

The perception of urban green space during the COVID-19 pandemic: The case of Wrocław

Agnieszka Jakóbiak¹⁾ , Wanda Patrzalek²⁾ , Rengin Aslanoğlu³⁾ 

¹⁾ Wrocław University of Environmental and Life Sciences, Department of Landscape Architecture, Grunwaldzka 55, 50-357 Wrocław, Poland

²⁾ University of Wrocław, Department of Consumer Behaviour, ul. Koszarowa 3, 51-149 Wrocław, Poland

³⁾ Wrocław University of Environmental and Life Sciences, Department Systems Research, Grunwaldzka 55, 50-357 Wrocław, Poland

* Corresponding author

RECEIVED 03.02.2024

ACCEPTED 22.07.2024

AVAILABLE ONLINE 18.10.2024

Highlights

- Investigated changes in urban green space usage before, during and after pandemic lockdowns.
- An online survey was conducted in Wrocław, Poland, involving 130 respondents.
- Residents prioritise easy and quick access to urban green space.
- Identified potential shift in social behaviour and ecological awareness as a result of the pandemic.
- Results suggest the need to redesign green spaces to meet diverse availability-based needs.

Abstract: Green spaces are integral to urban landscape, serving ecological, health, and recreational functions. During the pandemic, urban green spaces were crucial for enabling safe social distancing and enhancing well-being. This study delves into the perception, accessibilities, and qualities of urban green spaces in Wrocław during and after the pandemic. A survey was conducted to understand causes and effects of diverse usage of the urban green space, assessing changes in usage frequency before, during, and after lockdown, as well as public awareness of benefits associated with green spaces. Proximity to green spaces emerges as a key factor as people prefer easily and quick access to these areas. The study also noted a partial modification of social behaviour and increased social and ecological awareness. The results reveal evident development of new daily habits. Although the beginning of the pandemic led to discomfort, adaptive behaviours soon followed, changing daily routines and previous leisure activities. Given the findings on availability and adequacy of green spaces, it is advisable to rearrange these areas to meet the diverse needs of inhabitants.

Keywords: case study, COVID-19 pandemic, perception, survey, urban green space

INTRODUCTION

The COVID-19 pandemic has disrupted everyday life and altered daily routines and locations for economic activities, leisure, and remote work, necessitating adjustments to locations where these activities occur. During the new-normal period, many spaces

were repurposed due to restrictions. Work-related activities typically confined to offices moved into homes, and domestic routines had to be modified as well. Urban green spaces became crucial venues for new social events, serving as the only available and safe locations for leisure and regeneration during the pandemic. Many previous studies confirm that green spaces

provide tangible benefits to city dwellers, impacting their health, well-being, lifestyle, and social interactions. They reduce stress levels caused by the high pace of urban living, strengthen social ties, and recompense economic and cultural social inequalities (Gójska and Środoń, 2018). This study explores the use of green spaces during isolation, focusing on their perceived characteristics and the impact of contact with nature on well-being, quality of life, as well as social engagement with the natural environment.

Natural greenery takes complex forms, cultivating biodiverse ecosystems that continually evolve and expand. In cities, structured and deliberately designed greenery predominate, including lawns, solitary trees and shrubs, small clusters of shrubs, hedges, and meadows. More diverse compositions include flowerbeds, squares, plantings in pots, and parklets characteristic of compact inner-city areas. Additionally, urban forests and wildlife areas frequently reclaim degraded, desolate, or post-industrial sites. Urban green spaces also serve a multitude of functional purposes such as parks, forests, gardens, cemetery greenery, isolation greenery, housing estate greenery, and greenery isolating transport routes.

