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Urban Green Infrastructure and Green Open Spaces: An Issue of Social Fairness in Times of COVID-19 Crisis

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Abstract: At the time of the restrictions and lockdown during the COVID-19 pandemic, it became apparent how difficult it is for city dwellers to adhere to the prescribed behavioural measures and the protective distance in densely built urban areas. Inner-city parks and green spaces were heavily used for recreational purposes and were thus periodically overcrowded. These observations highlight the need for green open spaces in urban areas, especially in exceptional situations regarding pandemics and climate-related heat periods. Green open spaces and greened buildings help cities and the population cope with the consequences of climate change and have a decisive positive effect on human health and well-being. This paper aims to outline which social issues are related to the availability of green infrastructure close to home and which health consequences need to be considered. The COVID-19 challenges could offer a chance and an opportunity to increase the resilience of cities and their inhabitants in various terms. A cross-disciplinary team of authors (public health, urban and landscape planning, landscaping and vegetation technologies science) describes and discusses challenges and opportunities that arise from this crisis for cities from an inter-disciplinary perspective, concluding that urban green infrastructure helps in two ways: to adapt to climate change and the challenges posed by COVID-19.

Keywords: urban green infrastructure; social fairness; COVID-19 crisis; public health; climate changes

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1. Introduction

Starting in December 2019, the coronavirus disease 2019 (COVID-19) pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has changed life as we knew it globally [1]. Over the recent months, the pandemic has challenged healthcare delivery and led to dramatic preventive action in all affected countries to slow down the expansion of the virus. The virus mainly spreads during close interpersonal contact and by small droplets produced when sneezing, coughing or talking. Recommended preventive measures include frequent hand washing and disinfection, face masks, social distancing, working from home, and self-isolation for people suspected to be infected [2]. Nation-wide lockdowns and the call for people to stay at home and leave their home only for grocery shopping, medication supply, and key position work have swept the formerly crowded streets, public places, and tourist hotspots [3].

At the time of the restrictions and lockdowns during the COVID-19 pandemic, inner-city parks and green spaces were heavily used for recreational purposes, and were thus periodically overcrowded, contradicting social distancing rules. The pandemic, in addition to the manifold negative impact, raised awareness for the need to increase the resilience of cities and their inhabitants. In this context, resilience is understood to mean the resistance of urban, social and physical structures to (future) challenges and crisis situations and the ability to deal with them [4,5].

Central challenges cities are facing within this context are climate change and the consequences for urban development, as well as for the urban population [6]. Cities are affected by these challenges in two ways. On the one hand, the rising temperatures due to climate change increase urban overheating [7,8]; on the other hand, the so-called urban heat island effect (UHI) is increasing due to urban expansion and the redensification of sealed and built-up areas [9]. The long-known UHI effect [10] is additionally reinforced by climate change. It is characterised by the temperature difference between the city and rural areas [11] of up to several degrees centigrade [12]. The main cause of the emergence of urban heat islands is the building up and overbuilding of natural permeable surfaces covered with vegetation [13]. The UHI effect has an impact on human health through exposure to increasing temperatures, especially during heat waves [14–16]. Heat waves, in turn, have an impact on mortality rate [17–19]. However, several studies have already demonstrated that maintaining and expanding urban green infrastructure is a core strategy for mitigating urban heating and counteracting the effects associated with climate change [20–22]. These observations highlight the need for green open spaces in urban areas, especially in view of global challenges such as urbanisation, climate change, and the current COVID-19 crisis.

Numerous research projects have brought to light that people working at home (housework, self-employed, agriculture, etc.) or people with care responsibilities, as well as elderly and sick people, have different demands compared to those working in offices or other facilities and, therefore, spend relatively little time in the home environment [23–28]. These people are particularly dependent on the quality of the building and open space structures on-site [29,30]. Hence, it is important that their needs are considered in order to increase their quality of life, health, and well-being [31]. Due to the mobility range restrictions caused by the COVID-19 rules, the importance of a green living environment was suddenly important for (almost) everyone.

