., 2020; Holmes et al., 2020; Soga et al., 2020). The de-escalation of the State of Alarm plan was approved on April 28, 2020, allowing progressively the reintegration of citizens to their urban dwelling and gradually opening different public spaces. The completion of all the phases of de-escalation announced the end of the state of alarm on June 21, 2020 (<https://www.lamoncloa.gob.es/covid-19/Paginas/estado-de-alarma.aspx>).

It's possible that the COVID-19 pandemic, and its consequential financial, social, health and psychological chaos, have increased stress around the world. When lockdown systems were at their most restrictive, people were stuck inside their homes, and the situation led many people to focus on the negative side of the situation, increasing their stress levels (Lu and Huh, 2020; Rajkumar, 2020). Therefore, this study focuses on stress as the key pathogen against mental health. Given that stress manifests in different ways through each individual, its main indicators were chosen.

Madrid's green heritage is varied, with a wide number of different UGS from the ranks of small playgrounds to historic gardens, public parks and urban forests. Madrid also has one of the most extensive tree-alignment urban planification in Europe. This sums up more than 6000 ha of UGS, approximately 18 m² per inhabitant (Ayuntamiento de Madrid, 2009). Citizens were bound to stay home, with permission to go out one hour a day inside a 1 km radius. This authorization was granted at first just for bare necessities such as buying food and medicine. The last few weeks of quarantine, during the de-escalation measures, the authorization was extended to individual sports practices (running, walking). Public spaces such as restaurants, shopping stores and enclosed public parks were all shut (with the last ones opening when people were granted the individual sports permission). Large public parks that couldn't close for lack of a barrier, were limited to pedestrian's quick transit with no permission to linger. Aside from the tree-linings in sidewalks and boulevards, people lost full access to UGS.

This study aims to understand the relationship that people had with UGS prior to the COVID-19 pandemic and the new bond that may have emerged from the separation, and more specifically: i) determine the impact on stress levels caused by the lack of interaction with UGS due to induced COVID-19 lockdowns, ii) compare the public's perception of UGS before and after total lockdown, iii) identify the main manifestations of stress caused by isolation, iv) understand if indoor plants function as a substitute for UGS and v) analyze how people who made daily use of UGS before and during lockdown were affected by increasing, keeping or losing access to these spaces.

The hypothesis we work with incorporates the prediction that people will have greater symptoms of stress during lockdown than before. Changes in their routines, combined with being confined in their homes with no freedom to come and go as they wish, or little to no information of a cure will add to these symptoms. These circumstances, and probably the accumulation of feelings like nostalgia, can possibly lead people to give greater value to those UGS that were available to them. It is likely that most people agree on keeping such spaces open, as it is a safe way to go out and be distracted during confinement.

2. Materials and methods

2.1. Study design

The online survey, based on the review of literature regarding the impact of UGS on mental wellbeing, was developed to be anonymously responded online using Google Forms from May 13, 2020, to June 26, 2020. This was 2 months after the initial date in which the Spanish government stated a decree declaring the country under "state of alarm", to manage the new health crisis situation. An original Spanish version was formulated, later translated to English to include non-

Spanish speakers, to understand how frequently people used UGS, in which way and who they shared the interaction of UGS with, which sensation UGS provided and how important were UGS personally. At the beginning of the survey, the confidentiality of the research was guaranteed. The anonymous responses to the online survey were used as main database.

The survey consisted of 40 questions in 4 different parts: the first section had a series of questions regarding the individual's profile and the second section included the description of their current residence and living space typology. The third section studied the participants use and appreciation of UGS prior to lockdown, aiming to understand and gather information about the respondents nearest green spaces (1 km and 3 km).

Lastly a fourth section concerning the isolation due to COVID-19 in Phase Zero of the State of Alarm, which included questions as: which UGS were closed in their neighborhood, whether it was a good idea to keep UGS open, and their new relationship with UGS: how frequently, in which way and who they shared the interaction of UGS with. It comprised as well the sensation their confinement space gave them, who they shared their space with and whether they were vulnerable to the virus, if they were working or studying, what they missed the most of their prior lifestyle, and the importance they gave UGS during quarantine. It ended with the stress conditions they suffered prior to and during the confinement. There was also an option to provide additional comments at the end of the survey.

According Sierra's recommendations, it was ensured that all questions about an aspect or dimension were included together in the questionnaire, keeping a temporal, logical and psychological order (Bravo and Restituto, 1998).

Questions summarized in Table 1 were mostly closed-formed and multiple-choice type and some items were based on validated stress scales (Molina, 2005). There were some open questions that included the participant's opinion but these were not considered for this analysis. For the precise questions used in this study, see Appendix.

Participants were inquired about the appreciation of their own mental health. Self-assessment of mental health tends to be more related to stressful life events (van den Berg et al., 2010), therefore, it was

Table 1
Questionnaire structure.

Section	Description	Question items
1	Concerns about individual's profile	Age/ Gender/ Education/ Hometown / Residence location
2	Typology and description of their current residence location	Typology/ Population
2	Typology and description of their living space	Housing typology/ Private Green Spaces typology
2	Transport method	Transport method
3	About participants use of UGS prior to Covid-19 lockdown	Accessibility and typology of UGS (d < 1 km)/ Accessibility and typology of UGS (1 km < d < 3 km)/ Frequency of use/ Typology of use/UGS Sharing
3	About participants appreciation of UGS prior to Covid-19 lockdown	UGS Perception/UGS Importance
4	About participants interaction of UGS during Phase Zero Covid-19 lockdown	Accessibility and typology of UGS/ Frequency of use/ Typology of use/ UGS sharing
4	About participants appreciation of UGS during Phase Zero Covid-19 lockdown	UGS Perception/UGS Importance
4	About confinement living space	Perception/Sharing/ Description of working-studying place
4	About lifestyle	Missed lifestyle
4	About health prior lockdown	Self-perception/Stress conditions suffered
4	About health during lockdown	Self-perception/Stress conditions suffered

important to carry on with the survey when people were going through this crisis and not after having endured it, because they responded to what they felt at that moment (Lehberger et al., 2021; Poortinga et al., 2021), and not so much to a memory of what they may have felt at the time.

The participant's sample included anyone over the age of 18 with internet access. It was decided that children and teenagers would need a different kind of approach, and since there were no possibilities of going out of for a door-to-door survey, the formulation was unavoidably on-line. The distribution of the questionnaire was performed mainly through social networks (Twitter, Facebook, Instagram) and communication channels (WhatsApp, e-mail and links) using a snowball approach.

2.2. Sampling and data management

The survey was carried out in Madrid, capital city of Spain, one of Europe's most affected cities of the first wave (WHO Coronavirus (COVID-19) Dashboard, 2021), and Spain's critical area. The survey was open to the public while the "Phase Zero" of greatest confinement was operating in Madrid (May 13, 2020, to June 26, 2020, as mentioned before). A total of 132 responses were logged. It was intended that the largest number of people participated in the survey, without gender or age preference, excluding underage children and teenagers. Participants to had recall UGS and their sensations solely through remembrance, not being able to leave their homes and experience these spaces physically, while experiencing social distancing and confinement first hand.

Based on the statements of the WHO and experts that imply that stress levels increased with the quarantine confinement due to COVID-19 (Direk Tecirli et al., 2020), the study was limited to mental health relating specifically to stress and its most frequent conditions among the urban population ("How Stress Levels Are Measured," n.d., "Stress Effects - The American Institute of Stress," n.d., "Stress Management: Enhance your well-being by reducing stress and building resilience - Harvard Health," n.d., "Stress Symptoms, Signs, and Causes - HelpGuide.org," n.d.). These conditions were divided in different manifestations: physical (head, muscle, chest and stomach aches, fatigue, changes in sexual desire: with the decrease being the most typical and insomnia), mood (anxiety, restlessness, lack of motivation or concentration, irritability, frustration or anger, depression, anguish or sadness) or behavior (changes in food intake: overeating or eating less, outbursts of anger, increased intake of alcohol or drugs, tobacco use, social seclusion, and decreased exercise). The presence of these symptoms was studied in the participants based on access to UGS before and during confinement and its frequency of use according to Fig. 1.

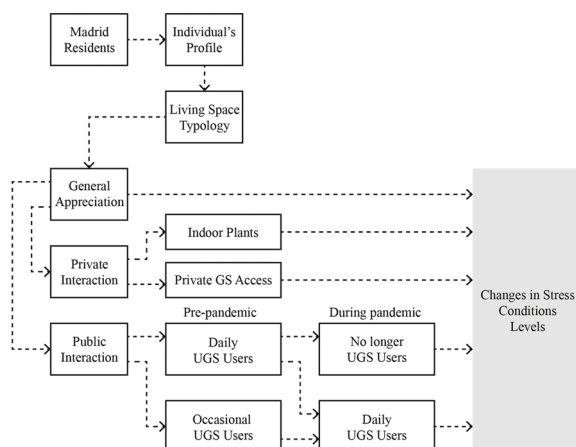


Fig. 1. Main analysis direction.

