



## Citizens' use of public urban green spaces at the time of the COVID-19 pandemic in Italy



De Meo Isabella<sup>a</sup>, Becagli Claudia<sup>a</sup>, Cantiani Maria Giulia<sup>b</sup>, Casagli Alessandro<sup>a</sup>, Paletto Alessandro<sup>c,\*</sup>

<sup>a</sup> Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Research Centre for Agriculture and Environment, Firenze, Italy

<sup>b</sup> Department of Civil, Environmental and Mechanical Engineering, University of Trento, Trento, Italy

<sup>c</sup> Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Research Centre for Forestry and Wood, p.zza Nicolini 1, 38123 Trento, Italy

### ARTICLE INFO

Handling Editor: Dr. Cecil Konijnendijk van den Bosch

**Keywords:**  
COVID-19 restrictions  
Urbanisation  
Nature-based recreation  
Green infrastructures  
Web-based survey  
Lockdown  
Italy

### ABSTRACT

Since early 2020, Coronavirus Disease 2019 (COVID-19) has spread rapidly, quickly becoming a global pandemic. To counter the COVID-19 outbreak, national governments have issued different measures and restrictions, forcing citizens to adapt to a whole new lifestyle. These restrictions have impacted on the use of green spaces by citizens owing to many factors: more available free time, increased flexibility in the work environment, and a need to relax in Nature to relieve anxiety and stress. Urban green spaces provide many benefits for the physical and psychological well-being of citizens (e.g., habitat conservation, pollution control, recreational and leisure opportunities). To understand if citizens' habits have changed due to the COVID-19 restrictions, this study provides insights from a web-based survey monitoring the use of such spaces before and during the COVID-19 lockdowns in Italy. A web-based questionnaire was conducted via "Facebook Messenger" and "WhatsApp" at the end of the second wave of COVID-19 (May–June 2021). Data collection having been concluded, 1075 completed questionnaires were collected and processed. The results show that while many reduced their weekly frequentation of green areas (−16.5%), the number of people frequenting green areas near their home every day increased (+7.7%). Two main groups of people were identified: the first, those who intensified their visits to green areas being those who desired to spend time in contact with Nature; the second, those who were reluctant to visit green areas for fear of being infected. The results also show most of the respondents felt urban green areas were either very important (82.1%) or important (14.4%). Overall, the results reveal that COVID-19 induced a positive perception of the benefits provided by urban green areas, with a consequent greater use of them, which seems destined to last even once the public health emergency has passed.

### 1. Introduction

This last century has seen the majority of the world's population becoming more urbanised as a result, inter alia, of socio-economic drivers such as industrialisation, globalisation, and education (Henderson, 2003; Hofmann and Wan, 2013). In the 1950s, fewer than 30% of the world's population lived in cities, while in the 2000s this rose to 47% (Sanesi and Chiarello, 2006), and is expected to grow to 70% by the year 2030 (Demuzere et al., 2014). In the European Union (EU) countries, in 2015, approximately 75% of the population was concentrated in urban areas and made up as follows: approximately 40% in big cities (more than 50,000 residents with a density of at least 1500 inhabitants per

km<sup>2</sup>), with the remaining 35% in towns and suburbs (5000 residents in a cluster with a density of at least 300 inhabitants per km<sup>2</sup>) (Lavalle et al., 2017).

In this context, prioritising the role that Nature plays can improve the quality of life in urban centres, making public urban green spaces (UGSs) of paramount importance for the sustainability of cities (Andersson et al., 2015). UGSs can be defined as any vegetated space found in an urban environment including parks, gardens, recreational areas, open spaces, residential gardens, or tree-lined streets (Kabisch and Haase, 2013; Geneletti et al., 2016), which can be different in dimension, vegetation cover, facility, or in other aspects (Wolch et al., 2014; Mouratidis, 2019). UGSs allow free public access, and represent pockets

\* Corresponding author.

E-mail addresses: [isabella.demeo@crea.gov.it](mailto:isabella.demeo@crea.gov.it) (D.M. Isabella), [claudia.becagli@crea.gov.it](mailto:claudia.becagli@crea.gov.it) (B. Claudia), [maria.cantiani@unitn.it](mailto:maria.cantiani@unitn.it) (C.M. Giulia), [alessandro.casagli@crea.gov.it](mailto:alessandro.casagli@crea.gov.it) (C. Alessandro), [alessandro.paletto@crea.gov.it](mailto:alessandro.paletto@crea.gov.it) (P. Alessandro).

of Nature for all residents (De la Barrera et al., 2016).

UGSs help in preserving and increasing biodiversity within urban ecosystems by means of habitats and species, as well as providing social benefits (Tzoulas et al., 2007; Cantiani et al., 2018). The role of UGSs for the physical-, psychological-, and social well-being of citizens is widely recognised by the scientific community (Andrade et al., 2015; Barton and Pretty, 2010; Turaga et al., 2020). In recent years, the importance of UGSs for human health and well-being has also been recognised by policy makers. Firstly, the European Commission (EC, 2013) has highlighted the importance of integrating the roles of UGSs in ecosystem services provision and green infrastructures support. In this way, the traditional concept of isolated UGSs has been transformed into a comprehensive vision of green infrastructure (Ugolini et al., 2020). Furthermore, the role of UGSs was embodied in Goal 11, Target 11.7 of the United Nations Sustainable Development Goals (UN SDGs) as follows: "By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities." The green spaces located in urban and peri-urban areas are resources capable of providing clean air, shade, protection for urban wildlife, leisure facilities, and recreational and sports opportunities (Van Herzele et al., 2005; Larabi et al., 2021). The use and frequentation of UGSs by people depends on several factors, including population density, physical accessibility, quality (presence and condition of vegetation and facilities), perceived safety, and size (Kessel et al., 2009; Gidlow et al., 2012; Steinfert et al., 2020). These factors apart, UGSs represent a good and a resource for cities and their citizens not only from an aesthetic point of view, but also in a holistic and fully functional sense. This implies that UGSs must be used and maintained using an integrated approach, combining their management with citizens' preferences and demands (Ryan, 2011).

In early December 2019, a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) affecting primarily the human respiratory system caused the Coronavirus Disease 2019 (COVID-19),<sup>1</sup> first identified in Wuhan, Hubei province, China. Since early 2020, this viral infection has spread rapidly, quickly becoming a global pandemic involving all countries in the world (Chen et al., 2020; Lu et al., 2020). To date, after four pandemic waves, the virus is still circulating with new variants, such that a situation of crisis and emergency persists in many countries worldwide (Aleta et al., 2020; Kupferschmidt and Wadman, 2021).

To counter the spread of this viral infectious disease, national governments across the globe have issued different kinds of measures and restrictions. As emphasised by Uchiyama and Kohsaka (2020), during each of the pandemic waves national governments have required citizens to adopt a "new normal" lifestyle, promulgating a set of restrictive measures aimed at containing the spread of the disease. Measures were based on the prohibition of mass gatherings, social distancing in public spaces, the use of protective face masks outdoors and indoors, mobility restrictions forcing citizens to stay at home, working from home to avoid crowds in traffic and workplaces, and the shutting down of main economic and industrial activities except essential businesses (Atalan, 2020; Kawohl and Nordt, 2020; Khanna et al., 2020; Wilder-Smith and Freedman, 2020).

The measures adopted during the numerous national lockdowns vary in severity from country to country. As highlighted by some authors, many people share the perception that the number of citizens walking or cycling in UGSs has increased (e.g., Derk et al., 2020; Freeman and Eykelbosh, 2020; Kleinschroth and Kowarik, 2020; Grima et al., 2020; Parnell et al., 2020; Venter et al., 2020), while a few other studies have shown the number of citizens who have increased– and those who have decreased their use of UGSs during the pandemic is more or less equal (Lopez et al., 2021). Other studies highlighted not only an increase in the use of UGSs, but also their discovery by citizens, many for the very first time (Berdejo-Espinola et al., 2021). This change in the use of UGSs can

be attributed to many factors, such as more free time at people's disposal, more flexibility in the work environment, increased pressure at home, and a need to relax in nature to relieve anxiety and stress (Derks et al., 2020; Rice et al., 2020; Weinbrenner et al., 2021).

Italy was one of the Western countries more severely affected by COVID-19, with the pandemic lasting from February 2020 to February 2021. The first wave, from approximately end February to end July 2020 (159 days), was particularly acute, and, as confirmed cases once again began to increase, was followed by the second wave, lasting from beginning August 2020 to end February 2021 (206 days) (Coccia, 2021). During the first wave, initial lockdown and quarantine measures were extended by approximately 50 days, while during the second wave the Italian government colour-coded the country's regions according to their risk factor (white, yellow, orange, and red), backed by weekly assessments by the Italian Ministry of Health with the support of Regional Prevention Departments (Ministero della Salute, 2021).

