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Usage of urban green space and related feelings of deprivation during the COVID-19 lockdown: Lessons learned from an Italian case study

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ABSTRACT

This study investigated perceptions and behavioral patterns related to urban green space (UGS) in Italian cities, during the period of national lockdown imposed due to the outbreak of SARS-CoV-2 in the spring of 2020. A survey was used to examine the responses of population groups in different municipal areas, comparing those in government-defined "red zones", mostly in the northern regions of the country, with "non-red zones" in the rest of the country, where the rate of infection was much lower. A total of 2100 respondents participated in the survey. The majority of respondents declared themselves to be habitual users of UGS, especially of parks or green areas outside the town – mainly visiting for relaxation and physical exercise, but also for observing nature. In the northern regions people more commonly reported the adoption of sustainable practices, in terms of the utilization of tools for "green mobility". During the lockdown, habits changed significantly: only one third of respondents reported visiting UGS, with frequent visits made mainly for the purpose of walking the dog. Other motivations included the need for relaxing, mostly in the red zones, and for physical exercise in non-red zones. The reduction in travel to urban parks was accompanied by increased visitation of gardens and other green spaces in close proximity, as social distancing and other regulations imposed restrictions on movement. In all regions, respondents who could not physically access UGS expressed a feeling of deprivation which was exacerbated by living in towns located in red zones, being a usual visitor of UGS and having no green view from the window. The extent to which these visitors missed UGS depended on the frequency of visitation before the pandemic and the UGS distance, as well as the type of previous activity. In fact, those activities that were most common before the pandemic were missed the most, reinforcing the importance of green areas for social gathering, sports, and observing nature – but simply "spending time outdoors" was also mentioned, even by those who visited UGS during the lockdown, as the time outdoors was not enough or not fully enjoyed. The feeling of missing UGS was only partially alleviated by the green view from the window – only a more open view to a natural landscape or adaptation to a view with little greenery reduced such feeling.

1. Introduction

In recent years, the perceived importance of urban green space (UGS) has grown among both public and private actors, especially due to the impacts of urban sprawl on the livability of towns and cities and on human health (Sanesi and Chiarello, 2006; Sanesi et al., 2017). Unregulated processes of urbanization in the periphery of towns and cities came at the expense of public investment in green spaces (Vicari Haddock, 2004) and examples of rapid and often chaotic urbanization can especially be found in the metropolitan areas of northern Italy, such as in the Milan metropolitan area (Sanesi et al., 2017).

While living in urban areas has obvious advantages, it creates and exacerbates environmental hazards such as air pollution (Wang et al., 2020; Carlsten and Rider, 2017), heat stress (Chapman et al., 2017; Oleson et al., 2015), and flooding (Jiang et al., 2018; Morelli et al., 2012). The importance of urban green infrastructure was initially recognized by the European Union in 2013, with its communication on how networks of green (and blue) areas (i.e. green infrastructure, and more recently Nature Based Solutions) could be the key for achieving many of the European policy objectives (EC, 2013; EC, 2020b). The need

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to make cities more sustainable and resilient has been promoted by the 11th Global Sustainable Goal of the United Nations Agenda 2030 (UN, 2015), and more recently reinforced by the European Union in the New Green Deal (EC, 2019) and in the EU Biodiversity Strategy (Target II) (EC, 2020a), which aims not only to protect nature but also to allow citizens to use it more. Green infrastructure provides a variety of "ecosystem services" to the community (Fisher et al., 2009; Haase et al., 2014), which include the reduction of the heat island effect (Block et al., 2012), the absorption of pollutants and regulation of water runoff during intense rainy events (Isaifan and Baldauf, 2020; Dhakal and Chevalier, 2017), the support of plant and animal biodiversity (Filazzola et al., 2019), the provision of food (e.g. through community gardens) and the provision of cultural and recreational services (Krajter Ostoic et al., 2020). For urban dwellers, UGS represents "oases of peace" where people can relax, do physical activity, observe nature etc. (Gozalo et al., 2019, Hunter et al., 2015). It is well known that densely populated environments can increase stress, in turn affecting health (Lambert et al., 2015), while natural elements can mitigate it and elicit both directly and indirectly a better quality of life (Lopes and Camanho, 2013), physical health (van den Bosch and Sang, 2017; Tzoulas et al. 2007), well-being and mental health (Felappi et al. 2020; Spano et al. 2020; Panno et al., 2017; Nath et al., 2018; Tsai et al., 2018; Bratman et al., 2019). The general population is increasingly attentive to the importance of UGS, and Kruize et al. (2020) demonstrated that such perceptions are keener when UGS are located in the vicinity of their home.

Accessing these natural amenities within the city takes on special significance in times of societal stress, such as during a severe public health crisis. The outbreak of the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) pandemic in early 2020 induced social isolation measures in many countries around the world, restricting the access of local populations to public open space and highlighting the urgency of changing development paradigms and integrating natural capital and ecosystem services at the urban scale (Azevedo et al. 2020). In general terms it is known that social distancing may be driven by a range of different factors, beyond the legal imposition of restrictions, during an epidemic. The tendency of people to congregate in public spaces is also tempered by their perception and awareness of the actual risk of contagion, as opposed to their need and desire for such contact. This can be influenced by subjective factors such as personal inclinations, as well as by objective factors such as the communication of information (e.g. through official channels and social media), the status of infrastructure systems and citizen services, and general economic and social conditions (Phua and Lee, 2005). Relatively few studies have scrutinized the social and behavioral impacts which large-scale epidemics may have on communities, and some focused on the impacts on people's relationships with urban green space (e.g. Kleinschroth and Kowarik 2020; Slater et al., 2020; Ugolini et al., 2020; Venter et al., 2020). In addition, we can hypothesize that in the near future pandemics may occur with increasing frequency (Scudellari, 2020).

While UGS are recognized to improve well-being and enhance social benefits, the limitation of movement during the epidemic might have induced people to feel deprivation and to perceive UGS in relation to what they could or could not do at the time of the pandemic, and to the actual risk of contagion.

Italy was the first country to experience a major outbreak of the virus after the original infection in China, and a high number of infections, hospitalizations and victims were especially recorded in the northern regions of Lombardy and Veneto. Beginning in late February 2020, the outbreaks were initially stemmed through containment measures: leaving home for non-essential purposes was prohibited, and virtually all economic activities were closed in the most affected municipal areas (ten municipalities in the provinces of Lodi and Padua). Soon after that other outbreaks started, and on the 25th of February the measures were extended to those regional territories and a few other provinces in other regions. As the number of infections rose, the territories of Lombardy, Veneto, Friuli Venezia Giulia, Piedmont, Emilia Romagna (Northern Italy) and Marche (Central Italy) were declared "red zones" – but soon, to prevent contagion in other regions, the containment measures were extended on the 9th of March to the national level.