3. Results and discussion

3.1. Sample characteristics

Participants were recruited through convenience sampling via the authors' professional email networks and through School of Agricultural, Food and Biosystems Engineering social media platforms (Facebook, Instagram) and the Gardening and Landscape Master's contacts. Since the survey was open to anyone over the age of 18 who lived in Madrid at the time of data collection, prior to the start of the pandemic and/or stayed in the city during lockdown, anyone we reached through our recruiting efforts were asked to share with others as a form of snowball sampling.

Regarding the participant's profile, 64 % of them were female, around 41–55 (40 %) and 31–40 (24 %) years old. 87 participants (66 %) acknowledged themselves as Master degree graduates and 17 participants (13 %) as p.H.D.'s, making each category of education too small to be able to calculate meaningful statistical analysis. For that reason, we generalize the participant's profile as higher educated. Residing in Madrid, most of them in apartments (61 %) and studios (32 %). According to the participants of the survey, the vast majority of them don't have green spaces like private gardens (83 %), patios or courtyards (69 %) or backyards (85 %) at home, but 66 % of them dedicate an area for plants inside their living space, which allowed them to interact with nature on a small scale, possibly assisting them with a distraction from the daily hustle and reduction of stress levels (Hunter et al., 2019; Lehberger et al., 2021; Pérez-Urrestarazu et al., 2021; Spano et al., 2021). Detailed data of the sample can be found in Table 2.

3.2. Main findings

Most respondents agree that it is a good idea to keep UGS open. Their main reasons have to do with health, especially mental health, recognizing people seek natural environments to relax. These environments reduce the physiological measures of stress (Ward Thompson, 2011) and appear to be more effective for improvement of well-being than the promotion of physical activity (Hartig et al., 2014). Before quarantine, both benefits: green exercise with little impact (Barton and Pretty, 2010) and use of the USG, were reinforced with 86 % of people using these

spaces for walking. Whether people were walking for mental restoration, physical benefits or both is unclear. Across Europe, people share a prevalence for the physical uses of parks, especially taking a walk. The sociocultural context matters particularly for physical park uses and is associated to a lesser extent with nature-related uses, which is why it's important to consider the specific backgrounds of people (Fischer et al., 2018). However, the quarantine drastically affected this use with a significant reduction of 34 %. All along, it remains the citizen's favored activity (Fig. 2a).

As shown in Fig. 2b and associated with the theory that people need solitary encounters with nature for mental restoration due to stress (Pálsdóttir et al., 2014) the preferred way of interacting with UGS is solitary (72 % pre-lockdown and 42 % during).

During confinement, different conditions that sum up to stress such as restlessness, little exercise, lack of motivation or focus, anxiety and muscle tension or pain were quite high, while stress manifestations as chest pain, irritability or anger, sadness or depression, upset stomach and low sex drive were very low before lockdown (Fig. 3). That supports the theory that interaction with GS provides physical improvements (Kuo, 2015). Stress manifestations that increased the most were drug or alcohol misuse, irritability or anger, social withdrawal (even more than the social distancing, people refused to talk or see other people), sadness or depression and lack of motivation or focus. There were only 2 decreases in percentage, those who reported no stress symptoms and tobacco use. This can be misleading, given that the tobacco question during quarantine included the disclaimer to only consider it if people started, resumed or increased consumption, and their reasons for decreasing their smoking habits can be numerous (not allowed to smoke inside premises, not being able to go out and buy, etc.) (Table 3).

The number of stress symptoms among people without green space at home (solely indoor-plant interaction) before lockdown began (Fig. 4a) was slightly higher than people with green space (gardens, patios, courtyards or backyards and no indoor plants) contact at home (Fig. 4b; Table 4). This is in line with past studies: indoor plants, although supportive, are not a surrogate for interaction with GS, and alternate actions such as looking out a window (Taylor et al., 2002) or interacting with simulated spaces (such as television) (van den Berg et al., 2010) may have the same effect.

On the other hand, people with green space at home (Fig. 4b) had more stress symptoms than those with indoor plants during lockdown. This may have been caused by the inability to access the shared green space(s) at their apartment or home complexes to avoid neighbor interactions and found no solace with indoor plants because they had none, meaning they lost all access to vegetation. This finding supports the discoveries that interaction with nature on a small scale (such as plant pots indoors) reduces stress levels or aids in mitigating the increase in stress symptoms (Hunter et al., 2019; Lehberger et al., 2021; Marques et al., 2021; Spano et al., 2021). The overall relative difference of stress conditions between people who had indoor plants was a 0.8 % relative increase from before lockdown to during lockdown, while people who had private green space and lost all contact with nature increased 1.23 % of stress conditions, demonstrating that it's difficult to replace outdoor green space interaction.

People with indoor plants and private green spaces had the lowest percentages of stress manifestation during lockdown and the percentage of people who had no stress manifestations before lockdown almost doubles the other two (Fig. 4c). This demonstrates that the most efficient way to find solace in stressful times will be with as much access to vegetation as possible. The overall relative difference of stress conditions between people who had indoor plants and private green spaces was a 0.95 % relative increase from before lockdown to during lockdown.

Comparing the relative difference (%) (Table 4) it can be concluded that small quantities of vegetation interaction is better than no interaction at all, given that people with plants at home were the ones with lowest percentages in relative difference. This was followed on a lower

Table 2
Composition of the Study Sample.

Participant profile	(%)
Gender	
Female	64
Male	46
Age	
18–24	5
25–30	11
31–40	24
41–55	40
56–70	7
>71	13
Education	
Primary studies	1
Secondary studies	3
Bachelor	17
Master's degree	66
PhD	13
Home/residence	
Shared apartment	8
Studio / Loft (1–2 bedrooms)	32
Apartment (3 or more bedrooms)	53
Single-family home (Townhouse, chalet)	7
Green space accessibility	
Private garden	17
Backyards	15
Patios or courtyards	31
Area for plants inside the living space	66

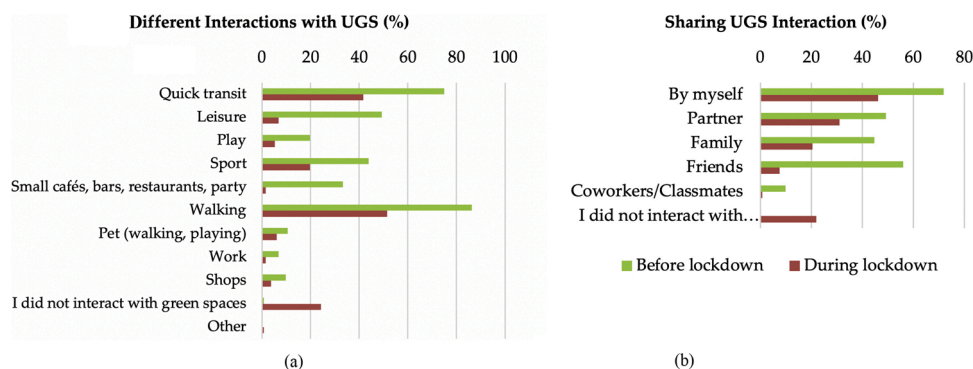


Fig. 2. Different interactions with Urban Green Spaces before and during lockdown: (a) Main uses of the Urban Green Spaces; (b) Sharing interaction of the Urban Green Space access.

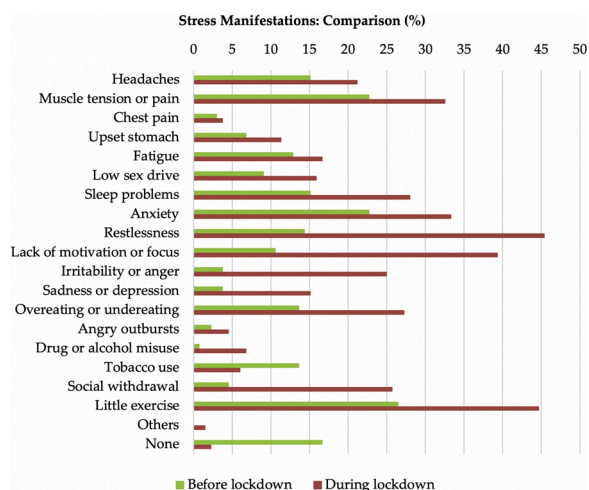


Fig. 3. Stress manifestations, comparison before lockdown and during lockdown.

Table 3
Percentage differences between stress manifestations before and during lockdown among the general population.

Stress Manifestations	Before lockdown (%)	During lockdown (%)	Relative Difference (%)
Drug or alcohol misuse	0.76	6.82	7.97
Irritability or anger	3.79	25	5.6
Social withdrawal	4.55	25.76	4.66
Sadness or depression	3.79	15.15	3
Lack of motivation or focus	10.61	39.39	2.71
Restlessness	14.39	45.45	2.16
Angry outbursts	2.27	4.55	1
Overeating or undereating	13.64	27.27	1
Sleep problems	15.15	28.03	0.85
Low sex drive	9.09	15.91	0.75
Little exercise	26.52	44.7	0.69
Upset stomach	6.82	11.36	0.67
Anxiety	22.73	33.33	0.47
Muscle tension or pain	22.73	32.58	0.43
Headaches	15.15	21.21	0.4
Fatigue	12.88	16.67	0.29
Chest pain	3.03	3.79	0.25
Others	0	1.52	-
Tobacco use	13.64	6.06	-0.56
None	16.67	2.27	-0.86

level by interaction with indoor plants and private green spaces. Alternatively, people with private green space access and no indoor plant interaction had the highest percentages in relative difference, announcing these were the people who had much more stress symptoms incrementation.