The aim of this paper is to outline which social issues are related to the availability of green infrastructure close to home and the effects urban green infrastructure could have on the resilience of cities and urban population in light of COVID-related challenges resulting from mobility restrictions and lockdowns. It is not our objective to cover COVID vaccination and therapeutic strategies in this respect. We intend, with this work, to initiate a novel discourse from an interdisciplinary perspective that has not taken place so far, though it has been explored scientifically in individual disciplines.

The energy-saving potentials that can be achieved through the greening of buildings is not our focus here. Further, addressing legislation aspects is not our objective, as these vary from nation to nation, from region to region, and from city to city. Specifications are not yet available uniformly.

2. Methodology

The challenges and opportunities that arise from COVID-19 and the climate co-crisis for cities are illuminated from an inter-disciplinary perspective, including landscape planning, landscaping and vegetation technologies science, and environmental health and medicine. The chosen inter-disciplinary approach allows us to address the identified challenges and opportunities from different points of view. For a better understanding of each discipline's approach and to find a common way of thinking, comprehension for the other disciplines must be established, combined with comprehensive inter-disciplinary translation work [32].

In this paper, the presented results are based on (I) an inter-disciplinary literature review (climate change, benefits of ecosystem services, effect on human health and well-being, social justice) and (II) on an analysis of the distribution of green and open spaces in the City of Vienna as an example, including (III) a secondary statistical evaluation of data from the City of Vienna. Relevant indicators, such as m^2 of green space per person, were calculated. Additionally (IV), an overview of the supply of open space in different districts of the City of Vienna in relation to the requirements of different populations or age groups for open spaces was used [33,34]. In this interdisciplinary analysis process, the authors centre the need for a supply of urban green infrastructure close to home in order to increase the resilience of cities and their people.

The result is an argument for the performance of urban green from the perspective of the current pandemic and the consequences of lack of green open space in the city. The availability of near-residential green infrastructure is critically reflected upon.

3. Results

3.1. The Distribution of Green and Open Spaces—the Example of the City of Vienna

In Vienna, Austria´s capital with around two million inhabitants, the green and open spaces are (like in most cities) unevenly distributed. In the following, a few examples (without claiming to be exhaustive) are shown to demonstrate this unequal distribution. The focus here is on greenery close to the home, i.e., street open spaces, parks, and building greening, which are elementary, especially during lockdowns.

Regarding the street open spaces, many inner-city sidewalks have less than two metres of width; hence, it is spatially difficult to keep a personal distance of one metre. This was found to be a challenge during COVID-19 restrictions, becoming even more evident in view of the quantitative supply of public green space in Viennese districts. For example, the district of Josefstadt has a park area of 0.79 m^2 per person only, and even in Mariahilf (per capita 0.94 m^2), Neubau (per capita 1.15 m^2), or Margareten (per capita 1.52 m^2) only a little green space per person is available on average [33,34]. Here, too, there was a high level of use while some parks were partially closed during the exit restrictions. However, a key resource of urban space is often neglected: the street space. Street open spaces are used for stationary and moving traffic, highlighting the spatial reserves of public space. On average, 9.26 m^2 of park space per inhabitant is available in Vienna, contrasted by 12.44 m^2 of per capita road space (without sidewalks and structurally separate cycle paths). The discrepancy is even higher in the densely built-up districts, e.g., 1.15 m^2 park space vs. 6.51 m^2 of road space in the district of Neubau [34,35].

Taking a look at the accessibility of the parks, it is noticeable that there is room for improvement, especially in the densely built-up districts in Vienna. According to the City of Vienna [36], around two-thirds of Viennese residents reach publicly accessible open spaces within 250 m, but many areas are undersupplied.

Other important types of open space are therefore private or partially public open spaces, i.e., close to apartments, such as green (roof) terraces, balconies, communal open spaces, etc. In the case of residential construction projects in Vienna, on average 50 to 70 percent of the total project area has remained free from building development in the last few decades [37,38]. These areas (potentially) offer space for urban green infrastructure with different functions, quality, and usability. This was confirmed by a study [39] in which typical development forms were compared within the City of Vienna regarding residential construction from different epochs. In order to reduce the land consumption for the urban expansion projects, more and more compact building forms are being used again. Both the degree of sealing and the average floor area have risen sharply in recent years. However, a contrary trend can be seen in the average open space per resident in housing projects: this fell from 24.1 m^2 (in the period from 1980 to 1999) to 8.7 m^2 (from 2000 to 2015) [39].