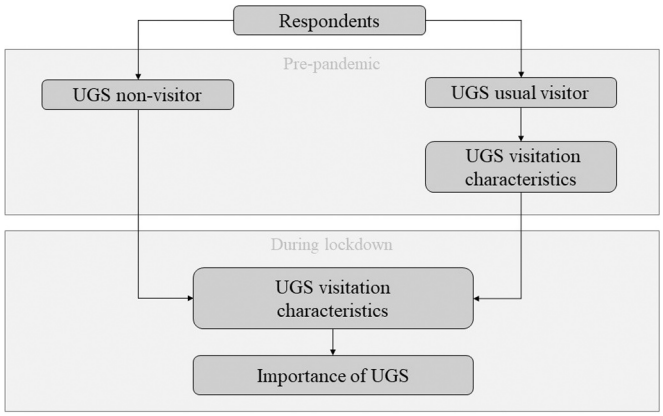

Fig. 1. Schematic structure of the questionnaire described in this work.

In these red zones the situation was dramatic, with hundreds of infections, overcrowded hospitals, and increasing deaths tolls for the Coronavirus Disease (COVID-19) witnessed daily. The containment measures escalated not only in their spatial extent, but also in their intensity, reducing freedom of movement. During the lockdown, only essential businesses were allowed to run at normal capacity, while all others were completely closed or restricted – including outdoor leisure activities, which were limited to a single person at any time and within a proximity of up to 200 m from home.

These containment measures also imposed increasingly strict limitations on the use of urban green space. During the first two weeks of the nationwide lockdown in mid-March, spending time outdoors was allowed due to health benefits – as contact with nature and fresh air are known to support the immune system (Li, 2010; Parsons et al., 1998). However, a counteracting effect was observed as parks and gardens transformed into public gathering places, increasing the potential risk of contagion. Hence, the Health Ministry decided to close access to city parks and gardens from March 20. Outings were allowed only for activities deemed necessary (e.g. going shopping or taking the dog out), while walking and exercising were limited to a distance of within 200 m from home.

With this extraordinary situation as a backdrop, the current research was initiated with the aim of assessing the extent to which the government-mandated isolation measures influenced citizens' use of urban green space, and their feeling of missing UGS during the lockdown. We hypothesized that the dramatic effects of the pandemic in the most affected regions would accentuate the perception of health-related risks outdoors, and in turn influence the behavior of UGS users.

2. Materials and methods

At the onset of the national lockdown and period of forced isolation (in March 2020), an exploratory study was carried out for the purpose of surveying UGS usage and the extent to which respondents missed UGS access and related activities during the lockdown. The survey was made through a questionnaire, targeted the general public and administered online using Google Forms, requesting the informed consent of respondents prior to their participation as well as their agreement regarding the handling of personal data.

The questionnaire (available in the Supplementary materials) contained five sections in a branched structure (Fig. 1), and together with the reporting of personal details (age, education, occupation) included a total of 32 questions.

The questionnaire was pre-tested by a small sample of respondents (n = 10), including people of different ages and education levels in order

to verify the clarity of the questions and logical structure (as well as the functionality of the online tool). The preliminary version of the questionnaire was corrected based on the suggestions and other types of feedback that were given before its actual administration.

2.1. Questionnaire administration

Distribution of the online questionnaire began in Italy on March 31, 2020 and ended on the 4th of May when the restrictive measures to contain the SARS-CoV-2 outbreak ended. The administration of the questionnaire and data collection were based on non-probability sampling through online survey (Fricker, 2008). Distribution of the questionnaire started via social media (Facebook, WhatsApp, etc.), initially addressing friends and colleagues and then extending to wider networks throughout the country via institutional mailing lists. The questionnaire was also published on websites of associations related to the topics of green space management and urban forestry. Participants were asked to fill in the questionnaire anonymously and distribute it further to their contacts. Thus, the distribution proceeded according to a snowball effect, and did not allow for personal identification of individual respondents.

It should be emphasized that the overriding purpose of the study was exploratory, and that the methods used for dissemination of the questionnaire could induce bias due to an implicit selection of respondents from certain population sectors. Therefore, while our intention was to survey a large population sample which would be sufficiently varied to reflect a range of perspectives and personal situations during the pandemic, we caution that the results obtained should not be considered as statistically representative of the entire Italian population.

2.2. Data management and statistical analysis

Data collected from the survey respondents (n = 2102) were checked for consistency, and any records missing essential details (e.g. for sample characterization) were excluded (n = 21). The resulting sample underwent further inspection and processing. Two separate groups of data were formed, based on the location of the respondents. Reflecting the preliminary regulations and restrictions set by the government to combat COVID-19, one group was made up of responses from the "red zones" instituted by the government in which COVID-19 had dramatic effects in terms of hospitalizations and victims (named "Red Zones") and the other group included responses from all other zones (named "Non-red Zones") in which the number of infected and hospitalized people was much lower (www.salute.gov.it).

The dataset was analyzed by performing descriptive statistics (frequencies and percentages). Differences between pairwise options were investigated by the Chi square test. The same test was also used for comparisons between two groups (e.g. responses representing "red" vs. "non-red" zones, UGS visitors vs. non-visitors, or before vs. during containment measures). The Chi square test was not applied when the variables did not meet the criteria of the required expected count of 5 in each cell.

While most questions took the form of a multiple choice, some included the option to specify an answer "other" than those presented in the predefined choices. If the respondent's text expressed the same concept as that of a predefined choice it was coded with that choice (for instance, regarding the activities in UGS, when respondents indicated "talking with my friends" as "other", this was coded as the predefined choice "meeting people"), and if the concept was different and indicated by several respondents, an additional common code was defined.

Multiple regression analysis was performed to assess the relationship between dependent variables such as the type of activities carried out in UGS during the lockdown or the extent of missing UGS and missed activities, with independent variables. Specifically, we assessed: i) the relationship between the activities performed during the lockdown by UGS visitors (dependent variables) and demographic characteristics of the group such as place of residence, frequency of UGS visitation, distance of UGS, age class, gender, activities done before the pandemic (independent variables); ii) the extent to which UGS access was missed (dependent variable) by all respondents with respect to living in a red zone; being a usual UGS visitor; size of the locality; gender; age class; work status; green view from the window (independent variables) and finally iii) the extent to which activities connected to UGS (dependent variables) were missed by UGS visitors in relation to frequency of UGS visitation before the pandemic, distance of UGS, activities performed before the lockdown (independent variables). All categorical variables were coded as dummy variables (0 not in the category, 1 within the category). Only statistically significant results are shown in the tables.

Statistical analyses were performed using Statistica (Release 12, StatSoft, Inc. 1984–2014).