In Italy, as in other countries, the restrictive measures caused psychological stress, exerting a strong, unavoidable impact on the daily activities and habits of its people (Davico et al., 2021); from an increase in digital solutions to fulfil different needs, to changes in food choices, hobbies and entertainment, to outdoor activities and the frequentation of public green spaces by people (Bin et al., 2021; Bracale and Vaccaro, 2020; De Girolamo et al., 2020). During both lockdowns in Italy, as the pandemic evolved, so, too, did the situation regarding outdoor activities: in early March 2020, sports activities and walking or cycling in UGSs were allowed, alone or in the company of family members. By the end of March, the rapid increase in COVID-19-positive cases led the government to forbid walking farther than 200 m from the home, and leaving one's home altogether was permissible only for urgent reasons (Barari et al., 2020; Gualano et al., 2020; Ugolini et al., 2020). Similar restrictions were imposed in 2021 in the red regions, where in COVID-19-positive cases and virus circulation were high. In regions at low- and medium risk level, sports activities were permitted in appropriately equipped areas and UGSs, provided they complied with the rules governing social distancing and public gatherings.

During the first lockdown in 2020 and in the red regions in 2021, public green areas inside Italian cities were closed due to the restrictive measures imposed by social distancing, forcing people to stay at home. As revealed by Ugolini et al. (2020, 2021), these restrictions meant a drastically reduced frequentation of UGSs by people. Those who visited UGSs for non-essential activities such as observing nature, and those who saw UGSs as representing a possible contagion risk because of the opportunity for social gatherings, maintained this behaviour even once lockdown had ended. On the other hand, also in Italy, during this period of social distancing and forced isolation, people became aware of the importance of having green spaces, and an increase in interest in UGSs was observed (Ugolini et al., 2020; Larcher et al., 2021). COVID-19 containment has also changed how the population perceives UGSs; they acknowledge the psychological benefits these spaces offer, and see them as ideal places to allow exercise and relaxation, and to provide consolation and respite (Larcher et al., 2021; Ugolini et al., 2020). In effect, once pre-lockdown activities had been reinstated, UGSs became crucial places to satisfy people's needs for recreation, sports activities, and relaxation, and an antidote to psychological stress.

Using these considerations as a starting point, the present study provides insights from a web-based survey monitoring the use of UGSs before and during the two COVID-19 lockdowns in Italy. This study seeks to contribute to enriching research aimed at understanding if and how citizens' use and habits have changed due to the COVID-19 restrictions, and to generate preliminary implications for management and policy of the sector. Our research hypotheses are that the COVID-19 pandemic has increased the perceived importance of UGSs by citizens, and that it is the young (under 21 years of age) and the elderly (over 61 years of age) who have most changed their UGS frequentation habits.

<sup>1</sup> Where appropriate, hereinafter referred to as "the pandemic".

## 2. Materials and methods

A web-based survey was designed and implemented with the aim of understanding the impacts of the COVID-19 pandemic restrictions on the use and frequentation of UGSs. The questionnaire was conducted at the end of the second wave of COVID-19 in Italy, when all the country's regions were again colour-coded white, correlating to the lowest level of risk (from May to June 2021). This period was chosen so that the memory of their habits during the restrictions would still be vivid in people's minds; in the meanwhile, however, as a period of time had since elapsed, the respondents were no longer affected by the strong emotions experienced during the COVID-19 pandemic waves.

The first version of the questionnaire was developed by the research team in April–May 2021, starting from a first draft compiled by a group of students from the University of Trento, within a laboratory study conducted as part of an Ecology course, and then pre-tested on a small sample of Master's students from the same university in order to verify its accuracy, and identify any comprehension problems in the formulation of its questions.

The final version of the questionnaire (Annex 1) was first posted only in Italian by the authors via their contacts in "Facebook Messenger" and "WhatsApp," and then disseminated through the many institutional and non-institutional social networks. The post included a quick overview of the purpose and context, some notes to explain the questionnaire, and the link to the online questionnaire (Google Form). To further recruit respondents, a snowball approach was adopted following the procedure used by Yao et al. (2019): starting from a list of contacts located in different regions of the country, respondents were asked to spread the link to their friends and on other online social networks.

The survey was completely anonymous and consisted of 14 closed-ended questions and one open-ended question investigating the use of UGSs before and during the COVID-19 pandemic, the perception of UGSs, and the main socio-demographic characteristics of respondents.

The first two questions investigated the means (Q1) and time (Q2) needed to reach the nearest UGS from the respondent's home. As regards the means, four options were provided (on foot, by bike, by car, and by public transport), with a possibility of indicating "other", while regarding the time, the following categories were provided (less than 15 min, between 15 and 30 min, between 30 min and 1 h, more than 1 h.).

In the six questions that followed, respondents were asked to describe their use of UGSs before the COVID-19 pandemic, and during the two lockdowns, to wit:

- 1) How often did you use UGSs before (Q3) and during (Q4) the COVID-19 pandemic? (choosing one of five options: almost every day; weekly; monthly; less than once a month; less than once a year);
- 2) What types of UGSs did you frequent before (Q5) and during (Q6) the COVID-19 pandemic? (distinguishing between five green areas and with a possibility of indicating "other": agricultural lands; forests; urban parks; riverbanks; lakeshores);
- 3) What kind of activity did you generally carry out in UGSs before (Q7) and during (Q8) the COVID-19 pandemic? (distinguishing between six options and with a possibility of indicating "other": routine leisure; companionship; sport/physical activity; activities with pets; contact with nature; therapeutic purpose).

After investigating the use of UGSs, three questions focused on different perceptions concerning the use and importance of UGSs for respondents. Q9 investigated the perceived importance of the presence of UGSs in urban centres. Respondents are asked to assign a score on a 5-point Likert scale format (from 1 =less important to 5 =very important). Q10 investigated respondents' perception as to whether during the COVID-19 pandemic frequentation of UGSs: increased; decreased; remained unchanged. Q11 analysed respondents' perception of how much compliance with anti-COVID-19 regulations (e.g., use of protective face masks, social distancing) had influenced people's use of UGSs.

Respondents answered using a 5-point Likert scale format (from 1 =very negative influence to 5 =very positive influence).

The last four questions (Q12, Q13, Q14, and Q15) focused on the socio-demographic characteristics of respondents, such as: gender (male and female); age (18–20; 21–40; 41–60; 61–80; over 80); level of education (elementary/technical school qualification; high school qualification; university/post-university degree), and city/town of residence (open-ended question).

Data collected from the questionnaire were processed to produce the main descriptive statistics. The Chi-square ( $\chi^2$ ) test ( $\alpha = 0.01$ ) was performed to highlight the differences, taking into consideration respondents' socio-demographic characteristics (gender, age, and level of education).

## 3. Results

### 3.1. Socio-demographic characteristics of respondents

At the end of the data collection phase, 1075 completed questionnaires were collected and processed, while fewer than 5% of those who had started filling out the questionnaire abandoned it before finishing. All the respondents are Italian citizens who resided in Italy during the COVID-19 lockdowns. The results by socio-demographic characteristics showed 57.6% of the sample to be female, the remaining 42.4% male. This result is similar to the distribution ratio of the Italian population: 51.3% females to 48.7% males (ISTAT, 2021).

Regarding sample distribution by age, the majority of respondents are between 21 and 40 years of age (39.4%), followed by those between the ages of 41 and 60 (36.6%), and those between the ages of 18 and 20 (11.9%). In our sample, younger respondents are overrepresented, while older respondents are underrepresented compared with the Italian population, as shown in Fig. 1.

Regarding level of education, the results show the majority of respondents have a university or post-university (PhD) degree, followed by those with a high school qualification, and those with an elementary or technical school qualification, as shown in Fig. 2.

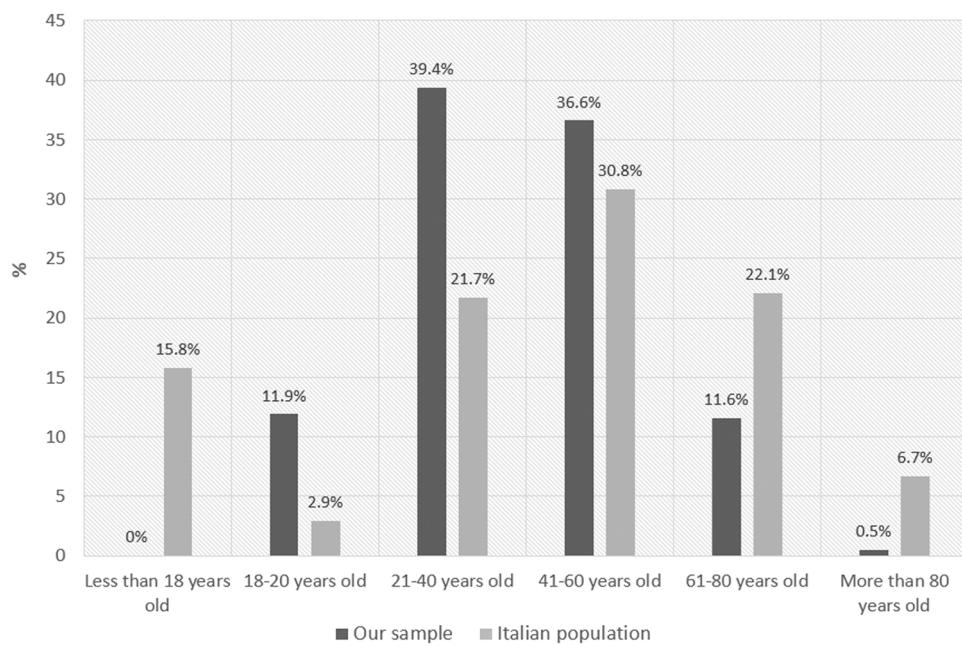
Regarding the city/town of residence, the results show our sample respondents reside mainly in urban centres of over 5000 inhabitants (88.1%), while the remaining 11.9% live in towns and suburbs with fewer than 5000 inhabitants. Concerning sample distribution by region, the results show the majority lives in the regions of Central and Southern Italy (54.7%), particularly Tuscany and Abruzzo. The remaining 45.3% lives in the regions of Northern Italy, particularly Veneto, Trentino-Alto Adige, and Lombardy.