At this point, it is emphasised that Vienna has long considered the issue of the provision of open space, especially for socially disadvantaged groups, as a central point in housing policy due to the tradition of subsidised housing.

3.2. The Accumulating Challenge of Climate Change (Adaptation) and COVID-19

Parts of the population particularly vulnerable to COVID-19 must continue to pay attention to social distancing and self-isolation and therefore spend most of their time at home [3]. In combination with the increasing problem of the urban heat island effect as a result of urban densification, the situation worsens in summer [40]. In light of widespread and drastic restrictions in mobility and government regulations for home confinement, many individuals will be specifically challenged during summer, and heat waves will hit the vulnerable population hard. Recent statistics show that elderly people with pre-existing medical conditions are the main risk group for a fatal COVID-19 infection [41,42].

Looking at the differently affected social groups in relation to urban overheating, similarities become visible, as environmental and socio-demographic factors have been observed to be linked with increased COVID-19 risk and with temperature adaptive capacities [43]. Here, too, studies and vulnerability analyses show that the elderly, particularly very old people and people with previous illnesses, are particularly stressed by the (increasing) heat [14–16]. Children are also a group who are particularly stressed. Moreover, socially disadvantaged groups (low education or income) more often live in rather dense urban areas that are more affected by the UHI effect [44,45].

The City of Vienna used this approach and analysed heat vulnerability, employing the population density of the age groups 0 to 14 and 60 and above as indicators [46]. They considered the amount of greening and the heat load in the different quarters of the city to analyse vulnerability. The resulting urban heat vulnerability index clearly shows that areas where a lot of young and elderly people live and where a low vegetation index can be found are particularly prone to urban heat [47]. We can conclude that especially the most vulnerable strata of the population regarding COVID-19 and the UHI effect stay at home, being specifically disposed to high summer temperatures. New York, for example, launched a campaign in which 74,000 free air conditioners were donated to risk groups, so they could safely stay at home during COVID-19, considering temperatures 40 °C and higher [48]. This is not necessarily a sustainable strategy, especially in light of climate change-relevant energy consumption.

By contrast, green infrastructure, e.g., trees planted near to buildings or green roofs and façades installed directly on buildings' envelopes provide shade and cooling effects thorough evapotranspiration of the plants [49–51]. Greenery in the immediate vicinity of buildings results in better indoor and outdoor microclimate conditions of buildings and city quarters. Municipalities are addressed to boost urban green to supply city dwellers, and especially the above-named vulnerable population group, with affordable, livable, and sustainable urban quarters.

3.3. Emotional Health and Well-Being: Crucial Ecosystem Services of Urban Green Infrastructure

Green spaces and building greenery in the city have numerous positive effects and their services are widely researched. They regulate heat, have a positive effect on aesthetic appearance, promote recreation and health of people, as well as neighbour relationships, and reduce leisure traffic [52]. These diverse services are summarised under the term ecosystem services (ESS). The most widespread ESS classifications refer to four categories [53,54]:

1. Supporting services or basic services and habitat services—including all services of an ecosystem that are based on serving the existence or the functioning of these (e.g., nutrient cycle or soil formation);
2. Regulatory services—these are services that have a (regulating) effect on (other) elements and processes of ecosystems (e.g., temperature reduction);
3. (Socio) cultural services—these summarise all non-material services that ecosystems provide for humans (e.g., recreation or social functions);
4. Utility services—these are used to describe goods that ecosystems provide (e.g., food or fresh water).

Several studies prove the positive effects of green surroundings on human health and well-being [55–57]. Lower mortality or overall rates of disease are associated with higher accessibility to green space [58,59]. In this context, size and type of green space are considered to be important, as is the distance of green spaces to the beneficiaries [60]. A health and environmental impact assessment of urban green space is currently receiving more attention and is being addressed in various aspects [61]. However, a direct connection between health and green space has not yet been elaborated. The authors of [61] correctly point out health to be a product of wider range (environmental, social, economic) and not to be attributable to one particular factor. Feeling well and healthy is, additionally, subject to significant subjective sensations and emotions.