3. Results

3.1. Description of the collected data

Of the total number of responses analyzed (n = 2081 from the entire national territory), 990 respondents were from the areas originally classified by the government as "red-zones", mainly in the regions of Lombardy (37%) and Emilia Romagna (28%), and 1091 respondents were from other parts of Italy, thus classified as "non-red zones", mainly in the Tuscany region (48%). The characteristics of the groups are shown in Table 1S (Supplementary materials). The groups were evenly distributed in terms of gender, and in total 57% respondents were female and 43% male. In both zones, the age of most respondents ranged from 30 to 69 years, with a slightly higher percentage of people in their fifties and forties (26% and 23% respectively in the non-red zones, and 24% and 26% respectively in the red zones) and a larger group (19%) of people in their thirties in the red zones (vs. 14% in non-red zones). The sample of non-red zones also counted a larger group (17%) of young people between 20 and 29 years old than in the red zones (8%).

A large majority of respondents had completed higher education, accounting for 56% in red zones and 67% in non-red zones, followed by respondents with a high school diploma which were more numerous in the red zones (38%) than in non-red zones (30%). Regarding their work profession, the majority in both groups were employees in public and private organizations (on average 48%) while the number of freelance/private business workers was higher in the red zones (30%) than in the non-red zones (19%). Students were more numerous in the non-red zones (17% vs. 4%).

Respondents in the two groups were fairly evenly distributed in terms of the size of the place where they live, with a large majority living in towns (73% and 83% respondents in red zones and non-red zones, respectively). In the red zones, 41% people lived in big towns (more than 100,000 inhabitants), 32% in small towns (100,000–10,000 inhabitants) and 27% in villages/rural areas, while in the non-red zones they were equally distributed in the two size classes of towns (41% in big towns, 42% in small towns) and 17% in village/rural areas.

3.2. Extent to which the visitation of UGS changed during the lockdown

3.2.1. UGS visitors' behavior in red vs. non-red zones

Before presenting the changes observed in UGS visitors' behavior during the lockdown, it is worth briefly describing the declared habits of this group of respondents before the pandemic. UGS visitors were mainly people living in towns (Table 2S), with the majority (> 79%) declaring that their UGS was farther than 200 m from home – in both red and non-red zones, and regardless the town size (Tables 3S, 4S). In both zones a large majority (91% and 87% in red and non-red zones, respectively) declared that they frequently visit UGS mainly for *relaxing* (29%), doing *physical exercise* (24%) and *observing nature* (19%), with no significant differences between the two zones. The typology of *Urban park* was selected slightly more frequently (61%) in red zones than in

Table 1
UGS usage by usual visitors and non-visitors before the pandemic and during the lockdown period, in the originally declared "red zones" and "non-red zones".

		UGS visitors			UGS non-visitors		
		Red zones (n, %)	Non-red zones (n, %)	Total (n, %)	Red zones (n, %)	Non-red zones (n, %)	Total (n, %)
UGS usage	Before the pandemic	843 (48%)	899 (52%)	1742 (100%)	–	–	339 (100%)
	During the lockdown	320 (18%)	317 (18%)	638 (36%)	18 (5%)	21 (6%)	39 (11%)

Percentages are calculated relative to the total number of respondents in each group (UGS visitors and UGS non-visitors).

Table 2
Characteristics of visitation of UGS **during the lockdown**.

A) Motivation to visit UGS	Red zones	Non-red zones	Significance	All groups
Physical exercise	20%	32%	***	26%
Taking the dog out	28%	21%	ns	25%
Relaxing	24%	19%	*	21%
Taking the kids outdoor	9%	8%	ns	8%
Observing nature	10%	10%	ns	10%
Other	7%	9%	ns	8%
Meeting people	1%	1%		1%
Reading	1%	0%		0%
Tot responses (n)	320	318		638
B) Type of UGS				
An urban park	42%	37%	ns	40%
An urban garden	16%	15%	ns	16%
A tree-lined street	5%	5%	ns	5%
River banks	13%	14%	ns	13%
Green area outside the town	19%	25%	ns	22%
Other	3%	4%	ns	4%
Tot responses (n)	315	318		632
C) Frequency of visitation				
More than once a week	50%	50%	ns	50%
Once a week	18%	22%	ns	20%
Less than once a week	11%	11%	ns	11%
Once	21%	17%	ns	19%
Tot responses (n)	320	318		637
D) Distance of UGS				
Less than 200 m	42%	35%	ns	38%
Between 200 and 500 m	29%	31%	ns	30%
More than 500 m	29%	34%	ns	32%
Tot responses (n)	320	318		638
E) Means of transportation				
On foot	84%	80%	ns	82%
Car	7%	11%	ns	9%
Bike	8%	8%	ns	8%
Public transportation	1%	1%		1%
Tot responses (n)	320	318		636

Significant differences between the two groups (red zones vs. non-red zones) were identified by the Chi square test and marked by * at $p < 0.05$, ** at $p < 0.01$, *** at $p < 0.005$ and ns for no significance.

non-red zones (56%) ($p < 0.05$), followed by *green area outside the town* (15%), *river banks* (11%) and *urban garden* – which was selected to a larger extent by respondents in non-red zones (13% vs. 7%, $p < 0.001$).

During the lockdown, there was a sharp decrease (−36%) in the number of UGS visitors (638, compared to 1742 before the pandemic) – with no difference between red zones and non-red zones (Table 1). For those who did visit UGS during the lockdown, the main motivations were *taking the dog out* (28%) and *relaxing* (24%) in the red zones, while doing *physical exercise* was the most selected option (32%) in the non-red zones (see Table 2-A). Other motivations included *physical exercise* (20%, less than prior the lockdown) in the red zones, and *taking the dog out* (21%) and *relaxing* (19%) in the non-red zones. To a more minor extent, *observing nature* (10%) and *other reasons* (on average 8%) were selected, with the latter mainly including *work* and *passing through the UGS* to reach another place (e.g. a pharmacy or supermarket) (Table 2-A).

It should be noted that *taking the dog out* was the only motivation that showed a strong increase during the lockdown, of + 17% ($p < 0.01$) and + 12% ($p < 0.05$) in the red and non-red zones, respectively. In the non-red zones *physical exercise* also showed an increase (+8%) (Fig. 2). All the *"other"* options decreased during the lockdown, especially *observing nature* in the red zones (−10%, $p < 0.05$).

Regarding the type of UGS visited, the choice remained the same as before the pandemic for about 73% of UGS visitors. The main reasons to change UGS were to stay closer to home (65%) and because the usual UGS was closed (16%) due to the municipal regulations (Table 3).