During quarantine, 30 % of people stopped using UGS (Fig. 5b) (before that, only 1.5 % used them in very few occasions (2–3 times a year) (Fig. 5a), but there were no claims of no use altogether). Either for fear of infection or fines, people viewed UGS as potential health risk spots, which produced feelings of rejection. A city like Madrid, with such an extensive tree-alignment and public plazas urban planning, allowed 28 % of people to continue to use UGS daily (Fig. 5b), even though they couldn't linger. It represented just 8% less from the 36 % who claimed to use them every day (and more than once a day) prior to lockdown (Fig. 5a). It's possible that UGS are associated with sanctuary and nostalgia, which promoted a reaction of familiarity. This is in line with Ulrich's theory: the first and most influential variable among the emotions regarding UGS is the affective state of the observer immediately before the visual encounter. This initial affective state directs and sustains attention, thus influencing the selection of the feature or scene that is perceived. When the perception of the natural environment reaches consciousness, the first response of the reaction is the generalized affect that motivates impulses or behaviors of approach or rejection (Ulrich, 1983) (Fig. 6).

Regarding the living space, most of the participants that decided to stop using UGS, had indoor plants to interact with back home. Accordingly, the percentage of indoor plants for those who continued daily interactions with UGS was lower. There are slight differences between the number of private UGS (gardens, patios or backyards) that participants had access to. The majority of citizens in Madrid's Central area don't have access to private green spaces, depending exclusively on public UGS for widespread interaction with nature. Most of the public green contact they have is through tree-alignments along streets, with Madrid having one of the most ambitious tree-alignment street planning in Europe (54 % of streets) (Vegetal and Del, 2009), followed closely by public parks and playgrounds. Concerning the different activities available and ways in which people use UGS, it changed in diverse ways. Those that continued to use UGS daily, continued to use it in any possible way, although we clearly see a reduction. Those who used it occasionally and decided to use it every day during lockdown, limited their use to walking, quick transit, sports and leisure, and even though there's a tendency to value more these UGS, those who stopped using UGS completely had a small decrease on the importance given to them (Fig. 7a, b, c and d).

The group of people who visited UGS daily and continued with their daily use during lockdown presented low symptoms of stress prior to quarantine. During lockdown, the same group of people attained symptoms of irritability or anger and social withdrawal (even more than the social distancing, refusing to talk/see some people) (Fig. 8a).

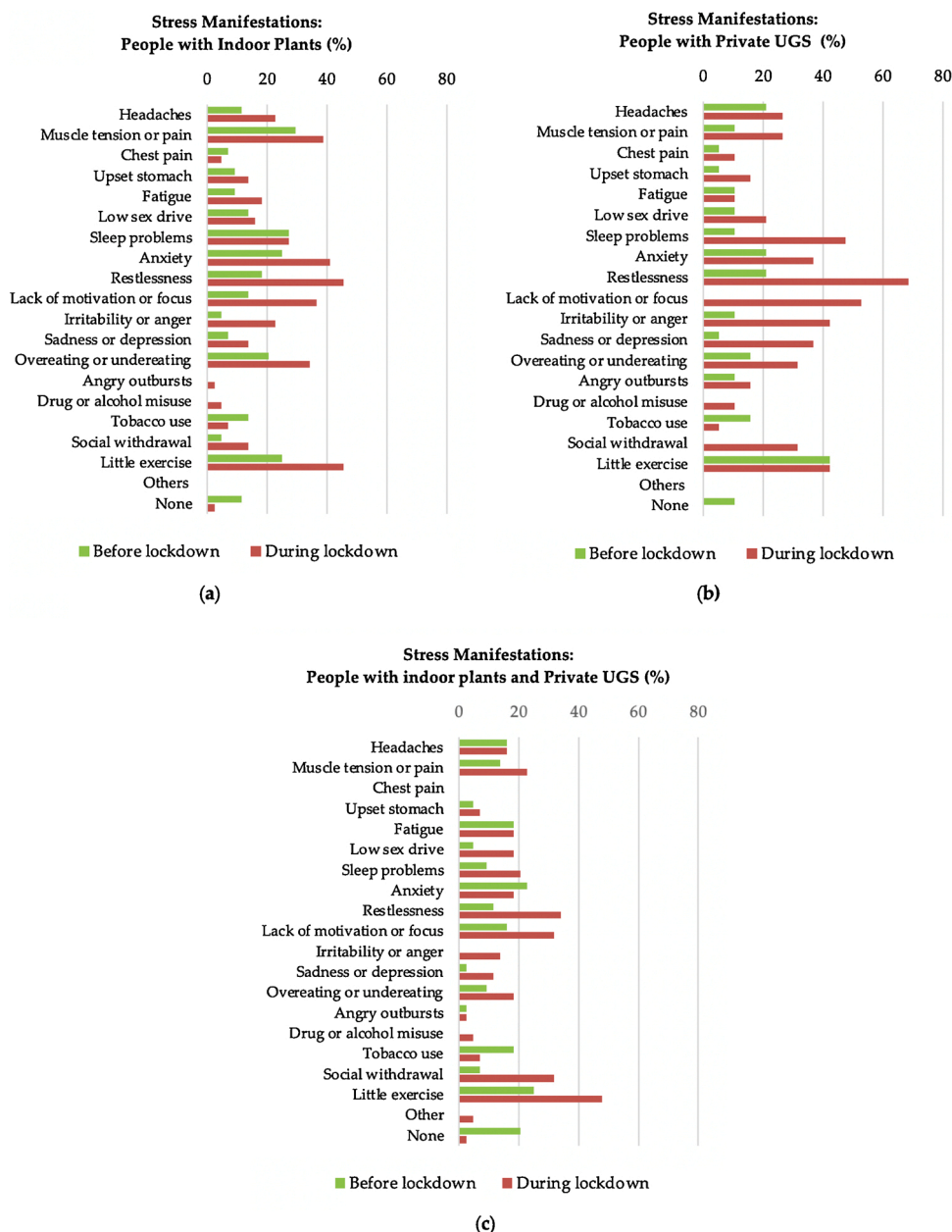


Fig. 4. Stress Manifestations: (a) People with indoor plants but no Private Urban Green Spaces; (b) People with Private Urban Green Space; (c) People with indoor plants and Private Urban Green Space.

Contrary to the general stress manifestations comparison (Fig. 3), the number of people with reduced exercise stress manifestation, one of the lowest values pre-lockdown, was the one that increased the most. This may be due to the fact that 55 % of them interacted with UGS through sports before the quarantine, with a 30 % decrease in this type of interaction during the lockdown.

Among pre-pandemic UGS daily users who stopped visiting these spaces, (Fig. 8b) the stress manifestations that they started noticing were irritability or anger, sadness or depression, outbursts of anger, and social withdrawal.

There wasn't a noticeable change between the stress manifestations of occasional pre-pandemic users that renewed into daily users during the pandemic (as seen in Fig. 8c), the graph bar looks very leveled with a lot of stress manifestations not changing their numbers before and during lockdown, this could be because the new dose of UGS adopted in their routine acted as a buffer of other stress motivators.

According to the different articles previously mentioned (Beyer et al.,

2014; Cox et al., 2017; Davvand et al., 2016; Gruebner et al., 2017; Kuo, 2015; Markevych et al., 2017; Russo and Cirella, 2018; Triguero-Mas et al., 2015; Tsai et al., 2018; van den Berg et al., 2010, 2016; von Lindern et al., 2016v; Wood et al., 2017) from where the hypothesis for this analysis was derived, it was expected that people that lost contact with UGS increased their stress symptoms, but the average percentage decreased by 5%. Comparing users that continued daily UGS visits and those who stopped, there's a similarity between the lack of some stress manifestation before lockdown, including a physical manifestation (chest pain for daily users and upset stomach for newly non-users), irritability or anger, angry outbursts, drug or alcohol misuse and social withdrawal. People that stopped going to UGS gained much more of these symptoms than their counterparts that continued using these spaces daily. The one thing that these people had in common was that all of them were daily users prior to the pandemic. Pre-pandemic, the stress manifestations for continuous daily users and newly non-users were relatively low, with an average of 9% and 10 % respectively.

Table 4

Percentage differences between stress manifestations before and during lockdown for people with indoor plants, people with private green space access and people with indoor plants and private green space access.