3.4. Spatial Distribution and Social Justice Regarding Urban Green Infrastructure

For a healthy urban life, not only a fair distribution of urban green infrastructure, but also social equality and barrier-free accessibility are decisive. Just as there are social differences, there are inequalities triggered by natural conditions and human actions that manifest themselves spatially, such as the unequal distribution of urban green infrastructure. This understanding, that (in)equality can relate to the environment and not just to social aspects and a connection between space and justice ("Spatiality of Justice"), can be found in numerous (urban) planning and socio-geographic discourses [62–65]. With the addition of "social" to the concept of justice, social justice shows the approach of seeing justice not as a purely normative concept with forever fixed rules and values, but rather in terms of its interdependence with social processes [63]. With the addition of a spatial dimension, it is indicated that (in)justice also and especially manifests itself in space and that social justice takes place in space.

Looking at the question of distribution of, e.g., spatial structures or the location of urban green infrastructure hides the differences and the individuality of the requirements. Beyond the aspect of distribution, social and spatial justice must also consider the procedural question and assessments as well as planning, participation, and decision-making processes. According to the requirements and demands of the different population groups, facilities for satisfying basic needs with equal access are to be provided in order to ensure a high quality of life, health, and well-being for the urban population [31,65]. This is also—or especially—valid for urban green and open and public space issues.

4. Discussion

Studies show that diverse ecosystem services of urban green infrastructure demonstrate their need through enhancing human health and well-being [66–68]. Improving the urban adaptation capacities is no longer just a matter of climate change, but also of pandemics and, even more so, the combination of challenges from both. Under quarantine situations, the green retrofit gains particular significance for reasons of emotional health and well-being, i.e., vis-à-vis greened façades and access to greened roofs have the potential to compensate for a lack of outdoor recreation. Hence, the COVID-19 crisis offers the opportunity to force adaptation in two ways. Green infrastructure provides both support in adapting to climate change and to the challenges related to COVID-19 [69]. A look back at the history of the City of Vienna shows that the solution of sanitary and health problems was one of the major drivers for the emergence of social housing in Vienna. As a first approach, the former strategy of focusing on the specific living environment, including an adequate supply of green and open spaces, should be a serious model for today [70,71]. The access to private green spaces in case of quarantine or during a lockdown is a decisive factor in terms of socially just distributed housing (and free) space.

A second approach is to renegotiate the distribution of the public space, including the street spaces. This is not a new approach either, but considering the first measures during the lockdown, namely the closure of some roads to motorised individual traffic, it is currently more urgent than ever. Here, too, the combination of adaptation to climate change and the response to COVID-19 challenges becomes evident. Many of the closed Viennese streets (18 in total) were temporarily turned into "Cool Streets" to provide the residents with free space and allow them to cool down [72,73].

A third approach is to progressively consider the improvement of physical and mental health through green infrastructure in planning, i.e., the procedural aspect of spatial justice. Urban and green infrastructure planning could hereby take advantage of impact assessments. As several studies [74–76] pointed out the chances to reflect health issues in strategic environmental assessment more holistically, and also opportunities for integrating climate change adaptation (and mitigation), we suggest considering the complex but promising connections between social equality, health, well-being, and green space when conducting health or environmental impact assessments [77].

5. Conclusions

The COVID-19 pandemic has brought to light that the availability of green infrastructure is not evenly distributed across all social strata and urban areas. This might worsen health conditions, especially among vulnerable people, when it comes to lockdown, self-isolation, and social distancing. The necessary adaptation of urban spaces and buildings to climate change also shows similar needs—improved and extended urban greening and the use of building green for adaptation. However, such crises offer an opportunity to renegotiate the distribution of (street) space and the need for greenery close to home. Building green (green roofs and façades, in this case) should be mandatorily implemented to compensate for a lack of urban greenery. In order to increase the resilience of cities—not just to adapt to climate change—a rethink is necessary. The green and open spaces in the city have to provide more functions than just allowing motorised mobility, and building surfaces have to provide more functions than housing and energy supply only. In either case, it is important to consider the question of spatial distribution of urban green infrastructure and accessibility, but also the social processes that are necessary to achieve social and spatial justice. This consequently contributes to advancing resilience both to climate change and pandemic challenges.

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