Urban parks remained the most visited UGS during the lockdown (42% in the red zones and 37% in the non-red zones) (Table 2-B), although there was a decrease of about 10% in their visitation with respect to before. In contrast, an + 8% increase in the visitation of *urban gardens* (Fig. 3) was observed in the red zones, reaching about 16% for visitors in both red and non-red zones. Other UGS types visited to a minor degree were *green areas outside the town* (19% in red zones and 25% in non-red zones), *river banks* (about 13%) and *tree-lined streets* (5%).

No substantial differences were found in the frequency of UGS visitation during the lockdown (Table 2-C) between red zones and non-red zones. In both zones, the largest share of respondents (50%) went to UGS *more than once a week*, with about 20% going *once a week* and another 20% visiting UGS *once in the whole period*.

However, the most frequent visitors were those living in rural areas or villages, in contrast to those living in towns (Table 5S).

During the lockdown, UGS visitation at shorter distance (*less than 200 m*) was the most selected (42% in the red zones and 35% in the non-red zones) (Table 2-D). Shorter distances slightly increased, by + 10 and + 7% in red zones and non-red zones respectively, although not to a statistically significant extent, whereas visitation of UGS at farther distance (*more than 500 m*) – which was the most selected before the pandemic (~50%, regardless of the size of the locality of residence) (Table 3S), slightly decreased, on average by 9% (also without significance) (Fig. 4).

Regarding the means of transportation taken, *going on foot* was the main way to reach UGS (Table 2-E) during the lockdown and this was a slight increase compared to previously (Fig. 5) (which could be expected, given the decrease in distance traveled) although this was also the most selected way before the lockdown (66% on average). Other means of transportation like *car* and *bike* were used to a lesser extent and their use did not substantially change as compared to the situation before the lockdown (Fig. 5). Going by *car*, the second most used means of transportation (on average 9%), was mainly used to reach UGS at *more than 500 m*, especially in non-red zones (32% vs. 22% in red zones) – while such distances were reached equally by *bicycle* (21%) in the red zones (Table 6S), confirming the bike as one of the traditional means of transportation in red zones before the lockdown (Table 2S-E).

Looking more in detail, important differences were observed for those who actually changed their visitation from one UGS to another (N = 175 out of 638) (Table 7S). These respondents increased their visitations of UGS at shorter distances (+36% and +26% in red zones and non-red zones, respectively), reducing as a consequence their visitation of UGS at greater distance (−36% and −29% in red zones and non-red zones, respectively). The distance travelled also induced a change in the means of transportation, with a consistent increase of walking *on foot* (+34% and +27% in red zones and non-red zones, respectively) and a decrease of other means of transportation, especially

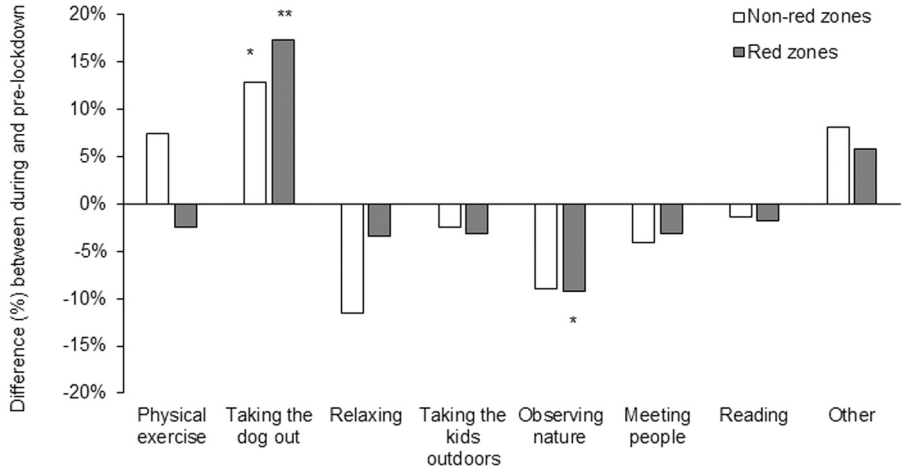

Fig. 2. Change in motivations to visit UGS during the lockdown, as compared to before it began. Significant differences between activities pre- and during lockdown in each group (red zones and non-red zones) were identified by the Chi square test and marked by * at $p < 0.05$, ** at $p < 0.01$ and *** at $p < 0.005$.

Table 3
Reasons to change the UGS **during the lockdown**.

	Red zones	Non-red zones	Significance	Al groups (n)
To stay closer	65%	66%	ns	105
The area is closed	17%	15%	ns	26
To change/explore places	5%	3%	ns	6
To follow prescribed measures	2%	4%	ns	5
Work	3%	3%	ns	5
To avoid people	3%	3%	ns	5
I live next to a green area	0%	4%	ns	3
Other than above	5%	3%	ns	6
Totals (n)	88	73		161

Significant differences between the two groups (red zones vs. non-red zones) were identified by the Chi square test and marked by * at $p < 0.05$, ** at $p < 0.01$ and *** at $p < 0.005$.

bikes (−19% and −8% in red and non-red zones respectively) and *cars* (−12% and −18% in red and non-red zones respectively).

The multiple regression analysis summarized in Table 4 reveals how some activities performed during the lockdown were related to the frequency and type of activities performed before the pandemic, as well as to other variables. For instance, the higher the frequency of visitation before the lockdown, the greater the visitation for activities such as physical exercise and taking the dog out. In addition, those UGS users who went outdoors with dogs and children regularly before the lockdown continued to do so – but for certain activities, including some considered non-essential (i.e. observing nature, relaxing and taking the dog out), greater distances required to reach green spaces were correlated with less the visitation for such purposes.

3.2.2. *UGS non-visitor behavior in red zones and non-red zones*

Among those respondents who declared that they do not regularly visit UGS, a large majority (88%) also did not visit UGS during the lockdown (Table 1). Respondents who visited UGS went mainly for *taking the dog out*, *relaxing,* and *doing physical exercise* – and especially in the red-areas, passing through UGS on the way to another destination (Table 8S-A and B). In the non-red zones, the respondents went mainly *once a week*, preferring UGS at farther distances (*more than 500 m*) in significantly greater numbers than in the red zones ($p < 0.01$) – while in the red zones no differences were observed in either the frequency or in the distance travelled (Table 8S-C and D). These visitors preferred going by *bicycle* in the red-zones and by *car* or *bicycle* in the non-red zones (Table 8S-E).