Stress Manifestations	People with indoor plants			People with Private GS			People with indoor plants & Private GS		
	Before Lockdown (%)	During Lockdown (%)	Relative Difference (%)	Before Lockdown (%)	During Lockdown (%)	Relative Difference (%)	Before Lockdown (%)	During Lockdown (%)	Relative Difference (%)
Headaches	11.36	22.73	1	21.05	26.32	0.25	1591	1591	0
Muscle tension or pain	29.55	38.64	0.31	10.53	26.32	1.5	1364	2272	0.67
Chest pain	6.82	4.55	-0.33	5.26	10.53	1	0	0	-
Upset stomach	9.09	13.64	0.5	5.26	15.79	2	455	682	0,5
Fatigue	9.09	18.18	1	10.53	10.53	0	1818	1818	0
Low sex drive	13.64	15.91	0.17	10.53	21.05	1	455	1818	3
Sleep problems	27.27	27.27	0	10.53	47.37	3.5	909	2045	1.25
Anxiety	25	40.91	0.64	21.05	36.84	0.75	2273	1818	-0,2
Restlessness	18.18	45.45	1.5	21.05	68.42	2.25	1136	3409	2
Lack of motivation or focus	13.64	36.36	1.67	0	52.63	-	1591	3182	1
Irritability or anger	4.55	22.73	4	10.53	42.11	3	0	1364	-
Sadness or depression	6.82	13.64	1	5.26	36.84	6	227	1136	4
Overeating or undereating	20.45	34.09	0.67	15.79	31.58	1	909	1818	1
Angry outbursts	0	2.27	-	10.53	15.79	0.5	227	227	0
Drug or alcohol misuse	0	4.54	-	0	10.53	-	0	454	-
Tobacco use	13.64	6.82	-0.5	15.79	5.26	-0.67	1818	682	-0,62
Social withdrawal	4.55	13.64	2	0	31.58	-	682	3182	3.67
Little exercise	25	45.45	0.82	42.11	42.11	0	25	4773	0.91
None	11.36	2.27	-0.8	10.53	0	-1	2045	227	-0,89

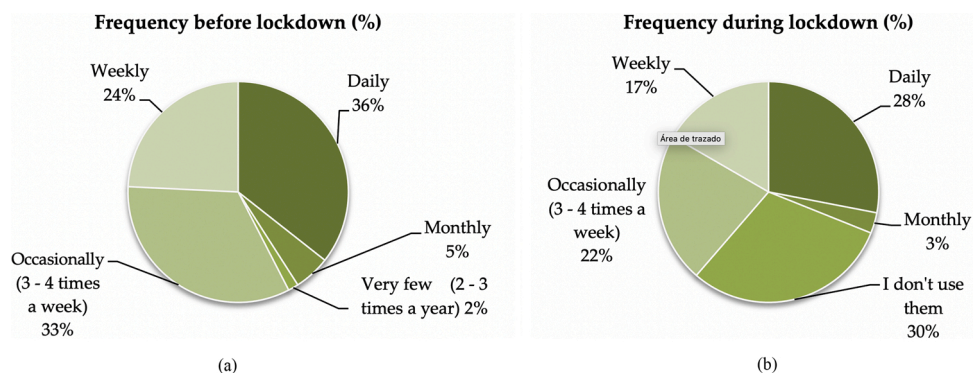


Fig. 5. Frequency of visits: (a) Before lockdown; (b) During lockdown.

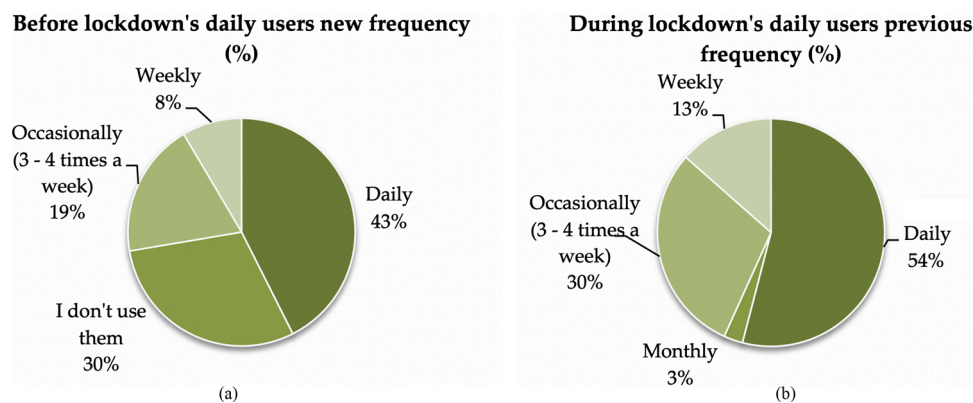


Fig. 6. Frequency of visits during lockdown of previous daily users: (a) Urban Green Spaces daily users before lockdown new frequency of use; (b) Daily users during lockdown previous frequency of use of Urban Green Spaces.

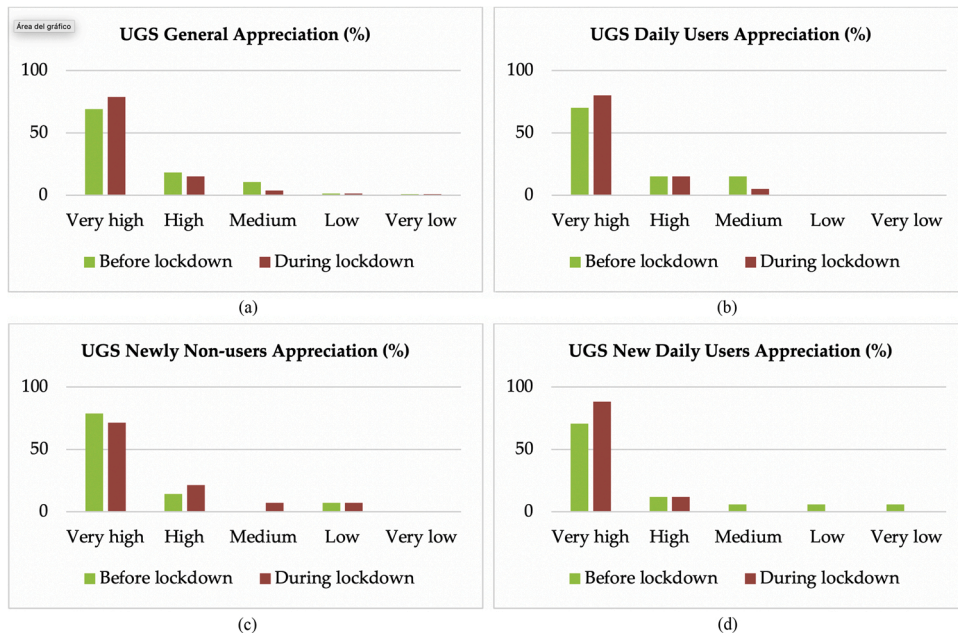


Fig. 7. Appreciation of urban green space before and during lockdown: (a) Urban Green Spaces general public appreciation before and during lockdown; (b) Daily users that continued to use Urban Green Spaces daily appreciation before and during lockdown; (c) Previous daily users that stopped using Urban Green Spaces appreciation before and during lockdown; (d) Urban Green Spaces occasional-turned-daily users' appreciation before and during lockdown.

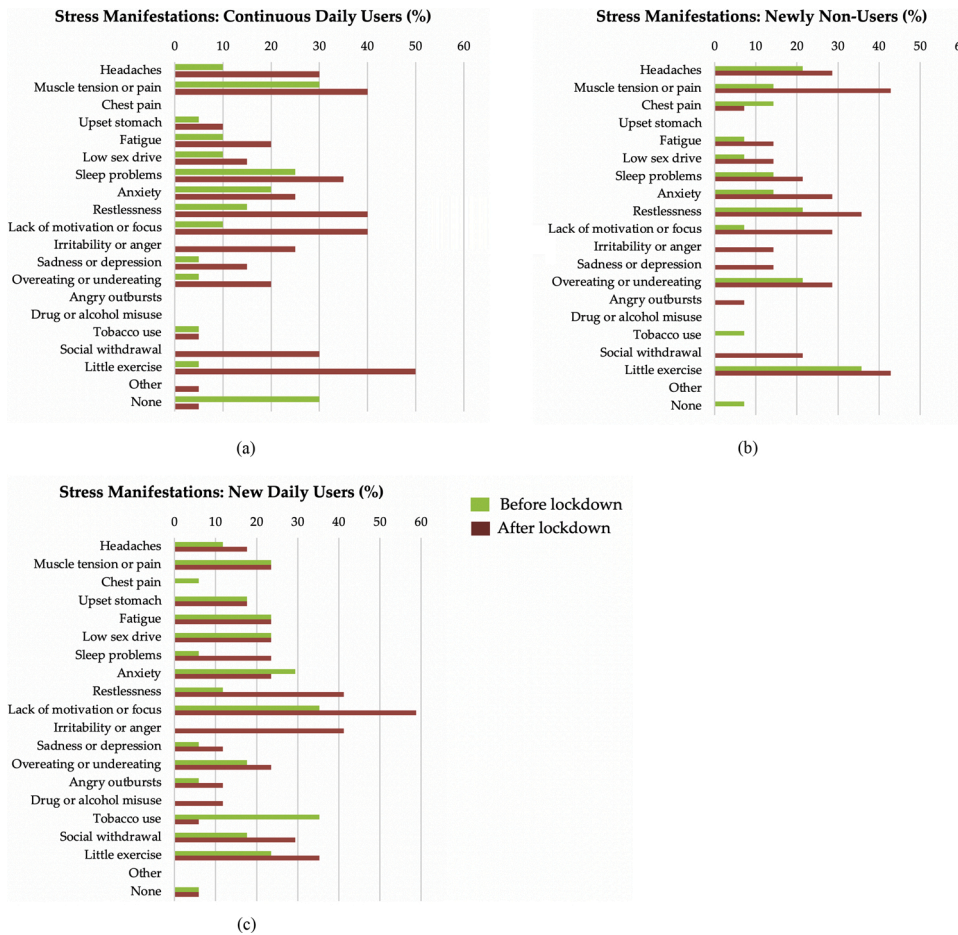


Fig. 8. Percentage of stress manifestations experimented by: (a) Daily users that continued to use Urban Green Spaces daily before and during lockdown; (b) Daily users that stopped visiting Urban Green Spaces altogether during lockdown; (c) Daily users that started visiting Urban Green Spaces during lockdown.