### 3.2. Use of UGSs before and during the COVID-19 pandemic

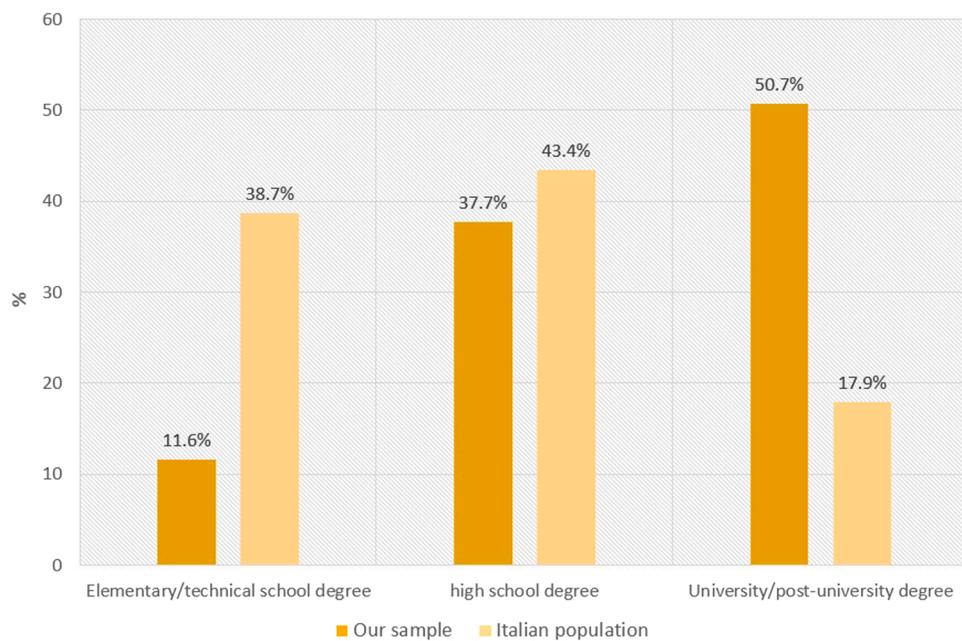
The results of the present survey show the majority of respondents are only 15 min away from their nearest UGSs (74.7%), 21.1% are between 15 and 30 min from theirs, while 2.9% are between 30 min and one hour, and 1.3% are more than one hour away from their nearest UGSs. Considering the means of transport normally used, the results highlight that 74.7% of respondents reach their UGSs on foot, 10.1% by bike, 10.0% by car, and the remaining 2.0% by other means of transport (e.g., motorbike or public transport).

It is interesting to note respondents who indicated it took them more than one hour to reach their nearest UGSs are people who live in metropolitan cities and use as their means of transport: car (64.2%), bike (28.6%), and public transport (7.2%). Conversely, respondents who are less than 15 min away from their nearest UGSs go on foot (83.4%) or by bike (8.5%).

Observing the data by gender (Table 1), the results show females go more frequently on foot than males (82.2% vs. 71.9%), while the latter more frequently use bikes (13.7% vs. 7.5%) or cars (13.3% vs. 7.5%) than females. The results also show there is an important correlation between age and means of transport: older people prefer to get to their



**Fig. 1.** Comparison between the distribution of the sample by age and Italian population (ISTAT, 2021).



**Fig. 2.** Comparison between the distribution of the sample by level of education and Italian population (ISTAT, 2021).

UGSs by car compared with young people (15.2% of respondents between the ages of 61% and 80%, and 20.0% who are over 80), while young people prefer going by bike compared with people of other age categories (13.3% of respondents between 18 and 20). The results by level of education show respondents with an elementary/technical school qualification use bikes and public transport more than the other two categories, while walking is preferred by respondents with a high school qualification (79.4%) and those with a university/post university degree (77.4%).

As regards geographical residence, the results show respondents living in towns with fewer than 5000 inhabitants reach their nearest UGS faster (84.1% in less than 15 min and 13.5% between 15 and 30 min) and on foot (91.3%) compared with respondents living in cities with 5000 inhabitants or more. Of the latter, 11.2% need a bike and

10.5% a car to reach their nearest UGS.

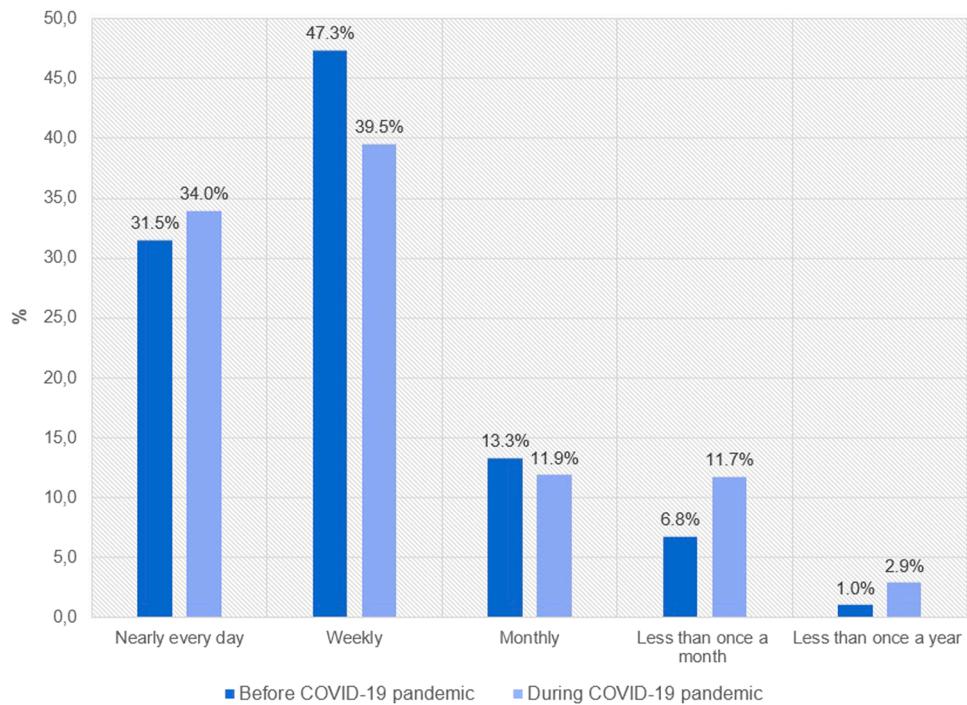
The Chi-square ( $\chi^2$ ) test shows statistically significant differences between males and females ( $p < 0.0001, \alpha = 0.01$ ) regarding the means of transport used to reach the UGSs, while it shows no statistically significant differences for the other two socio-demographic characteristics of the respondents (age and level of education).

The results of this study show the COVID-19 pandemic greatly affected the use of UGSs by citizens. Prior to the pandemic, respondents mostly used UGSs weekly (47.3%), followed by those who did so almost daily (31.5%), and those who did so monthly (13.3%). The restrictive measures launched by the Italian government to contain the pandemic gave rise to two trends (Fig. 3): on the one hand, the number of people who frequented UGSs near their home every day increased (34.0%, with an increase of +7.7% compared with the pre-COVID-19 period); on the

**Table 1**

Time and means of transport (%) to reach UGSs by socio-demographic characteristics of respondents.