3.3. *The importance of UGS and "missing" access to it*

The containment measures induced the great majority of

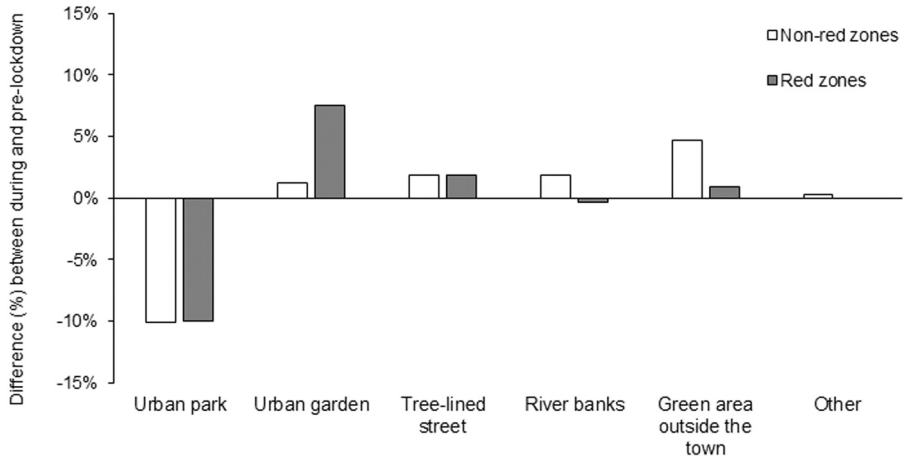

Fig. 3. Change in visitation of UGS typologies during the lockdown relative to before. Significant differences between the green spaces pre- and during lockdown in each group (red zones and non-red zones) were identified by the Chi square test and marked by * at $p < 0.05$, * * at $p < 0.01$ and * ** at $p < 0.005$.

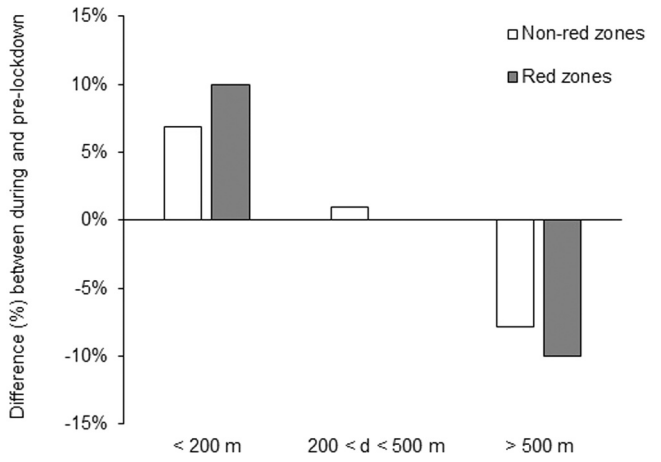

Fig. 4. Change in distance of visited UGS during the lockdown relative to before it. Significant differences between the green space distance pre- and during lockdown in each group (red zones and non-red zones) were identified by the Chi square test and marked by * at $p < 0.05$, ** at $p < 0.01$ and *** at $p < 0.005$.

respondents (86%, of whom the majority were women – Table 9S-A) to declare that they missed visiting UGS either *a lot* or *rather much*, especially when living in urban contexts (91% in big and small towns vs. 76% in village/rural areas) (Table 9S-B). The regression analysis showed a negative relationship between the extent to which respondents missed UGS and the proportion living in rural areas/villages or being male and older, while the feeling of deprivation was greater when respondents lived in red zones, were usual visitors of UGS and lacked any green view from their window (Table 5).

For usual visitors of UGS (Table 10S), the feeling of deprivation from lack of UGS access was differentiated between big and small towns, and depended also on usage characteristics before the pandemic such as the frequency of visitation and the distance of UGS. The extent of missing UGS depended also on activities performed in UGS before the pandemic (e.g. doing physical exercise, taking the kids outdoors, reading, observing nature and taking the dog out) and during the lockdown, especially relaxing.

What respondents in general missed the most, was mainly the possibility to *spend some time outdoors* (28%) and *exercising outdoors* (25%). *Observing nature* was also selected (19%) – regardless of where the respondents lived, in terms of red or non-red zones (Fig. 6) or town size (Table 11S).

There was a relationship between the type of activity missed by respondents and the activities they performed both before the pandemic and during the lockdown. For instance, in general respondents missed the same activities that they used to do before the pandemic, such as taking the kids outdoors (Table 6). This was positively related to the same activity, but also to meeting people before the lockdown. Physical exercise and observing nature were also missed when they were practiced before the pandemic, while missing "meeting people" was negatively related to people who used to perform activities implying movement (physical exercise) or relaxation (relaxing, observing nature) before the pandemic. Instead, missing "spending time outdoors" was related to some activities performed during the lockdown like reading and taking the dog out, while "relaxing" was missed despite "exercising" and "taking the dog out" during the lockdown.

In addition, missing activities such as "taking the kids outdoors" and "exercising" was related to the frequency of visitation before the pandemic, while missing "exercising" and "taking the dog out" was related to the distance from UGS.

When respondents were asked if they could see some green space or element from the window of their residence (Table 12S), the majority (on average 37.5%, without differences between red or non-red zones), could see a *private garden* and 25% some *natural landscape*, while 12% declared that they could not see anything green. Other types of green view indicated to a minor extent were *trees along the streets*, *public gardens* and *parks*. Some UGS typologies were more typical of certain urbanized contexts; for instance, *public gardens, tree-lined streets, river banks* and a *view of a few trees* were distinctive of big towns while *natural landscape* was typical of villages and rural areas (Table 13S).

For those who did report seeing greenery from their window, a connection was seen between the "level" of this green view and the extent to which respondents missed actually visiting a green space (Table 6, Fig. 7). In general, missing UGS was less substantial for respondents who could see a natural landscape than for those who could not see any green from the window. In non-red zones, the proportion of those reporting that they missed visiting UGS (either *a lot* or *rather much*) increased from 85% for those with an "open view" (when natural landscape could be seen), to slightly more for those with a "partly open view" (when tree-lined streets, gardens or parks could be seen), to a full 100% for those with a "limited view" (when only a few trees or plants could be seen). Interestingly, while those who defined their green view as "none" also reported overwhelmingly that they missed visiting UGS,

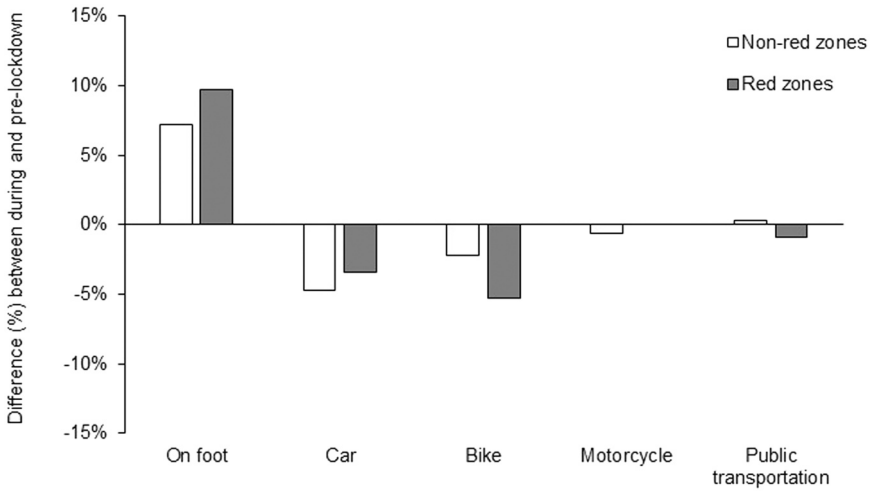

Fig. 5. Change in means of transportation of visited UGS between during the lockdown relative to before it. Significant differences between the means of transportation pre- and during lockdown in each group (red zones and non-red zones) were identified by the Chi square test and marked by * at $p < 0.05$, * * at $p < 0.01$ and * ** at $p < 0.005$.