On the other hand, occasional users had an average of 16 % stress manifestations prior to the pandemic. This is substantially higher than general pre-pandemic daily users, almost twice as continuous daily users, and even though their average percentage for stress manifestation during quarantine is the highest (24 %), it is not much higher than the stress manifestation during quarantine for continuous daily users (22 %) and non-users (19 %), which indicates that the implementation of a higher dose of interaction with UGS can provide restoration on an ongoing crisis.

There is convergent evidence from different research angles that support that contact with real or simulated natural environments can provide restoration from stress and mental fatigue (van den Berg et al., 2010). Accumulating many short episodes, the view from the window can provide long-term contact with the natural environment. Perhaps such a long-lasting connection is particularly helpful in maintaining restoration (Kaplan, 2001). However, in times of stress, the chances of contact with more large-scale areas of nature further away from home may be just as or even more important to staying healthy. When people are faced with important life events, such as death or divorce, they need time to reflect on their life, their actions and priorities, to cope with the events (Kaplan and Kaplan, 1989). Such reflection implies a deep level of restoration. Such a deep restoration is certainly possible in a nearby UGS.

3.3. Strength and limitations

The study was completed while the participants were still in Spain's governmental state of alarm, meaning they were in complete isolation, experimenting the effects firsthand, which increases the authenticity of the stress conditions. All participants that took the survey had the same exact set of rules, therefore there were no special exceptions of people who assumed quarantine differently. Meanwhile, users were asked to answer different questions relying on memories before the State of Alarm, which may be biased and subjective, given there was no data collected at that time. This may disserve the data collected, as it's not 100 % accurate.

The way the survey was administered, through Google Forms, was very practical, appropriate and very convenient to obtain suitable figures. This tool proved to be very useful, given that it was the safest way to reach the rest of the population in an equal manner without having to break quarantine. This tool also helped guaranteeing an all-out depiction of Madrid's City Center's population, given that it was able to reach people from different districts in a manner than a walk-by survey may have been limited. On the other hand, the use of the online survey provided a limitation regarding representation for the entirety of Madrid's City Center population, as the generated data cannot be considered representative. The survey was distributed through mailing lists, social and traditional media, relying on the researchers' social networks. This means that the sampling method was not randomized but relied on people's personal interest and their motivation to participate in the survey.

This has led to an important limitation of the current study that is the restricted representativeness of the samples of different age groups. The response rates were relatively low for the elderly (9% of the respondents were 71 years or older) and especially for younger adults (only 6% of 18-24-years-old). This was probably due to the way the survey was shared, among people of similar age groups, or maybe the fact that the survey was online, which could have limited the usage of the previous age group. This could have influenced the results, given that they may be one of the most avid UGS users. There's a risk of bias due to the clear underrepresentation of under-educated individuals, and therefore a limited potential for generalization. Also, given the manner that the questionnaire was provided, the need for a computer or an electronic device like a mobile phone or a tablet were necessary. Those people who couldn't afford one at home were automatically not considered, and these can include low-income families which rely on activities located

on UGS for entertainment and amusement. The biggest limitation of this study was not taking into account different socio-economic population groups, which would be required to better understand how UGS provide wellness.

External factors such as job/income loss, fear of or actual infection (personal or family), or routine alteration, among others, could have been responsible for the increase of stress conditions. The suppression of daily UGS interaction or the option of using these spaces cannot be accounted as the sole reason that increased stress conditions. The heightened stress symptoms during the pandemic cannot be attributed to lack of access to green spaces alone, as there were no questions in the survey regarding this matter. This might have misguided the results or conclusions and the approach may be considered generic and oversimplistic. There is no evidence provided by the survey that demonstrates that exclusively UGS or vegetation interaction were mitigating the stress effects, there could be outside factors like starting or continuing psychological therapy, newly found family time or hobbies, or stress relief from less office or traffic jams time. Even though individuals are happier, show significantly lower mental distress and significantly higher well-being when living in urban areas with greater amounts of green space rather than less green space, it has been demonstrated that aggregated values such as income, employment status, marital status, health, housing type, and local-area-level variables (e.g., crime rates) help mitigating stress levels (White et al., 2013). It's important to highlight that this study and results give no evidence that uniquely the lack of visitation to UGS has citizens increasing stress levels, but that UGS help mitigate stress caused by external attribution or provocation, such as the ones mentioned before.

The results obtained reinforce those of other studies that emphasize the importance of UGS in hard times (da Schio et al., 2021; Venter et al., 2021). And it concurs with Ribeiro (Ribeiro et al., 2021), who establishes a comparison between Portugal and Spain. Ribeiro found that in Portugal, maintaining or/and increasing the use of public natural spaces during the lockdown was associated with lower levels of stress and maintaining and/or increasing the frequency of viewing nature from home was associated with reduced psychological distress and somatization. In Spain, maintaining and/or increasing contact with green space (private community spaces) and greenery (indoor plants) was associated with lower stress levels.

3.4. Further research and urban implications

The need to study the response to stress in different population groups (such as the elderly and children) and in other vulnerable socioeconomic strata (the deprived and underprivileged) arises. Also, future studies that determine whether the impact on stress levels differ depending on the UGS typology with which the user interacts during confinement, doing this can help distinguish the areas of cities most vulnerable to UGS deprivation. Similarly, replicating this study in other parts of the world that may have different responses (due to climate, politics, city configurations, etc.) than the euro-centered or northern hemisphere could yield insight into a UGS global perspective, the common places where similarities and differences rely. Rapid, feasible, adaptive and transformable green design strategies should be generated in existing UGS and in other "empty" or "free" spaces in areas lacking UGS, which guarantee access by the entire population and a healthy and safe coverage during quarantine. All these measures should be included in the developing and future strategic plans of cities worldwide.

4. Conclusions

Stress conditions and manifestations increased during isolation. The general appreciation for UGS increased, except among daily users that stopped visiting UGS altogether. The main manifestations or conditions that indicated stress were restlessness, little exercise, lack of motivation and concentration, anxiety and muscle tension or pain. Indoor plant

interaction was not found to be a substitute for outdoor green experience when people are confronted with highly stressful situations. Even though interaction with nature on a small scale reduces stress levels, it is through the experience with open UGS that people find the most solace.

Pre-pandemic daily UGS users that continued to use UGS daily have the fewest stress indicators before lockdown, but even though they continued to use these UGS daily their stress increased considerably. The opposite happened with the pre-confinement daily users that stopped UGS use, they led slightly more stressful lives prior to lockdown, however their stress indicators did not increase as much as it did for continuous daily users. The occasional users that turned to daily users had a much more balanced stress-condition graph bar. Their stress level pre-confinement was significantly higher than daily users, but when they incorporated the daily UGS use during lock-down, this helped easing stress conditions, and there is no big difference between before and during the population's quarantine.

Daily UGS use relaxes the population, this is plainly exposed when daily users and occasional users before confinement are examined. But what became more evident is that when occasional users, suddenly faced with a stressful situation (like a pandemic) turn to UGS for relief, there is a higher chance of mitigating the negative influences or the increase of unhealthy conditions. However, it is inconclusive if UGS influence over people is reduced if exposed to them in longer amounts of time or in higher frequency use, or if people get accustomed to UGS as shelters for their everyday life, and when finally confronted with a difficult situation, they have to appeal to other sources of relaxation.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

AUTHORSHIP STATEMENT

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

To all the people who participated in the survey and specially to the Máster Universitario en Jardinería y Paisajismo, School of Agricultural, Food and Biosystems Engineering, Universidad Politécnica de Madrid.

Appendix A

Questions from online survey used for the study

We developed an online survey using Google Forms to understand the influence that urban green spaces have on our mental health and how people were using UGS during the early stages of COVID-19 pandemic.

Participants were recruited through convenience sampling via the authors' professional email networks and through School of Agricultural, Food and Biosystems Engineering social media platforms (Facebook, Instagram) and the Gardening and Landscape Master's contacts. Since the survey was open to anyone over the age of 18 who lived in Madrid at the time of data collection, prior to the start of the pandemic and/or stayed in the city during lockdown, anyone we reached through

our recruiting efforts were asked to share with others as a form of snowball sampling.

The study complies with the ethical research norms and standards reflected in the Declaration of Helsinki of the World Medical Association and in the Oviedo Convention on Human Rights and Biomedicine. Given its characteristics as an anonymous and voluntary survey, it was not previously evaluated by an Ethics Committee for Clinical Research. All data was treated with the utmost confidentiality, in accordance with current legislation.