Urban spaces struggle with conflicts between economic growth, societal needs, and the natural environment. They suffer from many environmental problems such as air pollution, traffic congestion, high levels of ambient noise, vacant houses and derelict lands. These issues not only degrade the quality of life for urban residents but also contribute to a negative perception of urban life (Voorde van de, Vlaeminck and Canters, 2008). Conversely, urban greenery is associated with subjective feelings, positive emotions, well-being, and reduced stress levels (Costanza *et al.*, 2007). For instance, research in the UK revealed that urban inhabitants in areas with substantial green coverage experienced lower levels of mental distresses and higher overall well-being (Huang, Yang and Jiang, 2018). Research during the pandemic confirmed that urban greenery, particularly areas rich in trees, has a positive impact on the mental health for people experiencing heightened worry, anxiety, and depressive states as a result of isolation (Wortzel *et al.*, 2021). Greenery increases social interaction, strengthening local community structures and improving health and well-being. These areas create coherent visually attractive compositions within urban setting, fulfilling didactic, educational, recreational, health, protective, and isolating functions (Jennings and Bamkole, 2019). As previously mentioned, greeneries offer biological, health, social, educational, and aesthetic functions. For instance, various forms of greenery alongside traffic routes adds unique charm to these areas, improves aesthetics, provides shade during hot weather, and protects streets and pavements from overheating (Raczkowski, 1963). Commonly used construction materials such as concrete, brick, glass, and aluminium promote elevated temperatures in the build-up environment and create urban heat islands (Sobczyńska, 2014). This effect can be mitigated by expanding greeneries. Trees effectively regulate temperature and provide shade, filter air pollutants, absorb carbon dioxide, manage and filter rainwater, stabilise soil and maintain soil health, provide food and shelter for living organisms, and act as urban reservoirs of biodiversity.

According to the UN, trees can lower the temperature by 2–8°C in summer. Conversely, in winter, trees can save 20–50% of energy used for heating. Additionally, healthy trees with robust root systems are effective in storing water and can reduce wind speed by 20–80% (Usiarczyk, 2021). The ecological function of

green spaces plays a vital role in regulating climatic parameters in urbanised areas, directly or indirectly influencing the perception of thermal comfort and air quality. These parameters translate directly into physical and mental health, forming the basis for general well-being of residents (Kus and Felski, 2018). According to biophilia theory, the interaction with green spaces offers relaxation and psychological recovery of cognitive and emotional functions, enhanced social capital, improved immune function, better physical fitness, and reduced obesity (WHO, 2016). These benefits are particularly important for socially or economically disadvantaged people. The sense of well-being comprises various elements that determine the subjective life satisfaction. While economic capital may be important for some people, others might prioritise their place of residence, social status, education, or professional success. These factors depend on individual needs, goals, and the extent to which they can be realised. During the pandemic, while external conditions and personal circumstances varied, the use of green spaces and the possibility to view greenery from home windows significantly contributed to a heightened sense of well-being. People who frequented green spaces reported higher self-esteem, life satisfaction, subjective happiness, and lower levels of depression, anxiety, and loneliness (Soga *et al.*, 2021).

In urban environments, the benefits derived from ecosystems are multifaceted, and ecosystem services are increasingly recognised as vital to human well-being in cities (Olander *et al.*, 2018). Effective integration of ecosystem services into urban planning is essential for achieving the UN sustainable development goals. These include ensuring good health and well-being (goal 3), sustainable cities and communities (goal 11), and climate action (goal 13) (UN, 2015). Awareness of opportunities and utilisation of ecosystem services in urban planning and design processes, and their correct identification not only meet local needs but also improve living standards and enable to adopt correct climate change adaptation strategies (Folkersen, 2018).

Sudden disruption to daily life can significantly impact well-being, especially for urban residents living in densely populated areas with limited access to public spaces. In such extraordinary circumstances, urban nature helps maintaining the well-being of urban populations and strengthening their resilience, while also addressing social distancing needs (Samuelsson *et al.*, 2020). The presence of urban green spaces not only encourages positive social interactions that foster social cohesion but also has a positive impact on health and well-being. These spaces are linked to positive healthier behaviours, increased physical activity, and higher levels of social engagement (Jennings and Bamkole, 2019).

A recent study showed the change in public awareness and use of urban green spaces during the COVID-19 pandemic (Fischer and Gopal, 2021). According to their findings, 69.0% of respondents increased or significantly increased the frequency of their visits to natural areas and urban forests. Furthermore, 80.6% of respondents recognise the importance of these areas in their lives. Before the pandemic, 25.8% of respondents had never or very rarely used local natural areas. However, 69.2% of those who were first-time or infrequent visitors considered access to these areas during COVID-19 as “very important”. The respondents highlighted that these areas were important for a wide range of activities, including exercise and birdwatching, and also valued them for their role in reducing stress during a period of global chaos.