Table 4
Results of multiple regression between activities performed in UGS during the lockdown (dependent variable) and independent variables (living in red zones, frequency of visitation before the pandemic, age class, gender, size of the living place, activities done before the pandemic and activities done before the pandemic).

Dependent variable	Independent variable:	Estimate	Std. Error	P
Physical exercise	(Intercept)	-0.02	0.16	
	Frequency of UGS visitation	0.02	0.01	*
	Taking the kids outdoor	-0.22	0.10	*
	Observing nature	-0.21	0.10	*
	Taking the dog out	-0.24	0.10	*
Taking the kids outdoor	(Intercept)	-0.02	0.09	
	Taking the kids outdoor	0.17	0.06	**
Observing nature	(Intercept)	-0.04	0.11	
	Distance of UGS	-0.02	0.01	**
Taking the dog out	(Intercept)	0.24	0.14	
	Frequency of UGS visitation	0.03	0.01	***
	Distance of UGS	-0.02	0.01	**
	Small town	-0.04	0.02	*
	Taking the dog out	0.45	0.09	***
Relaxing	(Intercept)	0.05	0.15	
	Living in red zone	-0.03	0.01	*
	Distance of UGS	-0.02	0.01	*

All categorical variables were coded as dummy variables (0 not in the category, 1 within the category). Only statistically significant independent variables are reported and marked by * at $p < 0.05$, ** at $p < 0.01$ and *** at $p < 0.005$.

Table 5
Results of multiple regression between the feeling of missing UGS as the dependent variable, and various independent variables (living in red zones, being usual UGS visitors, locality of residence, gender, age class and green view from the window).

Independent variables	Estimated coefficient	Std. Error	P
(Intercept)	2.77	0.11	***
Living in red zone	0.06	0.02	**
Being UGS visitor	0.27	0.02	***
Living in rural areas/villages	-0.17	0.02	***
Living in small town	-0.04	0.22	*
Gender (M)	-0.07	0.02	***
Age (50–69)	-0.06	0.02	**
Age (70–79)	-0.07	0.02	***
Green view from the window: none	0.05	0.02	*

All categorical variables were coded as dummy variables (0 not in the category, 1 within the category). Only statistically significant independent variables are reported and marked by * at $p < 0.05$, ** at $p < 0.01$ and *** at $p < 0.005$.

they did so at a slightly lower rate than those with a "limited view". This overall trend was similar for red zones, and it does suggest that the view of a natural landscape may alleviate the sense of deprivation felt by those who are in home isolation and cannot physically access outdoor green spaces.

4. Discussion

The results reported in this study shed light on the public's behavior and perception regarding UGS during the lockdown instituted for the containment of the first wave of the COVID-19 pandemic in Italy. Following the initial outbreak in China in the first months of 2020, Italy was the first western country to face the consequences of such a serious zoonosis – which caused an exponentially growing rate of infections and deaths and led the authorities to impose strong measures of social distancing and the closure of most businesses. As the virus outbreak was mainly concentrated in specific geographical locations (mainly in the northern part of the country, together with some localized areas in central Italy), it was possible to identify and quantitatively compare the responses of those living in these formerly instituted "red zones" with those in other parts of the country. As previously mentioned, this comparison is exploratory and given the practical limitations of the survey, it should not be seen as a comprehensive analysis of the overall Italian population.

Despite this, the characteristics of the group from the "red zones" do indeed reflect the population of these productive northern areas, with a large number of private business employees and free-lancers and a high percentage of people with higher education – which, as reflected by national statistics, is accompanied by a relatively high rate of employment among young people (Istat, 2019b).

For a variety of reasons ranging from geographical position, land morphology and climate to historical trends and availability of resources, the red zones located in northern regions also represent the economic core of the country, producing about 40% of the national gross domestic product (Istat, 2019a). These areas are characterized by rapid urban expansion, and an intensive and proactive economic network of industrial and agricultural producers for both domestic and international trade. Over the years, urban planning strategies have focused on transforming many abandoned industrial areas into UGS (e.g. Parco Nord Milano), with the participation of NGOs or citizens' associations involved in UGS governance (Sanesi et al. 2017). Regarding the attitude of these people toward UGS, it is firstly notable that the respondents who participated in the survey were largely accustomed to visiting urban parks and natural green areas before the pandemic. UGS visitors in the "red zones" declared visiting UGS more often than their (non-red) counterparts, and a majority of them were found to live in small towns –

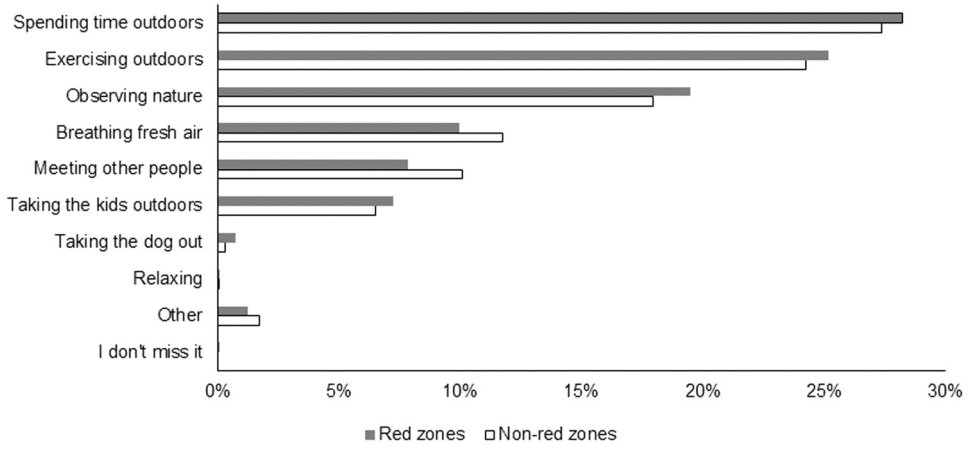

Fig. 6. Activities that were missed in times of lockdown. Significant differences between the two groups (red zones vs. non-red zones) were identified by the Chi square test and marked by * at $p < 0.05$, ** at $p < 0.01$ and *** at $p < 0.005$.