Questions analyzed in this study are shown in bold below.

GREEN SPACES DURING QUARANTINE

The Landscape and Gardening Master's degree at the Polytechnic University in Madrid is studying the influence that urban green spaces have on our mental health during this time of social reclusion. For this we would greatly appreciate your help, which consists in manifesting your opinion and answering some questions in the next voluntary poll.

Your answers are strictly confidential, and we guarantee you the anonymity of your data given by the Spanish laws 12/1989, de 9 de mayo, de la Función Estadística Pública.

THANK YOU!

* Compulsory

Consent* [Compulsory]

I confirm that I am willing and able to participate in this study and

I am over the age of 18*

Date * [Compulsory]

[MM/DD/XX]

Section 1 of 4- PROFILE

1 Age * [Compulsory] [option to select one response]

18–24

25–30

31–40

41–55

56–70

71 or older

2 Gender * [Compulsory] [option to select one response]

Male

Female

3 Education * [Compulsory] [option to select one response]

No studies

Primary Studies

Secondary Studies

Bachelor

Master's Degree

PhD

4 Hometown (Location, country & postal code if you may) * [Compulsory]

[Space to write in answer]

5 Current residence (Location, country & postal code if you may) * [Compulsory]

[Space to write in answer]

Section 2 of 4- CURRENT RESIDENCE

6 Type of location [Optional] [option to select one response]

- Urban
 Rural

7 Population * [Compulsory] [option to select one response]

- + 5 million
 2 million - 5 million
 500 thousand - 2 million
 100 thousand - 500 thousand
 50 thousand - 100 thousand
 1000–50 thousand
 Less than 1000
 I don't know

8 Housing typology * [Compulsory] [option to select one response]

- Student Residence
 Shared Apartment
 Studio/Apartment/Loft (1–2 rooms)
 Apartment (3 or more rooms)
 Single family home (Chalet or similar)
 Elderly residence

9 Do you have a private garden? * [Compulsory] [option to select one response]

- Yes
 No

10 Do you have an in-house patio? * [Compulsory] [option to select one response]

- Yes
 No

11 Do you have a backyard? * [Compulsory] [option to select one response]

- Yes
 No

12 Do you have a single small space you dedicate to plants (corner, porch, balcony, terrace, etc.) in your residence? * [Compulsory] [option to select one response]

- Yes
 No

13 How do you move around your current location? * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- My own car, motorcycle
 Uber/Taxi
 Bus/Tram
 Metro/Train
 Bicycle
 Walking
 Other: [Space to write in answer]

Section 3 of 4- ABOUT GREEN SPACES

By 'green spaces' we mean any public or private establishment that contains vegetation of any kind: grass, flowers, bushes, trees, etc. They can be parks, plazas, gardens, courtyards, etc.

14 Which are the nearest green spaces (no more than 1 km/half a mile) to where you live? * [Compulsory] [option to select one response]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- None
 Tree alignment along streets
 Sports plaza (exercise, football/soccer field, basketball court), playgrounds
 Pocket parks or Private courtyards (inside of your building or private residential area)
 Urban plaza
 Public park
 Gardens (large, historic)
 Forest (trail parks, grove, woods, jungle, sabana, mountain, etc.)
 Fields (agriculture, cattle)
 Other: [Space to write in answer]]

15 Which of these are accessible (1 km/half a mile up to 3 km/mile and a half) from your living space?* [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- None
 Tree alignment along streets
 Sports plaza (exercise, football/soccer field, basketball court), playgrounds
 Pocket parks or Private courtyards (inside of your building or private residential area)
 Urban plaza
 Public park
 Gardens (large, historic)
 Forest (trail parks, grove, woods, jungle, sabana, mountain, etc.)
 Fields (agriculture, cattle)
 Other: [Space to write in answer]]

16 How frequently did you interact with green spaces (prior to COVID-19 confinement)? * [Compulsory] [option to select one response]

If you check 'other' please let us know which.

- More than once a day
 Daily
 Occasionally (3–4 times a week)
 Weekly Monthly
 Very few (2–3 times a year)
 Other: [Space to write in answer] [Space to write in answer]

17 How did you interact with these green spaces (prior to COVID-19 confinement)? * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- Quick transit
 Leisure
 Play Sport
 Small cafés, bars, restaurants, party
 Walking
 Pet (walking, playing) Work

- Shops
- I did not interact with green spaces
- Other: [Space to write in answer]

18 Who did you share green space interaction with (prior to COVID-19 confinement)? * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- By myself
- Partner
- Family
- Friends
- Coworkers/classmates
- I did not interact with green spaces
- Other: [Space to write in answer]

19 Please, use your imagination and mentally place yourself in your favorite green space. Which sensation do you have while you're in that place? [Optional] [option to select one response by pair]

Respond intuitively, don't stop to think

- Active Passive
- Pleasant Unpleasant
- Light Heavy
- Pretty Ugly
- Entertaining Boring
- Quiet Loud
- Happy Sad
- Peaceful Agitated
- Natural Artificial
- Warm Cold
- Safe Unsafe
- Civilized Uncivilized
- Free Imposed
- Relaxing Stressful

20 On a scale of 1 to 5: How important were green spaces for you prior to COVID-19 confinement? * [Compulsory] [option to select one response]

- 1 Not important at all
- 2
- 3
- 4
- 5 Very important

ABOUT COVID-19 QUARANTINE

Please base your answers according to Phase Zero, or fullest lockdown, that your current confinement location went through

21 Have they closed green public spaces where you live? * [Compulsory] [option to select one response]

- All of them
- Some of them
- No

22 If your answer is "some of them", could you please specify which ones? [Optional]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- Sport plazas, playgrounds

- Plazas
- Small urban parks
- Urban parks
- Large public gardens or forests
- Other: [Space to write in answer]

23 Do you think it's a good idea to keep green spaces open to general public during the pandemic? [Optional] [option to select one response]

- Yes
- No

24 Why? [Optional]

[Space to write in answer]

25 How frequently do you interact with green spaces (during Phase Zero, or fullest lockdown of COVID-19 confinement)? * [Compulsory] [option to select one response]

If you check 'other' please let us know which.

- More than once a day
- Daily
- Occasionally (3–4 times a week)
- Weekly
- Monthly
- I don't interact with them
- Other: [Space to write in answer]

26 How do you interact with these green spaces (during Phase Zero, or fullest lockdown of COVID-19 confinement)? * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- Quick transit
- Leisure
- Play Sport
- Small cafés, bars, restaurants, party
- Walking
- Pet (walking, playing) Work
- Shops
- I don't interact with green spaces
- Other: [Space to write in answer]

27 Who do you share green space interaction with (during Phase Zero, or fullest lockdown of COVID-19 confinement)? * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- By myself
- Partner
- Friends
- Coworkers/classmates
- I don't interact with green spaces
- Other: [Space to write in answer]

28 Which sensation does your confinement space give you? [Optional] [option to select one response by pair]

Respond intuitively, don't stop to think

- Active Passive
- Pleasant Unpleasant
- Light Heavy

- Pretty Ugly
- Entertaining Boring
- Quiet Loud
- Happy Sad
- Peaceful Agitated
- Natural Artificial
- Warm Cold
- Safe Unsafe
- Civilized Uncivilized
- Free Imposed
- Relaxing Stressful

29 Who do you share your living space with? * [Compulsory] [option to select one response]

- By myself
- Pet
- Partner
- Roommates/Friends
- Children
- Family (partner and children)
- Parents/Uncle/Aunts
- Grandparents

30 Please let us know if you live with someone vulnerable to the virus ("high risk population") [Optional] [option to select one response]

- Yes
- No

31 Are you working/studying? [Optional] [option to select one response]

- Yes
- No

32 If you are working/studying, please describe your working/studying space. [Optional]

[Space to write in answer]

33 What do you miss the most of your lifestyle prior to the pandemic? * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- Walking freely the city or traveling along the country
- Training (general sports)
- Seeing my friends or family
- Walking in nature
- Air travel (national or international)
- Other: [Space to write in answer]

34 Do you consider yourself a healthy person? [Optional] [option to select one response]

- Yes
- No

35 Did you suffer from any of the next conditions prior to COVID-19 confinement? If so, please specify. * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- Headaches
- Muscle tension or pain
- Chest pain
- Upset stomach
- Fatigue
- Low sex drive
- Sleep problems
- Anxiety
- Restlessness
- Lack of motivation or focus
- Irritability or anger
- Sadness or depression
- Overeating or undereating
- Angry outbursts
- Drug or alcohol misuse
- Tobacco use
- Social withdrawal
- Little exercise
- Other: [Space to write in answer]

36 Did you develop any of the next conditions during COVID-19 confinement? If so, please specify. * [Compulsory]

Multiple choice, please check all that resonate with you. If you check 'other' please let us know which.