Socio-demographic characteristics	Time				Means				
	< 15 min	15–30 min	30 min–1 h	> 1 h	On foot	By bike	By car	By public transport	Other means
<i>Gender</i>									
Male (n = 452)	77.2	17.7	2.9	1.8	71.9	13.7	13.3	0.2	0.9
Female (n = 614)	72.6	23.6	2.9	1.0	82.2	7.5	7.5	1.8	1.0
<i>Age</i>									
18–20 years old (n = 128)	67.2	29.7	0.8	2.3	72.7	13.3	11.7	2.3	0.0
21–40 years old (n = 424)	75.5	19.8	4.0	0.7	78.3	9.7	10.1	1.4	0.5
41–60 years old (n = 393)	78.4	18.6	1.8	1.3	78.4	12.2	7.4	0.8	1.3
61–80 years old (n = 125)	70.4	23.2	4.0	2.4	80.8	2.4	15.2	0.0	1.6
More than 80 years old (n = 5)	20.0	60.0	20.0	0.0	60.0	0.0	20.0	0.0	20.0
<i>Level of education</i>									
Elementary/technical school degree (n = 125)	66.4	28.8	2.4	2.4	74.4	12.8	9.6	3.2	0.0
High school degree (n = 405)	74.6	21.2	3.0	1.2	79.5	9.1	9.4	0.7	1.2
University and post-university degree (n = 545)	76.7	19.3	2.9	1.1	77.4	10.3	10.5	0.9	0.9
<i>Geographical residence</i>									
Cities with 5000 inhabitants or more (n = 127)	73.6	22.0	3.0	1.4	76.5	11.2	10.5	1.0	0.8
Towns and suburbs with fewer than 5000 inhabitants (n = 939)	84.1	13.5	2.4	0.0	91.3	2.4	5.6	0.8	–

**Fig. 3.** Changes in the use of UGSs by citizens during the COVID-19 pandemic for all respondents (n = 1075).

other, many people reduced their frequentation of UGSs (−16.5% weekly– and −10.5% monthly visits). During the pandemic period, the number of people who attended UGSs less than once a month rose to 11.7% (+72.6% compared with the pre-COVID-19 period), and those who did so less than once a year to 2.9% (+181.8% compared with the pre-COVID-19 period).

Observing the data by socio-demographic characteristics (Table 2), the results show the same trend for male and female: 51.8% of males and 44.1% of females used UGSs weekly prior to the COVID-19 pandemic, while 43.8% and 36.4%, respectively, used UGSs weekly during the COVID-19 pandemic, a decrease in frequentation of −15.4% in males and −17.5% in females during the COVID-19 pandemic. However, the Chi-square ( $\chi^2$ ) test shows statistically significant differences before and during the COVID-19 pandemic in the use of UGSs for females ( $p < 0.0001$ ,  $\alpha = 0.01$ ), but not for males ( $p < 0.047$ ,  $\alpha = 0.01$ ).

With regard to age, the results reveal that during the COVID-19

pandemic young people between the ages of 18 and 20 were the ones who increased their daily visits the most (from 24.2% to 29.7% almost daily), while the daily frequentation habits of those over 61 remained unchanged. It is interesting to highlight two types of behaviours in people between the ages of 21 and 60: a first group (between the ages of 41 and 60) increased their daily use of UGSs at the expense of those doing so weekly, while a second group (between the ages of 21 and 40) decreased their weekly use by increasing their sporadic use (less than once a month/year). This result is confirmed by the Chi-square ( $\chi^2$ ) test that shows statistically significant differences before and during the COVID-19 pandemic in the use of UGSs, but only for one age category: those between 41 and 60 years old ( $p = 0.005$ ,  $\alpha = 0.01$ ).

With regard to the level of education of respondents, the results point out people with an elementary/technical school qualification – more so than those from the other two groups – increased their daily use of UGSs during the pandemic (from 32.8% before– to 39.2% during the COVID-

**Table 2**

Use of UGSs (%) before and during the COVID-19 pandemic by socio-demographic characteristics.

	Nearly every day		Weekly		Monthly		Less than once a month		Less than once a year	
	Before	During	Before	During	Before	During	Before	During	Before	During
<i>Gender</i>										
Male ( <i>n</i> = 452)	28.1	31.9	51.8	43.8	11.7	12.2	6.6	7.7	1.8	4.4
Female ( <i>n</i> = 614)	34.0	35.5	44.1	36.4	14.4	11.7	6.9	14.6	0.5	1.8
<i>Age</i>										
18–20 years old ( <i>n</i> = 128)	24.2	29.7	45.3	32.0	21.1	16.4	7.0	17.2	2.3	4.7
21–40 years old ( <i>n</i> = 424)	31.6	31.8	45.5	42.5	16.7	14.4	5.7	9.2	0.5	2.1
41–60 years old ( <i>n</i> = 393)	31.6	36.1	50.6	39.4	10.2	9.9	6.4	12.2	1.3	2.3
61–80 years old ( <i>n</i> = 125)	39.2	39.2	45.6	37.6	2.4	5.6	12.0	12.8	0.8	4.8
More than 80 years old ( <i>n</i> = 5)	20.0	20.0	40.0	40.0	0.0	0.0	20.0	0.0	20.0	0.0
<i>Education</i>										
Elementary/technical degree ( <i>n</i> = 125)	32.8	39.2	44.0	31.2	16.0	11.2	4.8	13.6	2.4	4.8
High school degree ( <i>n</i> = 405)	32.3	33.8	45.7	39.0	14.3	12.3	6.7	11.9	1.0	3.0
University and post-university degree ( <i>n</i> = 545)	30.6	32.8	49.4	41.8	11.9	11.7	7.3	11.2	0.7	2.4
<i>Geographical residence</i>										
Cities with 5000 inhabitants or more ( <i>n</i> = 127)	28.2	32.3	35.5	41.6	9.1	5.6	0.0	7.2	0.0	1.6
Towns and suburbs with fewer than 5000 inhabitants ( <i>n</i> = 939)	55.4	44.0	49.2	39.5	14.1	12.8	7.3	12.3	1.2	3.1

19 pandemic) at the expense of weekly users (from 44.0% before– to 31.2% during the COVID-19 pandemic). However, the Chi-square ( $\chi^2$ ) test shows no statistically significant differences before and during the COVID-19 pandemic in the use of UGSs for any of the three groups of respondents with different levels of education.

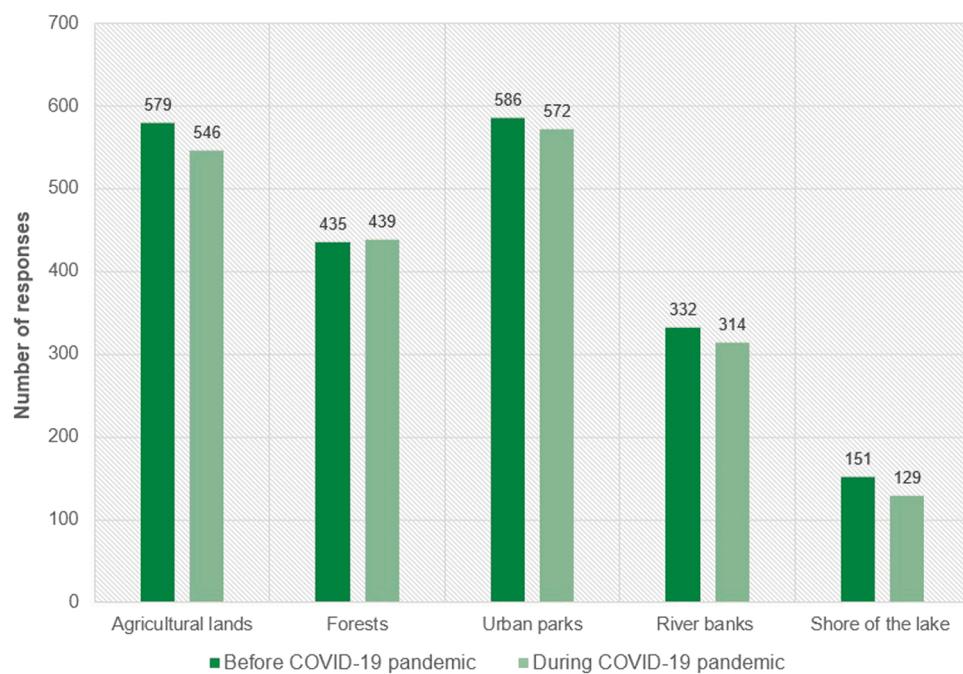
In addition, it is interesting to point out that the geographical residence of respondents had a significant influence on their frequentation of UGSs. Those living in towns with fewer than 5000 inhabitants were more likely to frequent UGSs compared with those living in cities with more than 5000 inhabitants. During the COVID-19 pandemic, however, the residents of the small towns reduced their almost daily frequentation (−18.0%), whereas it was the residents of the big cities who most increased theirs (+14.0%).

With regard to the preferred UGSs frequented (Fig. 4), the results show prior to the COVID-19 pandemic the three preferred UGSs were: urban parks (28.1%), followed by agricultural lands (27.8%), and forests (20.9%). Riverbanks and lakeshores were preferred, respectively, by 15.9% and 7.3% of the respondents. During the pandemic, use of forests increased (+0.9%), while use of other UGSs decreased: agricultural

lands (−5.7%), urban parks (−2.4%), riverbanks (−5.4%), and lakeshores (−14.6%). It is interesting to underline that the UGSs generally most densely populated – e.g., lakeshores – are those that were the least frequented during the COVID-19 pandemic.

The three UGSs preferred by males were, in descending order, agricultural lands, urban parks, and forests; by females, urban parks, agricultural lands, and forests. During the COVID-19 pandemic, females increased their use of forests (+3.6%), while decreasing their use of urban parks (−6.2%) and lakeshores (−18.9%). Conversely, males increased their use of urban parks (+3.3%), while decreasing that of all other UGSs: agricultural lands (−7.1%), forests (−1.9%), riverbanks (−9.0%) and lakeshores (−7.1%). However, the Chi-square ( $\chi^2$ ) test shows no statistically significant differences in the preferred UGSs frequented before and during COVID-19 pandemic neither by males nor females.