Table 6
Results of multiple regression between the activities missed by UGS visitors during the lockdown (dependent variables) and frequency of UGS visitation before the pandemic, distance of UGS and activities performed before the lockdown (independent variables).

		Estimated coefficient	Std. Error	P
Spending time outdoors	(Intercept)	0.434	0.176	*
	Physical exercise (pre-pandemic)	-0.233	0.112	*
	Reading (during-lockdown)	0.459	0.222	*
	Taking the dog out (during-lockdown)	0.124	0.049	*
Taking the kids outdoors	(Intercept)	-0.079	0.137	
	Frequency of UGS visitation	0.021	0.008	**
	Meeting people (pre-pandemic)	0.188	0.090	*
	Taking the kids outdoor (pre-pandemic)	0.550	0.089	***
Exercising outdoors	(Intercept)	0.078	0.237	
	Living in red zone	-0.044	0.021	*
	Distance of UGS	0.040	0.013	**
	Frequency of UGS visitation	0.033	0.015	*
	Physical exercise (pre-pandemic)	0.425	0.152	**
	Taking the dog out (during-lockdown)	-0.163	0.067	*
	Other (during- lockdown)	-0.174	0.079	*
Meeting other people	(Intercept)	0.402	0.133	**
	Physical exercise (pre-pandemic)	-0.186	0.085	*
	Observing nature (pre-pandemic)	-0.200	0.085	*
	Relaxing (pre-pandemic)	-0.176	0.086	*
	Relaxing (during-lockdown)	-0.064	0.031	*
Observing nature	(Intercept)	-0.003	0.204	
	Reading (pre-pandemic)	0.284	0.141	*
	Observing nature (pre-pandemic)	0.425	0.131	**
	Relaxing (during-lockdown)	0.096	0.048	*
Taking the dog out	(Intercept)	-0.008	0.031	
	Distance of UGS	0.004	0.002	*
Relaxing	(Intercept)	0.004	0.014	
	Frequency of UGS visitation	-0.002	0.001	**
	Small town	-0.003	0.002	*
	Physical exercise (during-lockdown)	0.007	0.003	*
	Taking the dog out (during-lockdown)	0.008	0.004	*
	Relaxing (during-lockdown)	0.013	0.003	***

All categorical variables were coded as dummy variables (0 not in the category, 1 within the category). Statistically significant independent variables are reported and marked by * at $p < 0.05$, ** at $p < 0.01$ and *** at $p < 0.005$.

which are typically located in large urban networks and metropolitan areas that provide the greatest green surface *per capita* (e.g. with large parks) – as compared to the center or south of Italy (Istat, 2016), and also in closer proximity to periurban forests or natural areas.

There might be several other aspects driving the preferences in the type and use of UGS, accessibility, size of UGS, and security issues, in addition to the presence of nearby natural landscapes. The findings presented here are reflective of the generally scarce accessibility and availability of UGS (or preferred UGS) in the proximity of the residence, as before the pandemic about 80% of usual visitors in both zones visited UGS farther than 200 m from home (and around 50% were able to go even farther than 500 m). This is an issue linked also to the sustainability of such habit: if in the red zones, respondents were used to reaching UGS that were farther away (more than 500 m from home) by means of "green mobility" such as walking or biking – which is quite common in the northern regions, in non-red zones, respondents declared to go on foot first, and secondly by car. Many studies have found a negative relationship between the distance of UGS, which decreases accessibility, and the amount of outdoor physical exercise undertaken (Toftager et al. 2011; Jones et al. 2009; Coombes et al. 2010) – but in this study it also seems that distant UGS (e.g. more than 500 m) were probably appreciated by some respondents precisely for the opportunity they offer to do *more* physical exercise. Included among open comments were the statements *"I go farther for walking more"* and *"I usually go to farther UGS because the closer area is too small for walking"* (not shown in the Results), but obviously, it might depend on the actual distance (which was not stated) to UGS.

Respondents in the red zones declared that before the pandemic they used to visit urban parks as well as green areas outside the town in larger numbers than those in non-red zones, while respondents in non-red zones mainly went to urban gardens. This also reflects the findings of Valente et al. (2020) about the distribution of UGS across the country, as they found that cities in the North are mainly characterized by wooded areas and large urban parks and other types of UGS, while cities in the South are more commonly characterized by historical green areas – mainly represented by gardens and parks.

During the lockdown, customs and habits changed dramatically – as going outdoors was allowed only for matters of necessity, within the limits of the escalating containment measures. In the formerly instituted "red zones", where at the time of the first wave COVID-19 was much more diffused than in other areas of Italy (www.salute.gov.it), it is conceivable that the psychophysical state of the people was very different from the rest of the Italian population, as they were likely to have a keener perception of the health emergency and the risk of contagion. Indeed, the large majority of respondents did not visit any green areas during this period, although the reduction was also confirmed by respondents in non-red zones.

For those who did visit UGS during the lockdown, the main reason was to take the dog out, as it was an essential activity that was allowed without restrictions, and for other reasons such as relaxing (mainly in the red zones) and doing physical exercise (in non-red zones). There was also a relationship between activities performed before and during the lockdown: taking the dog out and taking the kids outdoors continued, while activities like observing nature and relaxing became less common – especially as UGS distance increased.

In both zones, there was an increase of visitation of UGS closer home, of urban gardens in town and green areas outside the town. Those who visited UGS during the lockdown did so several times, as they likely brought the dog out or maybe visited as a way to simply stay outdoors a little bit. However, the most frequent visitors were those living in rural areas or villages rather than in towns.