Another study analysed changes in the frequency of visits to urban forests from April 2019 through February 2020 (Day, 2020). It was found that the number of visitors has more than doubled since COVID-19 started in March 2020. The pattern of visits also changed dramatically, moving from an even distribution throughout the day with slight peaks before and after working hours, to a pronounced increase in the late afternoon. Additionally, a new group of visitors, comprising young people, families with children, and people from other locations, started to visit these areas. A similar study compared the use of urban green infrastructure during the pandemic to responses from the same individuals in 2018 (Korpilo *et al.*, 2021). As their results showed, residents were more likely to visit areas closer to their homes during the pandemic compared to the pre-pandemic period. Usage patterns were related to the quality of nearby green spaces; for example, people preferred forests close to their homes and tended to avoid crowded parks and recreational areas to maintain social distancing. Moreover, activities during the pandemic became more dispersed, suggesting an active exploration for new areas, including agricultural and residential zones with dense tree coverage. Activity in suburban areas either declined or remained unchanged. The results indicate a growing need and value of such areas in times of crisis.

Lockdown periods prompted by COVID-19 altered perceptions of urban green spaces (Larcher *et al.*, 2021). Global research confirms a positive correlation between increased activity in green spaces and improved well-being. Notable studies highlight the trend: in Sweden (Löhmus *et al.*, 2021), Norway (with a reported 291% activity increase in Oslo) (Zander *et al.*, 2020), Asia (Lu *et al.*, 2021), Saudi Arabia (Addas and Maghrabi, 2022), and Croatia (Marin *et al.*, 2021), all noting the crucial role of green spaces in reducing stress, anxiety, and the effects of isolation during the pandemic. Additionally, initial post-pandemic analyses are underway. However, a contrasting study from the United States revealed a concerning 56% decrease in urban park usage, with a shift towards a more homogenous user base (Larson *et al.*, 2020). The study highlights a concerning rise in park visits during off-peak hours and a decline in visits by vulnerable and lower-income communities. This suggests that existing social inequalities might be exacerbated by restricted access to parks and green spaces. Further research in Kraków, Poland, revealed that despite an initial decrease in urban green space usage, residents continued to value these areas highly for stress reduction and mental well-being (Noszczyk *et al.*, 2022).

Germany has also witnessed a surge in urban green space appreciation during the pandemic. A study focusing on international students in Berlin noted an increased usage of green spaces for both recreation and transportation, highlighting their adaptability amid social distancing requirements (Collins *et al.*, 2022). However, research from Bonn suggests a need for further investigation into the specific activities and demographics associated with the increased usage (Soer, 2021). This emphasises the importance of context-specific studies to fully understand how residents utilise urban green spaces during crises. Building upon existing knowledge, a new study investigated the perceptions of urban green space in Wrocław, Poland, throughout the COVID-19 pandemic. An online survey methodology was utilised to analyse changes in the frequency of urban green space usage before, during, and after lockdown periods. Additionally, the study examined the influence of accessibility factors on resident

behaviours and explored potential shifts in social and ecological awareness brought on by the pandemic. It is crucial for future planning strategies to consider the design of urban green spaces promoting urban life (Larcher *et al.*, 2021) and enhancing well-being (El Khateeb and Shawket, 2022). These spaces serve as unique elements within the multi-layered urban fabric, acting as landmarks in mental maps, both within local neighbourhoods and in the city as a whole. By attributing meaning and value beyond their physical and visual properties, users transform these spaces into meaningful places. Sustainable urban design can foster environments that are stimulating or calming, offering relaxation or stimulating activity within appropriately selected forms of greenery (Sobczyńska, 2014). During the pandemic, urban green spaces were invaluable for maintaining safe personal distances, thereby supporting public well-being. This study aimed to gather and analyse perceptions of urban green spaces, focusing on their accessibility and qualities during and after the pandemic.