Regarding the age of respondents, the results point out that during the pandemic young people between the ages of 18 and 20 decreased their use of urban parks (−8.8%) and river banks (−10.2%), but increased that of forests (+4.3%). Conversely, those over the age of 60



**Fig. 4.** Changes in the type of UGSs frequented during the COVID-19 pandemic in accordance with the respondents' answers.

maintained constant frequentation of urban parks, while increasing their use of forests (+11.4% for those between 61 and 80 years old) and decreasing that of river banks (-26.1%) and agricultural lands (-8.3%). The Chi-square ( $\chi^2$ ) test shows no statistically significant differences before and during the COVID-19 pandemic in the activities carried out in UGSs for any age category.

Considering the level of education of respondents, the results show the same trend for all three groups, but with some interesting differences: those with an elementary/technical school qualification increased their use of forests (+11.4%) and lakeshores (+6.7%) during the COVID-19 pandemic, while the other two groups decreased their use of lakeshores (-23.1% of people with a high school qualification and -8.6% for people with a university/post university degree) and river-banks (+6.2% and +1.3%, respectively). In addition, those with a high school qualification increased their use of urban parks (+1.0%), while the other two groups decreased theirs (-6.6% for those with an elementary/technical school qualification, and -3.5% for those with a university/post university degree). Despite these differences, the Chi-square ( $\chi^2$ ) test shows no statistically significant differences in the preferred UGSs frequented before and during COVID-19 pandemic for any of the three groups of respondents with a different level of education.

As expected, for residents of towns with fewer than 5000 inhabitants the most popular UGSs prior to the pandemic were agricultural lands (28.5%) and forests (33.2%), while for residents of cities with more than 5000 inhabitants the most popular UGS was urban parks. During the COVID-19 pandemic, the use of forests increased for both groups, but with greater importance for residents of small towns: + 1.0% for residents in cities with 5000 inhabitants or more, and + 2.0% for residents in towns with fewer than 5000 inhabitants.

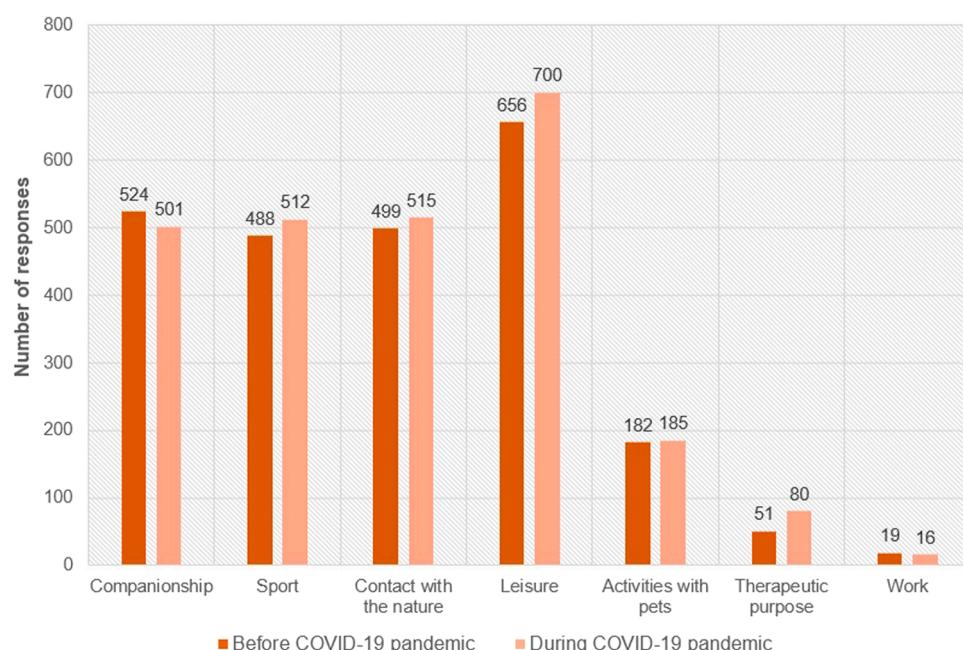
Regarding the activities carried out in UGSs (Fig. 5), the results show during the pandemic there was an increase in individual activities such as: therapeutic purpose (+36.3% from before to during the COVID-19 pandemic), leisure (+6.3%), sport (+4.7%), and contact with nature (+3.1%), while activities together with others – companionship (-4.6%) – decreased. Overall, for the majority of respondents the most important activity in UGSs was leisure, both prior to and during the pandemic. The results by gender highlight some interesting differences during the COVID-19 pandemic: males reduced sports activities in UGSs

(-1.6%), but increased activities such as those for therapeutic purpose (+42.9%), leisure (+4.6%), contact with nature (+1.5%), and companionship (+1.1%). Conversely, during the pandemic, females decreased their activities with other people (companionship -7.2%), but increased those for therapeutic purpose (+62.2%), sports (+11.8%), and leisure (+8.1%). The Chi-square ( $\chi^2$ ) test shows statistically significant differences in the activities carried out in UGSs prior to and during the COVID-19 pandemic for males ( $p < 0.0001$ ,  $\alpha = 0.01$ ), but not for females ( $p = 0.111$ ,  $\alpha = 0.01$ ).

Considering the age of respondents, it is important to emphasise that during the COVID-19 pandemic some activities carried out by young people increased: sport (+27.5% for people between the ages of 18 and 20, and +3.0% for those between the ages of 21 and 40); and leisure (+8.1% for people between the ages of 18 and 20, and +3.2% for those between the ages of 21 and 40), while activities for therapeutic purpose increased particularly for the over 60 s (+100.0%). Conversely, other activities (i.e., companionship) carried out during the COVID-19 pandemic decreased in all age categories, except for a small increase in social activities in UGSs for those between the ages of 41 and 80 (+4.1%). The Chi-square ( $\chi^2$ ) test shows no statistically significant differences in the activities carried out in UGSs prior to and during the COVID-19 pandemic for any of the age categories.

With regard to the level of education of respondents, it is interesting to highlight there was a greater decrease in activities carried out with others, such as companionship (-12.3%), by people with a high school qualification. In particular, three activities carried out in UGSs during the COVID-19 pandemic increased for all three groups: activities with pets (+11.1 for those with an elementary/technical qualification, +2.2% for those with a high school qualification, +4.4% for those with a university/post university degree); leisure (+5.6%, +8.2%, and +5.9%, respectively); and activities for therapeutic purpose (+44.4%, +45.8%, and +77.8%, respectively). However, the Chi-square ( $\chi^2$ ) test shows no statistically significant differences prior to and during the COVID-19 pandemic in the activities carried out in UGSs for any groups of respondents with a different level of education.

Finally, the results show during the COVID-19 pandemic the residents of towns with fewer than 5000 inhabitants mainly decreased two activities in UGSs (companionship -11.3% and activities with pets -13.8%), while they increased their use of UGSs for therapeutic



**Fig. 5.** Changes in the activities carried out in UGSs during the COVID-19 pandemic in accordance with the respondents' answers.

purpose. Conversely, the residents of cities with more than 5000 inhabitants increased all their activities in the UGSs apart from companionship (−3.4%).

### 3.3. Perception towards UGSs during the COVID-19 pandemic

The results regarding the perceived importance of UGSs during the COVID-19 pandemic show the majority of respondents considered UGSs “very important” (82.1%) or “important” (14.4%), while only 0.2% of respondents thought they were “not important”.

Observing the data by gender (Table 3), the results highlight females assign a higher importance to UGSs compared with males: 16.1% of females and 14.8% of males considered them “important”; 13.0% of females and 9.5% of males considered them “very important”. In addition, the results by age show people over the age of 60 assign greater importance to UGSs than young people, as do respondents with a higher level of education (university or post-university degree) compared with the other two groups of respondents with a lower level.

With regard to the perceived change in the use of UGSs during the COVID-19 pandemic, the results show the majority of respondents perceived an increase in the use of UGSs (64.0% of total respondents), while for 22.7% of them the use did not change, and for the remaining 13.4% the use decreased. What is more, as shown in Table 3, there are no significant differences between males and females in the perceived change in the use of UGSs during the COVID-19 pandemic: for 60.6% of males and 66.4% of females such use increased, while for 16.9% of males and 10.8% of females it decreased. Despite these differences, the Chi-square ( $\chi^2$ ) test shows no statistically significant differences between males and females in their perceived change in the use of UGSs during the COVID-19 pandemic.

Considering the age of respondents, people over the age of 60 perceived a decrease in the use of UGSs during the COVID-19 pandemic, more than did young people: for 36% of those between the ages of 61 and 80%, and 40% of those over 80, the use of UGSs decreased during the COVID-19 pandemic, while only 25.2% of people between the ages of 18% and 21%, and 17.2% of people between the ages of 21 and 40, confirmed this perception. These differences are confirmed by the Chi-square ( $\chi^2$ ) test that shows statistically significant differences between age categories in the perceived change in the use of UGSs during the COVID-19 pandemic ( $p < 0.0001$ ,  $\alpha = 0.01$ ).