- Headaches
- Muscle tension or pain
- Chest pain
- Upset stomach
- Fatigue
- Low sex drive
- Sleep problems
- Anxiety
- Restlessness
- Lack of motivation or focus
- Irritability or anger
- Sadness or depression
- Overeating or undereating
- Angry outbursts
- Drug or alcohol misuse
- Tobacco use
- Social withdrawal
- Little exercise
- Other: [Space to write in answer]

37 On a scale of 1 to 5: How important are green spaces for you now, during COVID-19 confinement? * [Compulsory] [option to select one response]

- 1 Not important at all
- 2
- 3
- 4
- 5 Very important

If it's more or less than before, please explain why. [Optional]

[Space to write in answer]

SUGGESTIONS [Optional]

Please, let us know if you have any observations or suggestions for your community leader regarding public green space use during the lockdown or any future use you can imagine.

[Space to write in answer]

References

- Adli, M., Berger, M., Brakemeier, E.L., Engel, L., Fingerhut, J., Gomez-Carrillo, A., Hehl, R., Heinz, A., Mayer, J., Mehran, N., Tolaas, S., Walter, H., Weiland, U., Stollmann, J., 2017. Neurourbanism: towards a new discipline. *Lancet Psychiatry* 4, 183–185. [https://doi.org/10.1016/S2215-0366\(16\)30371-6](https://doi.org/10.1016/S2215-0366(16)30371-6).
- Amerio, A., Brambilla, A., Morganti, A., Aguglia, A., Bianchi, D., Santi, F., Costantini, L., Odone, A., Costanza, A., Signorelli, C., Serafini, G., Amore, M., Capolongo, S., 2020. COVID-19 lockdown: housing built environment's effects on mental health. *Int. J. Environ. Res. Public Health* 17, 5973. <https://doi.org/10.3390/ijerph17165973>.
- Ayuntamiento de Madrid, 2009. *Plan Director De Las Zonas Verdes*.
- Beyer, K.M.M., Kaltenbach, A., Szabo, A., Bogar, S., Javier Nieto, F., Malecki, K.M., 2014. Exposure to neighborhood green space and mental health: evidence from the survey of the health of wisconsin. *Int. J. Environ. Res. Public Health* 11, 3453–3472. <https://doi.org/10.3390/ijerph110303453>.
- Bratman, G.N., Anderson, C.B., Berman, M.G., Cochran, B., de Vries, S., Flanders, J., Folke, C., Frumkin, H., Gross, J.J., Hartig, T., Kahn, P.H., Kuo, M., Lawler, J.J., Levin, P.S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., Scarlett, L., Smith, J.R., van den Bosch, M., Wheeler, B.W., White, M.P., Zheng, H., Daily, G.C., 2019. Nature and mental health: an ecosystem service perspective. *Sci. Adv.* <https://doi.org/10.1126/sciadv.aax0903>.
- Bravo, S., Restituto, 1998. *Técnicas De Investigación Social: Teoría Y Ejercicios*.
- Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., Rubin, G.J., 2020. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet*. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8).
- Cox, D.T.C., Shanahan, D.F., Hudson, H.L., Plummer, K.E., Siriwardena, G.M., Fuller, R. A., Anderson, K., Hancock, S., Gaston, K.J., 2017. Doses of neighborhood nature: the benefits for mental health of living with nature. *BioScience* 67. <https://doi.org/10.1093/biosci/biw173>.
- da Schio, N., Phillips, A., Fransen, K., Wolff, M., Haase, D., Ostoić, S.K., Živojinović, I., Vuletić, D., Derks, J., Davies, C., Laforzezza, R., Roitsch, D., Winkel, G., De Vreese, R., 2021. The impact of the COVID-19 pandemic on the use of and attitudes towards urban forests and green spaces: exploring the instigators of change in Belgium. *Urban For. Urban Green.* 65, 127305 <https://doi.org/10.1016/J.UFUG.2021.127305>.
- Dadvand, P., Bartoll, X., Basagaña, X., Dalmau-Bueno, A., Martínez, D., Ambros, A., Cirach, M., Triguero-Mas, M., Gascon, M., Borrell, C., Nieuwenhuijsen, M.J., 2016. Green spaces and General Health: roles of mental health status, social support, and physical activity. *Environmental International* 91, 161–167. <https://doi.org/10.1016/j.envint.2016.02.029>.
- Direk Tecirli, N., Ucu, G., Özel, F., 2020. İzolasyon, Karantina, Sosyal Mesafe Ve ruh sağlığı. *Bull. Leg. Med.* 25, 33–39. <https://doi.org/10.17986/blm.2020.v25i.1412>.
- Fagerholm, N., Eilola, S., Arki, V., 2021. Outdoor recreation and nature's contribution to well-being in a pandemic situation - Case Turku. Finland. *Urban Forestry & Urban Greening* 64, 127257. <https://doi.org/10.1016/J.UFUG.2021.127257>.
- Felappi, J.F., Sommer, J.H., Falkenberg, T., Terlau, W., Kötter, T., 2020. Green infrastructure through the lens of "one Health": a systematic review and integrative framework uncovering synergies and trade-offs between mental health and wildlife support in cities. *Sci. Total Environ.* 748, 141589 <https://doi.org/10.1016/J.SCITOTENV.2020.141589>.
- Fink, G., 2016. *Stress: Concepts, Cognition, Emotion, and Behavior: Handbook of Stress Series, Volume 1*.
- Fischer, L.K., Honold, J., Botzat, A., Brinkmeyer, D., Cvejić, R., Delshammar, T., Elands, B., Haase, D., Kabisch, N., Karle, S.J., Laforzezza, R., Nastran, M., Nielsen, A. B., van der Jagt, A.P., Vierikko, K., Kowarik, I., 2018. Recreational ecosystem services in European cities: sociocultural and geographical contexts matter for park use. *Ecosyst. Serv.* 31, 455–467. <https://doi.org/10.1016/j.ecoser.2018.01.015>.
- Gruebner, O., Rapp, M.A., Adli, M., Kluge, U., Galea, S., Heinz, A., 2017. Cities and mental health. *Arztebl. Int.* <https://doi.org/10.3238/arztebl.2017.0121>.
- Hartig, T., Mitchell, R., de Vries, S., Frumkin, H., 2014a. Nature and health. *Erratum Annu. Rev. Public Health* 35, 207–228. <https://doi.org/10.1146/annurev-publichealth-032013-182443>.
- Holmes, E.A., O'Connor, R.C., Perry, V.H., Tracey, I., Wessely, S., Arseneault, L., Ballard, C., Christensen, H., Cohen Silver, R., Everall, I., Ford, T., John, A., Kabir, T., King, K., Madsen, I., Michie, S., Przybylski, A.K., Shafran, R., Sweeney, A., Worthman, C.M., Yardley, L., Cowan, K., Cope, C., Hotopf, M., Bullmore, E., 2020. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry*. [https://doi.org/10.1016/S2215-0366\(20\)30168-1](https://doi.org/10.1016/S2215-0366(20)30168-1).
- Hunter, M.R., Gillespie, B.W., Chen, S.Y.-P., 2019. Urban nature experiences reduce stress in the context of daily life based on salivary biomarkers. *Front. Psychol.* 10, 722. <https://doi.org/10.3389/fpsyg.2019.00722>.
- Kaplan, R., 2001. The nature of the view from home psychological benefits. *Environ. Behav.* 33, 507–542. <https://doi.org/10.1177/00139160121973115>.
- Kaplan, R., Kaplan, S., 1989. The Experience of Nature: a Psychological Perspective. *The Experience of Nature: a Psychological Perspective*. <https://doi.org/10.1097/00005053-199111000-00012>.
- Kuo, M., 2015. How might contact with nature promote human health? Promising mechanisms and a possible central pathway. *Front. Psychol.* 6, 1093. <https://doi.org/10.3389/fpsyg.2015.01093>.
- Lawton, E., Brymer, E., Clough, P., Denovan, A., 2017. The relationship between the physical activity environment, nature relatedness, anxiety, and the psychological well-being benefits of regular exercisers. *Front. Psychol.* 8, 1058. <https://doi.org/10.3389/fpsyg.2017.01058>.
- Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., Wüst, S., Pruessner, J.C., Rietschel, M., Deuschle, M., Meyer-Lindenberg, A., 2011. City living and urban upbringing affect neural social stress processing in humans. *Nature* 2011, 498–501. <https://doi.org/10.1038/nature10190>, 474:7352 474.
- Lehberger, M., Kleih, A.K., Sparke, K., 2021. Self-reported well-being and the importance of green spaces – a comparison of garden owners and non-garden owners in times of COVID-19. *Landsc. Urban Plan.* 212, 104108 <https://doi.org/10.1016/J.LANDURBPLAN.2021.104108>.
- Lu, T., Huh, C., 2020. The protective effects of resilience on COVID-19 stress. *J. Humanit. Soc. Sci.* 21 (11), 279–290. <https://doi.org/10.22143/HSS21.11.1.21>.
- Manning, N., 2019. Sociology, biology and mechanisms in urban mental health. *Social Theory and Health* 17, 1–22. <https://doi.org/10.1057/S41285-018-00085-7> FIGURES/3.
- Markevych, I., Schoierer, J., Hartig, T., Chudnovsky, A., Hystad, P., Dzhambov, A.M., de Vries, S., Triguero-Mas, M., Brauer, M., Nieuwenhuijsen, M.J., Lupp, G., Richardson, E.A., Astell-Burt, T., Dimitrova, D., Feng, X., Sadeh, M., Standl, M., Heinrich, J., Fuertes, E., 2017. Exploring pathways linking greenspace to health: theoretical and methodological guidance. *Environmental Research*. <https://doi.org/10.1016/j.envres.2017.06.028>.
- Marques, P., Silva, A.S., Quaresma, Y., Manna, L.R., de Magalhães Neto, N., Mazzoni, R., 2021. Home gardens can be more important than other urban green infrastructure for mental well-being during COVID-19 pandemics. *Urban Forestry & Urban Greening*. <https://doi.org/10.1016/J.UFUG.2021.127268>, 127268.
- Menzel, C., Dennenmoser, F., Reese, G., 2020. Feeling Stressed and Ugly? Leave the City and Visit Nature! An Experiment on Self-and Other-Perceived Stress and Attractiveness Levels. *International journal of environmental research and public health* 17, 1–15. <https://doi.org/10.3390/IJERPH17228519>.
- Molina, R.T., 2005. *La Calidad de Vida, su importancia y cómo medirla*. Barranquilla (Col.) 21, 76–86.
- Pálsdóttir, A., Persson, D., Persson, B., Grahn, P., 2014. The journey of recovery and empowerment embraced by nature – clients' perspectives on nature-based rehabilitation in relation to the role of the natural environment. *International Journal of Environmental Research and Public Health* 11, 7094–7115. <https://doi.org/10.3390/ijerph110707094>.
- Pérez-Urrestarazu, L., Kaltsidi, M.P., Nektarios, P.A., Markakis, G., Loges, V., Perini, K., Fernández-Cañero, R., 2021. Particularities of having plants at home during the confinement due to the COVID-19 pandemic. *Urban Forestry & Urban Greening* 59, 126919. <https://doi.org/10.1016/J.UFUG.2020.126919>.
- Poortinga, W., Bird, N., Hallingsberg, B., Phillips, R., Williams, D., 2021. The role of perceived public and private green space in subjective health and wellbeing during and after the first peak of the COVID-19 outbreak. *Landscape and Urban Planning* 211, 104092. <https://doi.org/10.1016/J.LANDURBPLAN.2021.104092>.
- Pykett, J., Osborne, T., Resch, B., 2020. From Urban Stress to Neurourbanism: How Should We Research City Well-Being?, pp. 1936–1951. <https://doi.org/10.1080/24694452.2020.1736982>, 110 <https://doi.org/10.1080/24694452.2020.1736982>.
- Qiao, Y., Chen, Z., Chen, Y., Zheng, T., 2021. Deciphering the link between mental health and green space in Shenzhen, China: the mediating impact of residents' satisfaction. *Frontiers in Public Health* 9. <https://doi.org/10.3389/FPUBH.2021.561809>.
- Rajkumar, R.P., 2020. COVID-19 and mental health: a review of the existing literature. *Asian Journal of Psychiatry* 52, 102066. <https://doi.org/10.1016/J.AJP.2020.102066>.
- Ribeiro, A.L., Triguero-Mas, M., Jardim Santos, C., Gómez-Nieto, A., Cole, H., Angelovski, I., Silva, F.M., Baró, F., 2021. Exposure to nature and mental health outcomes during COVID-19 lockdown. A comparison between Portugal and Spain. *Environment International* 154. <https://doi.org/10.1016/J.ENVINT.2021.106664>.
- Russo, A., Cirella, G., 2018. Modern Compact Cities: How Much Greenery Do We Need? *International Journal of Environmental Research and Public Health* 15, 2180. <https://doi.org/10.3390/ijerph15102180>.
- Samuelsson, K., Barthel, S., Colding, J., Macassa, G., Giusti, M., 2020. Urban Nature As a Source of Resilience During Social Distancing Amidst the Coronavirus Pandemic. <https://doi.org/10.31219/osf.io/3wx5a>.
- Soga, M., Evans, M.J., Tsuchiya, K., Fukano, Y., 2020. A room with a green view: the importance of nearby nature for mental health during the COVID-19 pandemic. *Ecological Applications* 0, 1–10. <https://doi.org/10.1002/eap.2248>.
- Spano, G., D'Este, M., Giannico, V., Elia, M., Cassibba, R., Laforzezza, R., Sanesi, G., 2021. Association between indoor-outdoor green features and psychological health during the COVID-19 lockdown in Italy: a cross-sectional nationwide study. *Urban Forestry & Urban Greening* 62, 127156. <https://doi.org/10.1016/J.UFUG.2021.127156>.
- Taylor, A.F., Kuo, F.E., Sullivan, W.C., 2002. Views of nature and self-discipline: evidence from inner city children. *Journal of Environmental Psychology* 22, 49–63. <https://doi.org/10.1006/jevp.2001.0241>.
- Triguero-Mas, M., Dadvand, P., Cirach, M., Martínez, D., Medina, A., Mompert, A., Basagaña, X., Gražulevičienė, R., Nieuwenhuijsen, M.J., 2015. Natural outdoor environments and mental and physical health: relationships and mechanisms. *Environment International* 77, 35–41. <https://doi.org/10.1016/j.envint.2015.01.012>.
- Tsai, W.-L., McHale, M., Jennings, V., Marquet, O., Hipp, J., Leung, Y.-F., Floyd, M., 2018. Relationships between characteristics of urban green land cover and mental health in U.S. Metropolitan areas. *International Journal of Environmental Research and Public Health* 15, 340. <https://doi.org/10.3390/ijerph15020340>.
- Ulrich, R.S., 1983. Aesthetic and affective response to natural environment, in: behavior and the natural environment. Springer US 85–125. https://doi.org/10.1007/978-1-4613-3539-9_4.