MATERIALS AND METHODS

STUDY MATERIALS

A detailed survey was formed and distributed to fully understand the causes and effects of the activities related to the urban green spaces. The survey aimed to assess changes in the frequency of green space usage before, during, and after the pandemic lockdowns. It also sought to capture subjective opinions about the green spaces near the respondents' residences and their awareness of benefits associated with the contact people had with these areas. The survey questions integrate both the quantitative methods – to address questions of “how many” and “who” – and the qualitative methods featuring in-depth questions designed to explore the “why” and “how” (Sullivan and Sargeant, 2011).

SURVEY

The survey questions were formed by the authors after following a detailed literature review, incorporating a variety of question types. The survey features single-choice, including also 5-point Likert scale with options ranging from “very satisfied”, “rather satisfied”, “neither satisfied nor dissatisfied”, “rather dissatisfied”, to “very dissatisfied”, multiple-choice questions, and both closed and open-ended questions, totalling 54 questions. The survey prompted respondents to evaluate the situation in three different periods: before, during, and after pandemic. Thus, some of the questions required a retrospective interpretation of past events and the current geopolitical situation, recognising that all those three periods may have provided various possibilities and limitations for mobility. Accordingly, the design enabled a deeper understanding of mechanisms behind associations, subconscious needs, expectations, and motivations (Stolecka-Makowska, 2016).

The survey starts with outlining its purpose and scope, and brief information about anonymity. The introductory questions inquire about the type of residence and the construction year of their buildings, having a balcony, garden, and or allotment was asked. With further questions, the respondents' contact (physically and/or visually) with the greenery and if they use those areas for cultivation or not were asked. Those questions were followed by questions about the quality of life before and during the

COVID-19 pandemic. They also provided information about the green space usage frequency before, during, and after the COVID-19 pandemic.

Respondents were asked to give a subjective assessment of the quality, accessibility, and diversity of green spaces, and asked to provide information on the activity they use those spaces. As the declared frequency of use of green areas and the distance from the place of residence were important information, the survey included a drop-down list with the names of public transport stops in the whole city, which the geographical coordinates were also known, making it possible to determine and illustrate on maps the approximate location of respondents. It is worth highlighting that only the locations of the nearest public transport stops were collected, not the exact location of the respondents' residences was documented. The information obtained was crucial for mobility analyses and assessing the spatial differentiation in responses. Additionally, respondents were asked to provide information the time it takes to reach their most frequently visited green area, the distance from their place of residence to these areas, mode of transport, their preferred leisure activities, and any issues they encounter in green areas.

Moreover, respondents provided self-assessments related to green care, reflecting their awareness of the importance of urban greenery, ecosystem functions, environmental consciousness, and the benefits of interacting with nature in green spaces. Respondents were asked to indicate their level of satisfaction with these aspects, as well as their degree of individual and collective social engagement and activity within these spaces. The survey also included questions on environmental awareness and activities undertaken in the broader context of protecting and caring for green spaces. At its end, the questionnaire included a set of demographic questions to collect information about respondents' age, gender, education, and employment status.

The survey was conducted using the online platform Survey123, which, in addition to standard questionnaire functionalities, allows respondents to specify locations of green spaces

they frequently use. These data can be presented using geovisualisation tools in a web-GIS environment. The survey is designed for compatibility across smartphones, tablets, and computers. It took approximately 6-8 min to complete and the survey was distributed online via email and groups on social media platforms and Messenger in May 2022.

STUDY AREA SELECTION AND SAMPLING

The impact of the COVID-19 pandemic was profoundly experienced across various cities in the world as strict bans were implemented to curb the spread of the virus. In Poland, for instance, forests were temporarily closed following the announcement of the pandemic, while in Portugal beaches and the U.K. parks were also closed. Most people had restricted or no access to green areas in their cities in the early days of the pandemic. Thus, this study aimed to gather information about the perception of urban green spaces, their accessibility, and their features during and after the pandemic. An important goal of the study was to obtain information focusing on the perceiving and using these areas have changed as a result of the lockdowns and restrictions, and whether the fact of the pandemic has left any consequences. For this aim, Wrocław, which is located in southwestern Poland and a part of Central Europe, was selected as the case study. The reason for selecting Wrocław has strong connections to the Czech Republic and Germany can still be noticed in both the cultural and architectural sphere, which is caused by the historical affiliation of Wrocław to the aforementioned countries, as well as its close vicinity to those countries which can be seen in the Figure 1 (Prague 217 km and Berlin 295 km far from Wrocław). Wrocław is also not so far away from the capital city of Poland (Warsaw 301 km) and Austria (Vienna 326 km) (Książek and Suszczewicz, 2017). Wrocław's close vicinity to other Central European countries also affected its urban layout. Also, in 2016, Wrocław was declared the European Capital of Culture (Kołodzyńska, 2016).