The results by education of respondents reveal that people with a lower level of education (elementary/technical school qualification) perceived less change in the use of UGSs during the COVID-19 pandemic – for 14.9% there was no change at all – than those with a higher level of

education (for 12.3% of respondents with a university/post university degree there was no change). However, the Chi-square ( $\chi^2$ ) test shows no statistically significant differences between people with a different level of education.

The results by geographical residence show small differences between respondents living in towns with fewer than 5000 inhabitants and those living in cities with 5000 inhabitants or more. The only interesting difference relates to the perceived influence of measures to contain the pandemic on the use of UGSs: respondents from small towns perceive the measures more negatively (10.3% indicated “very negative” and 23.8% “negative”) compared with respondents from big cities (9.4% indicated “very negative” and 14.2% “negative”).

The results of this study highlight measures to contain the COVID-19 pandemic influenced the use of UGSs, in accordance with the respondents’ opinions. In particular, 15.5% of respondents think the measures have “positively” and 11.5% “very positively” influenced the use of UGSs, while 24.9% think the measures have “negatively” or “very negatively” done so (Fig. 6).

Observing the data by gender, the results show a higher percentage of females than males emphasise the positive influence of measures to contain the COVID-19 pandemic on UGSs (for 16.1%, they have had a positive effect, and for 13.0% a very positive effect). In addition, it is interesting to emphasise that older people perceive a more positive influence of the measures to contain the COVID-19 pandemic on the use of UGSs with respect to the other age categories. Finally, considering level of education, people with a low level of education place slightly more emphasis on the negative influence of the measures in question as opposed to those with a high level of education (university or post-university degree).

## 4. Discussion

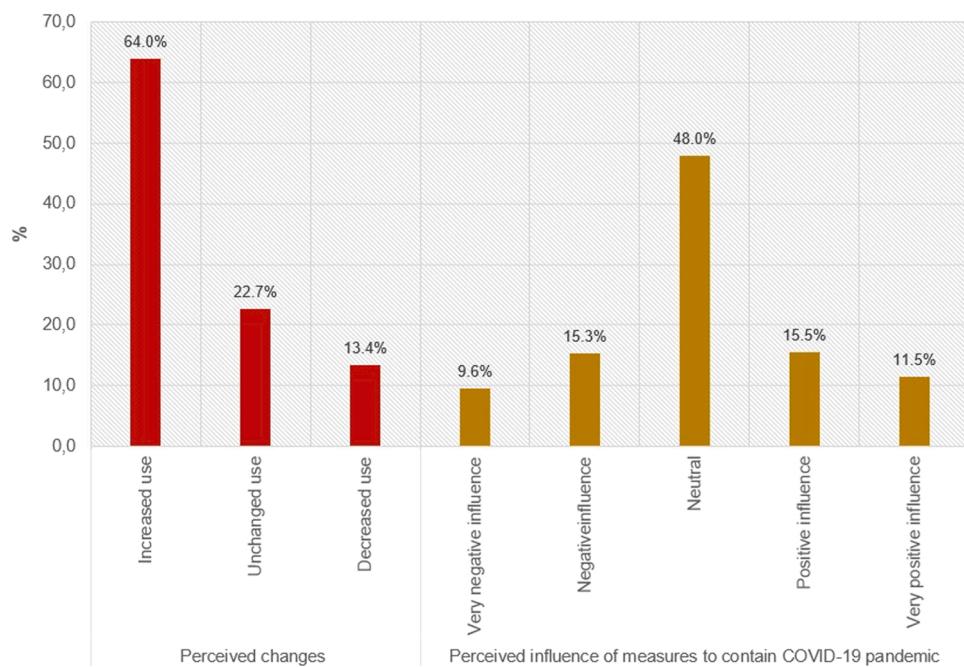
Our research covers a time span that includes the two lockdowns: the first characterised by a strong degree of restriction on citizen mobility all over the country; the second, by different levels of limitation depending on region and time period. Therefore, it allows an overall, general assessment of the effects of the pandemic on people’s perception of UGSs, a perception unaffected by the emotional aspects immediately linked to the lockdown, but rather the result of personal experience and mature reflection.

The results of our study are in line with other research conducted both here in Italy and in other countries in the world. It is obviously necessary to consider the behavioural differences that may derive from the various degrees of restriction adopted in the various countries (Derkx

**Table 3**

Perceived changes and influence of restrictive measures (%) on the use of UGSs by socio-demographic characteristics.

Socio-demographic characteristics	Perceived changes in the use of UGSs			Perceived influence of measures to contain the COVID-19 pandemic on the use of UGSs				
	Increased use	Unchanged use	Decreased use	Very negative	Negative	Neutral	Positive	Very positive
<i>Gender</i>								
Male (n = 452)	60.6	16.9	22.5	12.6	15.9	47.1	14.8	9.5
Female (n = 614)	66.4	10.8	22.8	7.4	14.9	48.6	16.1	13.0
<i>Age</i>								
18–20 years old (n = 128)	57.5	17.3	25.2	7.0	22.7	46.1	17.2	7.0
21–40 years old (n = 424)	67.1	15.8	17.2	9.7	15.6	50.7	16.5	7.5
41–60 years old (n = 393)	66.3	10.5	23.2	9.9	14.2	47.6	13.7	14.5
61–80 years old (n = 125)	52.8	11.2	36.0	11.2	11.2	43.2	14.4	20.0
More than 80 years old (n = 5)	60.0	0.0	40.0	0.0	0.0	20.0	60.0	20.0
<i>Level of education</i>								
Elementary/technical qualification (n = 125)	61.2	14.9	24.0	10.4	15.2	48.0	16.8	9.6
High school qualification (n = 405)	63.5	14.4	22.1	12.1	18.3	43.5	14.8	11.4
University and post-university degree (n = 545)	64.9	12.3	22.8	7.5	13.2	51.4	15.8	12.1
<i>Geographical residence</i>								
Cities with 5000 inhabitants or more (n = 127)	64.2	22.9	12.9	9.4	14.2	48.1	15.9	12.4
Towns and suburbs with fewer than 5000 inhabitants (n = 939)	63.6	19.8	16.6	10.3	23.8	48.4	12.7	4.8



**Fig. 6.** Perceived changes and influence of restrictive measures on the use of UGSs for all respondents ( $n = 1075$ ).

et al., 2020; Ugolini et al., 2021), or the socio-economic problems that may limit access to green areas, particularly in large cities (Uchiyama and Kohsaka, 2020).

The results of the present study reveal that in regard to various aspects thereof the pandemic has greatly affected the use of UGSs by citizens. There are also other studies from which similar conclusions can be drawn (Derks et al., 2020; Rice et al., 2020; Weinbrenner et al., 2021), showing a generalised change in the use of UGSs: places frequented, frequency of visits, visiting times, age of visitors, and activities carried out. What then emerges very clearly in the international literature is the pandemic has made citizens aware of the strategic role of forests and urban greenery and, in many cases, has made people mindful of the importance of their management.

In a study conducted in the city of Burlington (Vermont, USA), Grima et al. (2020) highlighted that 69.0% of people had increased or greatly increased the frequency of their visits to natural areas and urban forests during the COVID-19 lockdown, 25.8% of the sample declared they had never or very rarely frequented the local natural areas prior to the pandemic, and 80.6% of people considered the importance of these areas had either increased or greatly increased. In addition, these authors showed people considered natural areas and urban forests important for a wide range of activities (e.g., just getting outside or doing physical activity, connecting with nature, dog walking), but also in order to reduce stress related to a fear of the COVID-19 pandemic. Similar results were reported in Europe by Derks et al. (2020) for the city of Bonn, and by Venter et al. (2020) for the city of Oslo.

Our study highlights that while, on one hand, many people reduced their frequentation of urban green areas, on the other, the number of people frequenting every day green areas near their home increased. In this sense, it is important to recall in Italy and Spain the restrictions on visits to green areas were more severe, particularly during the first lockdown when parks and gardens were closed to the public. While this naturally conditioned their visits, in many cases it made people even more aware of the importance of such areas. In confirmation of this, Spano et al. (2021) highlighted the fact that, during the COVID-19 pandemic lockdown in 2020, for the Italian population the natural outdoor environment (as a proxy for living on a road with higher levels of greenness) was associated with anxiety, fear, boredom, irritability, and disturbed sleep, while a greater presence of green views from a

window was associated with a lesser increase in the abovementioned psychological health outcomes (Spano et al., 2021).

A study conducted in Italy during the first COVID-19 pandemic wave (April–May 2020) highlighted the fact that the restrictions had influenced citizens' perceptions towards UGSs, with a consequent increase in general interest in such areas (Larcher et al., 2021). Those authors also showed more than 70% of the 3286 respondents felt the need to use urban green areas close to their home during the first lockdown in Italy (Larcher et al., 2021). At a time of high fear and uncertainty, frequenting the green areas next to one's home was associated with psycho-physical well-being, and considered a form of entertainment.