Those who declared to be non-visitors of UGS before the pandemic

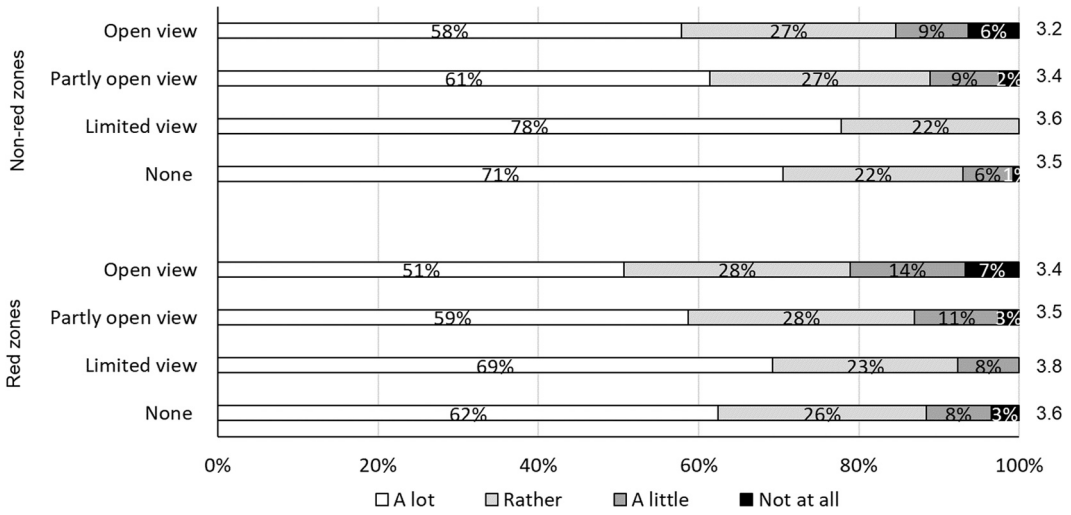

Fig. 7. Extent to which respondents in non-red and red zones missed visiting UGS, according to the view of green elements that could be seen from the window of their residence. "Green views" were associated with four levels: "none" in the case of no green elements; "limited view" in the case of greenery in the balcony or a few trees/flower beds outside; "partly open view" in the case of parks, gardens and/or tree-lined streets and river banks; and "open view" in the case of an open vista toward a natural landscape. Numbers to the right of the bars indicate the weighted average calculated by associating a numerical value to each "missing" value (A lot = 4; Rather = 3; A little = 2; Not at all = 1).

mainly did not visit UGS during the lockdown either – although a small group did so, for the same reasons as UGS usual visitors: taking the dog out and relaxing. Contrarily to more frequent users, they used a car (especially in non-red zones) or bike (in red zones) as their preferred means of transportation.

All respondents missed UGS visitation, but especially those living in red zones and in urban contexts, regardless of the size of the town. Women, those who lacked any green view from their window and usual UGS visitors all expressed missing UGS more than their counterparts. The lockdown gave many urban-dwellers a reason to appreciate the importance of UGS for the simple reason of spending some time outdoors, exercising outdoors and observing nature.

Respondents often missed the same activities they were used to engaging in before the pandemic, such as "physical exercise" and "observing nature," as well as "taking the kids outdoors" – which was also related to "meeting people", lending support to the social importance of UGS. This sense of deprivation only partly depended on the "alternatives" that were available, such as a view of greenery and open space from the window of their residence, as respondents who declared that they could not see any green at all from their window also preferentially missed UGS and respondents in the red zones with a limited "green view" missed actually going to green spaces to a larger extent than respondents who could see some greenery.

Only those who could see a larger vista of natural landscapes missed visiting UGS to a slightly lesser extent – perhaps because the wider horizon gave them opportunity to observe nature without leaving home. This is an important aspect, since many people living in urban areas can only experience nature incidentally, by viewing it by through their window (Cox et al., 2017).

As policy should aim to match the sustainability and resilience goals for our cities, as indicated by the 11th Global Sustainable Goal (ONU 2015), buildings and green spaces should be planned to guarantee human wellbeing, a healthy environment, social equality and personal security. If the goal is to provide comfortable living conditions that help families cope with stress-inducing situations, then the "view from the window" is an important parameter which should be considered by both building designers and city planners. High-rise buildings might allow wide panoramic views, but only for a limited number of residents – since as the density of these buildings increases, so does the restriction on the panoramic views they are meant to provide. Instead, moderating urban density and ensuring the proximity of green spaces and green corridors – as suggested by respondents – would allow more equal access to UGS and landscape views, reducing the sense of "green deprivation". It has been demonstrated that giving city-dwellers the chance to spend time outdoors at a short distance from home can be highly beneficial for the community, contributing to feelings of mutual solidarity and social inclusion that support interpersonal relationships (Rugel et al. 2019) – and this in turn has psychological benefits, reducing stress-related illnesses and enhancing overall health and wellbeing (Grahn and Stigsdotter, 2003; Chiesura, 2004; Lee et al. 2011; Bertram,and Rehdanz, 2015; Carrus et al. 2015).

5. Conclusions

The period of lockdown that was imposed to manage and limit the initial spread of COVID-19 in Italy provided a distinctive opportunity to reflect on the functions of urban green space and its importance for urban dwellers. Although limited in its scope, this study tapped into an unprecedented moment in modern history and provided some telling insights. Italians experienced the spread of the pandemic before it had taken hold in any other western country, and therefore they were the first to face lifestyle changes with which they were uniquely unfamiliar. These changes included basic limitations on their access urban green space – which as shown in this study, represents an essential resource for such a highly urbanized population.

Among the conclusions that may be drawn is that the proximity of UGS to people's place of residence is critical: for many, the lack of green space availability within a short distance meant that they had to travel farther than 200 m to reach their preferred UGS. Obviously the limitations of movement during the first lockdown strongly changed the habits of UGS visitors, although without great differences between red and non-red zones: the lockdown restrictions set a maximum travel distance from home, which strongly limited access to UGS and induced visits to closer UGS. Also the reasons for visiting were noticeably different than before the pandemic, as there was a decrease in "non-essential activities" such as observing nature, relaxing or taking the kids outdoors. UGS instead became a destination for essential needs like "taking the dog out," and "physical exercise" especially in the non-red zones.

In order to guarantee access to people with diverse interests and needs, and to respond to wellbeing needs during times of lockdown and pandemic, urban planning should reshape the towns and provide a diversity of accessible typologies of green spaces that can provide further

benefits. Increasing biodiversity is directly beneficial for activities such as observing nature, and ultimately for human wellbeing. Playgrounds and footpaths may satisfy the needs of a range of different people, from those searching for a place to take the kids outdoors to those for whom practicing sports is a central part of life.

It is significant that the majority of survey respondents missed having access to UGS, and the feeling was deeper for those living in the "red zones", especially for women and for those living in towns. These aspects invite reflection on the multiple effects of the pandemic and its resulting social isolation, and on the psychological need for green space – especially when its accessibility is threatened. The fact that visitors missed access to UGS to a greater extent when their pre-lockdown visitation was more frequent, and when their preferred UGS destination was farther away, provides further confirmation of the importance of an urban fabric that is rich and diverse, with a wide variety of accessible green spaces. We may conclude that in a time of pandemic, urban green spaces can represent an "oasis" of peace for urban dwellers, easing their feeling of deprivation and allowing them to feel a sense of "normality" within a distinctly abnormal context. But in order to fulfill this role, they must actually be accessible to those who need them most.

CRediT authorship contribution statement

Francesca Ugolini: Conceptualization, Methodology, Data curation, Writing - original draft.; **Luciano Massetti**: Conceptualization, Data curation, Writing - original draft. **David Pearlmutter**: Conceptualization, Writing - review & editing. **Giovanni Sanesi**: Conceptualization, Supervision, Writing - original draft.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.landusepol.2021.105437.

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