- Ulrich, R.S., Simons, R.F., Miles, M., 1991. Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology* 11 (4944), 201–230. [https://doi.org/10.1016/S0272-4944\(05\)80184-7](https://doi.org/10.1016/S0272-4944(05)80184-7), 201-230.
- United Nations, Department of Economic and Social Affairs, and Population Division, 2019. *World Population Prospects Highlights, 2019 Revision Highlights, 2019 Revision*. Available online: <https://www.un.org/development/desa/publications/world-population-prospects-2019-highlights.html> (accessed on Nov 11, 2020).
- van den Berg, A.E., Maas, J., Verheij, R.A., Groenewegen, P.P., 2010. Green space as a buffer between stressful life events and health. *Social Science and Medicine* 70, 1203–1210. <https://doi.org/10.1016/j.socscimed.2010.01.002>.
- van den Berg, M., van Poppel, M., van Kamp, I., Andrusaityte, S., Balseviciene, B., Cirach, M., Danileviciute, A., Ellis, N., Hurst, G., Masterson, D., Smith, G., Triguero-Mas, M., Uzdanaviciute, I., Wit, Pde, van Mechelen, W., Gidlow, C., Grazuleviciene, R., Nieuwenhuijsen, M.J., Kruize, H., Maas, J., 2016. Visiting green space is associated with mental health and vitality: a cross-sectional study in four european cities. *Health and Place* 38, 8–15. <https://doi.org/10.1016/j.healthplace.2016.01.003>.
- Vegetal, P., D.E.H.O.Y.Y. Del, 2009. *Plan Director de las Zonas Verdes*. Ayuntamiento de Madrid. Available online: <https://www.madrid.es/UnidadesDescentralizadas/ZonasVerdes/ToDoSobre/PlanInfraestructuraVerdeYBiodiversidad/PlanesDirectores/Plan%20Director%20Zonas%20Verdes.pdf> (accessed on May 11, 2021).
- Venter, Z.S., Barton, D.N., Gundersen, V., Figari, H., Nowell, M.S., 2021. Back to nature: norwegians sustain increased recreational use of urban green space months after the COVID-19 outbreak. *Landscape and Urban Planning* 214, 104175. <https://doi.org/10.1016/J.LANDURBPLAN.2021.104175>.
- von Lindern, E., Lymeus, F., Hartig, T., 2016v. . The Restorative Environment: a Complementary Concept for Salutogenesis Studies, in: *the Handbook of Salutogenesis*. Springer International Publishing, pp. 181–195. https://doi.org/10.1007/978-3-319-04600-6_19.
- Ward Thompson, C., 2011. Linking landscape and health: the recurring theme. *Landscape and Urban Planning* 99, 187–195. <https://doi.org/10.1016/j.landurbplan.2010.10.006>.
- White, M.P., Alcock, I., Wheeler, B.W., Depledge, M.H., 2013. Would you Be happier living in a greener urban area? A fixed-effects analysis of panel data. *Psychological Science* 24, 920–928. <https://doi.org/10.1177/0956797612464659>.
- Wood, L., Hooper, P., Foster, S., Bull, F., 2017. Public green spaces and positive mental health – investigating the relationship between access, quantity and types of parks and mental wellbeing. *Health and Place* 48, 63–71. <https://doi.org/10.1016/j.healthplace.2017.09.002>.
- World Health Organization - Europe, 2017. *Urban Green Spaces: a Brief for Action*. Regional Office For Europe, p. 24.
- Zhu, J., Xu, C., 2021. Sina microblog sentiment in Beijing city parks as measure of demand for urban green space during the COVID-19. *Urban Forestry & Urban Greening* 58, 126913. <https://doi.org/10.1016/J.UFUG.2020.126913>.