Another Italian study conducted by Ugolini et al. (2020) showed, despite the reduced frequentation of UGSs owing to government restrictions on personal mobility during the period of lockdown, the need to visit green areas certainly did not disappear. This was confirmed by the fact 36% of respondents continued to head for some UGS during the period of containment.

In a study conducted in Hong Kong in 2020, Yang et al. (2021) revealed people who lived in greener neighbourhoods increased their physical activities in the UGSs during the COVID-19 pandemic. In other words, the UGSs played an important role in mitigating any decrease in physical activity while at the same time providing a refuge for people during the COVID-19 crisis (Yang et al., 2021).

The aspect that emerges most strongly from our research is people looked for green areas close to home, often reachable in less than 15 min, and preferably on foot. This is in line with the results of a study carried out by Ugolini et al. (2020) in Italy and in other countries (Spain, Croatia, Lithuania, Slovenia, and Israel). Our research has highlighted two types of UGS visitor: those who were eager to go out and spend time in green areas and in contact with nature, and those (mainly women) reluctant to do so for fear of coming into contact with other people and getting infected. The first group therefore intensified their visits to UGSs, while the second decreased them. Young people were the ones who increased their visits to UGSs the most, intensifying particularly activities related to sport and leisure. As for people's perception towards UGSs during the COVID-19 pandemic, our results show the vast majority of respondents considered UGSs very important (82.1%) or important (14.4%), thus confirming what emerged from the international literature regarding the perception of the value of green areas in times of

crisis.

The modifications in the perception and use of green areas, highlighted not only by our research but also stressed in other articles, seem destined to last even once the health emergency has passed (Larcher et al., 2021; Soga et al., 2021; Venter et al., 2020). This change in interaction between Humans and Nature, discovered and highlighted during a time of crisis, undoubtedly offers ample space for future research and reflection.

From a methodological point of view, the main strength of this study is the large sample size – more than a thousand respondents – and the distribution of respondents by socio-demographic characteristic. The web-based dissemination of the survey facilitated the data collection stage compared with other survey research methods such as face-to-face, mail, and telephone surveys. Conversely, the main weakness relates to the snowball sampling technique used to identify additional people to be involved in the survey. In the snowball sampling technique, as the sample depends on the initial contacts, it can be characterised by a potential bias. Here, an attempt was made to overcome this weakness by spreading the questionnaire link across many different social networks and web pages.

The results of the present study are potentially useful to planners and managers to enable them to design and manage UGSs aimed at satisfying the needs and requests of citizens in times of crisis. In this sense, our results revealed the UGSs most appreciated and frequented in situations of normality (i.e., urban parks and river banks located in urbanised areas) lose some of their functionality in times when a ‘‘new normal’’ lifestyle is based on social isolation. In times of crisis, the most important UGSs are forests located in the proximity of urban areas – e.g., peri-urban forests – because they allow direct contact with nature while simultaneously providing a refuge from society. In addition, the largest size urban and peri-urban forests compared with urban parks and gardens allowed for greater social distancing between visitors during the COVID-19 pandemic. For these reasons, peri-urban forests need to be actively managed and shaped by managers in order to meet social demands (Derks et al., 2020).

## 5. Conclusions

The surge in literature on the frequentation of UGSs at the time of the COVID-19 pandemic and the reported evidence have taught us that Humans needs Nature, and that Nature must be widely present, albeit ‘‘tamed’’, in our cities.

The pandemic has dramatically highlighted this need. In particular, as has also emerged from our research, young people, probably the component of society most severely affected by the pandemic from a psychological point of view, have begun frequenting green areas more, finding refuge in them.

However, even once the COVID-19 emergency has – and soon, we hope – passed, all the other problems will still remain, problems that are now part of the history of our civilisation. The psycho-physical well-being Humans derive from contact with Nature combats the stresses of a frenetic life spent in increasingly crowded and polluted cities. Today, the importance of planting trees is recognised more and more at all levels and in the most diverse fields of interest. So, can we expect trees to save the planet? It is evident this is not just a problem of the number of trees, but also how the green areas are managed. Many of the research papers analysed clearly show the need for planners, managers, and decision-makers not only to engage with each other but also to take into consideration the demands and expectations of the population (Derks et al., 2020; Larcher et al., 2021; Soga et al., 2021; Venter et al., 2020).

Planners would do well to recognise that, added together, even diverse solutions have the potential for being more effective in the benefits they offer. In this sense, the integration of private green areas is an important resource for expanding the services public green spaces can offer citizens of urban systems (Semeraro et al., 2021). For UGSs to be effectual, a strict ‘‘alliance’’ needs to be forged between those

involved in the planning and management of these spaces and those responsible for public health, including medical practitioners (Soga et al., 2021; Uchiyama and Kohsaka, 2020).

## 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.

## Data availability

Data will be made available on request.

## Acknowledgements

We are grateful to the group of students of the course of Ecology in the third year of the degree course in Environmental Engineering at the University of Trento, who worked on the conception and first development of the questionnaire; we thank all those colleagues, students, friends, and relatives who collaborated in its online diffusion.

## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ufug.2022.127739.

## References

- Aleta, A., Martin-Corral, D., Piontti, A.P., Ajelli, M., Litvinova, M., Chinazzi, M., Moreno, Y., 2020. Modelling the impact of testing, contact tracing and household quarantine on second waves of COVID-19. *Nat. Hum. Behav.* 4 (9), 964–971.
- Andersson, E., Tengö, M., McPhearson, T., Kremer, P., 2015. Cultural ecosystem services as a gateway for improving urban sustainability. *Ecosyst. Serv.* 12, 165–168.
- Andrade II, R., Deng, J., Gazal, K., 2015. Exploring people’s preferences on specific attributes of urban forests in Washington DC: a conjoint approach. *J. Hortic. For.* 7 (10), 200–209.
- Atalan, A., 2020. Is the lockdown important to prevent the COVID-19 pandemic? Effects on psychology, environment and economy-perspective. *Ann. Med. Surg.* 56, 38–42.
- Barari, S., Caria, S., Davola, A., Falco, P., Fetzer, T., Fiorin, S., Slepov, F.R., 2020. Evaluating COVID-19 public health messaging in Italy: Self-reported compliance and growing mental health concerns. *MedRxiv*.
- Barton, J., Pretty, J., 2010. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environ. Sci. Technol.* 44, 3947–3955.
- Berdejo-Espinola, V., Suárez-Castro, A.F., Amano, T., Fielding, K.S., Ying Oh, R.R., Fuller, R.A., 2021. Urban green space use during a time of stress: a case study during the COVID-19 pandemic in Brisbane, Australia. *People Nat.* 3, 597–609.
- Bin, E., Andruetto, C., Susilo, Y., Pernestål, A., 2021. The trade-off behaviours between virtual and physical activities during the first wave of the COVID-19 pandemic period. *Eur. Transp. Res. Rev.* 13 (1), 1–19.
- Bracale, R., Vaccaro, C.M., 2020. Changes in food choice following restrictive measures due to Covid-19. *Nutr. Metab. Cardiovasc. Dis.* 30 (9), 1423–1426.
- Cantiani, M.G., Betta, A., De Meo, I., Paletto, A., Tamanini, S., Maino F., 2018. Integrated Green Cities: Urban Meets Forest—A Case Study of the Town of Trento. In: Smart and Sustainable Planning for Cities and Regions: Results of SSPCR 2017, Green Energy and Technology 2018, Bolzano.
- Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Zhang, L., 2020. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 395, 507–513.
- Coccia, M., 2021. High health expenditures and low exposure of population to air pollution as critical factors that can reduce fatality rate in COVID-19 pandemic crisis: a global analysis. *Environ. Res.* 199, 111339.
- Davico, C., Ghiggia, A., Marcotulli, D., Ricci, F., Amianto, F., Vitiello, B., 2021. Psychological impact of the COVID-19 pandemic on adults and their children in Italy. *Front. Psychiatry* 12, 572997.
- De Girolamo, G., Ciceri, G., Clerici, M., Monzani, E., Spinogatti, F., Starace, F., Vita, A., 2020. Mental health in the coronavirus disease 2019 emergency—the Italian response. *JAMA Psychiatry* 77 (9), 974–976.
- De la Barrera, F., Reyes-Paecke, S., Harris, J., Bascuñán, D., Farías, J.M., 2016. People’s perception influences on the use of green spaces in socio-economically differentiated neighborhoods. *Urban For. Urban Green.* 20, 254–264.
- Demuzere, M., Orru, K., Heidrich, O., Olazabal, E., Geneletti, D., Orru, H., Bhave, A., Mittal, N., Feliu, E., Faehnle, M., 2014. Mitigating and adapting to climate change: multi-functional and multi-scale assessment of green urban infrastructure. *J. Environ. Manag.* 146, 107–115.

- Derkx, J., Giessen, L., Winkel, G., 2020. COVID-19-induced visitor boom reveals the importance of forests as critical infrastructure. *For. Policy Econ.* 118, 102253.
- European Commission (EC), 2013. Green Infrastructure (GI)—Enhancing Europe's Natural Capital. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committees of the Regions. COM/2013/0249 final. Available online: (<http://eurlex.europa.eu/legalcontent/EN/TXT>).
- Freeman, S., Eykelbosch, A., 2020. COVID-19 and outdoor safety: Considerations for use of outdoor recreational spaces. National Collaborating Centre for Environmental Health.
- Geneletti, D., Zardo, L., Cortinovis, C., 2016. Promoting nature-based solutions for climate adaptation in cities through impact assessment. *Handbook on Biodiversity and Ecosystem Services in Impact Assessment*, pp. 428–452.
- Gidlow, C.J., Ellis, N.J., Bostock, S., 2012. Development of the neighbourhood green space tool (NGST). *Lands. Urban Plan.* 106 (4), 347–358.
- Grima, N., Corcoran, W., Hill-James, C., Langton, B., Sommer, H., Fisher, B., 2020. The importance of urban natural areas and urban ecosystem services during the COVID-19 pandemic. *PLoS One* 15 (12), e0243344.
- Gualano, M.R., Lo Moro, G., Voglino, G., Bert, F., Siliquini, R., 2020. Effects of Covid-19 lockdown on mental health and sleep disturbances in Italy. *Int. J. Environ. Res. Public Health* 17 (13), 4779.
- Henderson, V., 2003. The urbanization process and economic growth: the so-what question. *J. Econ. Growth* 8 (1), 47–71.
- Hofmann, A., Wan, G., 2013. Determinants of urbanization. Asian Development Bank, Economics Working Paper Series No. 355, Manila.
- ISTAT, 2021. Censimento popolazione e abitazioni. Popolazione residente al 1° gennaio 2021. Istituto Nazionale di statistica (ISTAT), Roma.
- Kabisch, N., Haase, D., 2013. Green spaces of European cities revisited for 1990–2006. *Lands. Urban Plan.* 110, 113–122.
- Kawohl, W., Nordt, C., 2020. COVID-19, unemployment, and suicide. *Lancet Psychiatry* 7 (5), 389–390.
- Kessel, A., Pinder, J.G.R., Wilkinson, P., Grundy, C., Lachowycz, K., 2009. Multidisciplinary research in public health: a case study of research on access to green space. *Public Health* 123 (1), 32–38.
- Khanna, R.C., Cincinelli, M.V., Gilbert, S.S., Honavar, S.G., Murthy, G.V., 2020. COVID-19 pandemic: Lessons learned and future directions. *Indian J. Ophthalmol.* 68 (5), 703.
- Kleinschroth, F., Kowarik, I., 2020. COVID-19 crisis demonstrates the urgent need for urban greenspaces. *Front. Ecol. Environ.* 18 (6), 318.
- Kupferschmidt, K., Wadman, M., 2021. Delta variant triggers new phase in the pandemic. *Science* 372, 1375–1376.
- Larabi, F., Berrichi, M., Paletto, A., 2021. Social demand for ecosystem services provided by peri-urban forests: the case study of the Tlemcen Forest (Algeria). *J. Environ. Account. Manag.* 9 (1), 19–29.
- Larcher, F., Pomatto, E., Battisti, L., Gullino, P., Devecchi, M., 2021. Perceptions of urban green areas during the social distancing period for COVID-19 containment in Italy. *Horticulturae* 7, 55.
- Lavalle, C., Pontarollo, N., Batista, E., Silva, F., Baranzelli, C., Jacobs, C., Kavalov, B., Kompil, M., Perpiña Castillo, C., Vizcaino, M., Ribeiro Barranco, R., Vandecasteele, I., Pinto Nunes Nogueira Diogo, V., Aurambout, J., Serpieri, C., Marín Herrera, M., Rosina, K., Ronchi, S., Auteri, D., 2017. European Territorial Trends - Facts and Prospects for Cities and Regions. Publications Office of the European Union, Luxembourg.
- Lopez, B., Kennedy, C., Field, C., McPhearson, T., 2021. Who benefits from urban green spaces during times of crisis? Perception and use of urban green spaces in New York City during the COVID-19 pandemic. *Urban For. Urban Green.* 65, 127354.
- Lu, H., Stratton, C.W., Tang, Y.W., 2020. Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle. *J. Med. Virol.* 92 (4), 401.
- Ministero della Salute, 2021. Covid-19 - Situazione in Italia (<http://www.salute.gov.it/portale/nuovocoronavirus/detttaglioContenutiNuovoCoronavirus.jsp?>).
- Mouratidis, K., 2019. The impact of urban tree cover on perceived safety. *Urban For. Urban Green.* 44, 126434.
- Parnell, D., Widdop, P., Bond, A., Wilson, R., 2020. COVID-19, networks and sport. *Manag. Sport Leis.* 1–7.
- Rice, W.L., Meyer, C., Lawhon, B., Taff, B.D., Mateer, T., Reigner, N., Newman, P., 2020. The COVID-19 Pandemic is Changing the Way People Recreate Outdoors: Preliminary Report on a National Survey of Outdoor Enthusiasts amid the COVID-19 Pandemic. The Pennsylvania State University Department of Recreation, Park, and Tourism Management.
- Ryan, R.L., 2011. The social landscape of planning: integrating social and perceptual research with spatial planning information. *Lands. Urban Plan.* 100 (4), 361–363.
- Sanesi, G., Chiarello, F., 2006. Residents and urban green spaces: the case of Bari. *Urban For. Urban Green.* 4 (3–4), 125–134.
- Semeraro, T., Scarano, A., Buccolieri, R., Santino, A., Arrevaara, E., 2021. Planning of urban green spaces: an ecological perspective on human benefits. *Land* 10 (2), 105.
- Soga, M., Evans, M.J., Cox, D.T.C., Gaston, K.J., 2021. Impacts of the COVID-19 pandemic on human-nature interactions: pathways, evidence and implications. *People Nat.* 3, 518–527.
- Spano, G., D'Este, M., Giannico, V., Elia, M., Cassibba, R., Laforteza, 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 For. Urban Green.* 62, 127156.
- Steinfurt, U., Contreras, A., Albornoz, F., Reyes-Paecke, S., Guilleminot, P., 2020. Vegetation survival and condition in public green spaces after their establishment: evidence from a semi-arid metropolis. *Int. J. Agric. Nat. Resour.* 47 (2), 90–104.
- Turaga, R.M.R., Jha-Thakur, U., Chakrabarti, S., Hossain, D., 2020. Exploring the role of Urban Green Spaces in 'smartening' cities in India. *Impact Assess. Proj. Apprais.* 38 (6), 479–490.
- Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., James, P., 2007. Promoting ecosystem and human health in urban areas using Green Infrastructure: a literature review. *Lands. Urban Plan.* 81 (3), 167–178.
- Uchiyama, Y., Kohsaka, R., 2020. Access and use of green areas during the COVID-19 pandemic: green infrastructure management in the "new normal". *Sustainability* 12, 9842.
- Ugolini, F., Massetti, L., Calaza-Martínez, P., Cariñanos, P., Dobbs, C., Ostoić, S.K., Sanesi, G., 2020. Effects of the COVID-19 pandemic on the use and perceptions of urban green space: An international exploratory study. *Urban For. Urban Green.* 56, 126888.
- Ugolini, F., Massetti, L., Pearlmuter, D., Sanesi, G., 2021. Usage of urban green space and related feelings of deprivation during the COVID-19 lockdown: lessons learned from an Italian case study. *Land Use Policy* 105, 105437.
- Van Herzele, A., De Clercq, E.M., Wiedemann, T., 2005. Strategic planning for new woodlands in the urban periphery: through the lens of social inclusiveness. *Urban For. Urban Green.* 3, 177–188.
- Venter, Z.S., Barton, D.N., Gundersen, V., Figari, H., Nowell, M., 2020. Urban nature in a time of crisis: recreational use of green space increases during the COVID-19 outbreak in Oslo, Norway. *Environ. Res. Lett.* 15 (10), 104075.
- Weinbrenner, H., Breithut, J., Hebermehl, W., Kaufmann, A., Klinger, T., Palm, T., Wirth, K., 2021. "The forest has become our new living room" – the critical importance of urban forests during the COVID-19 pandemic. *Front. For. Glob. Change* 4, 672909.
- Wilder-Smith, A., Freedman, D.O., 2020. Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. *J. Travel Med.* 27 taaa020.
- Wolch, J.R., Byrne, J., Newell, J.P., 2014. Urban green space, public health, and environmental justice: the challenge of making cities 'just green enough'. *Lands. Urban Plan.* 125, 234–244.
- Yang, Y., Lu, Y., Yang, L., Gou, Z., Liu, Y., 2021. Urban greenery cushions the decrease in leisure-time physical activity during the COVID-19 pandemic: a natural experimental study. *Urban For. Urban Green.* 62, 127136.
- Yao, R.T., Langer, E.R., Leckie, A., Tremblay, L.A., 2019. Household preferences when purchasing handwashing liquid soap: a choice experiment application. *J. Clean. Prod.* 235, 1515–1524.