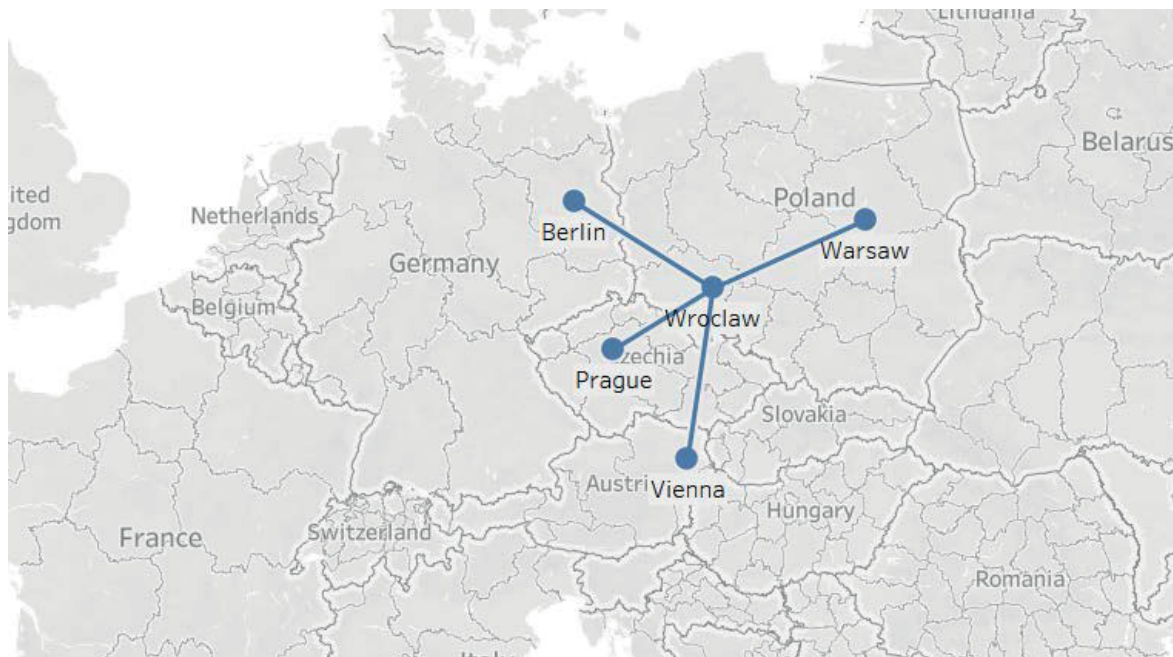


Fig. 1. Vicinity of Wrocław to the nearest capital cities; source: own study

In this study purposive sampling method was adopted which involves including individuals indicated by the researcher in the sample group. Based on their knowledge, experience and recommendations, the researcher develops subjective criteria for the selection of respondents (Miszczak and Walasek, 2003). As mentioned by Patrzalek (2017, p. 364) “Conviction about the possibility of beneficial influence on the state of the environment in the place of residence is most often declared by residents of the largest agglomerations, the best educated, representatives of such occupational groups as managers and specialists with higher education, technicians and middle-level staff, administrative and office workers, service workers, private entrepreneurs, and financially well-off people. In contrast, less inclination is observed among the oldest respondents, the least educated, manual workers – especially unskilled labourers, farmers, those who are dissatisfied with their material status, and individuals who do not engage in religious practices.” To ensure an inclusive sample group, from June to September 2021, online monitoring of social networking sites, including forums and community groups, was conducted. This approach facilitated the creation of a database providing access to people living in Wrocław, including people who are not always involved in local activities, those who are more attached to their housing estates rather than specific users of groups interested in nature conservation and urban greenery, as well as thematic forums that bring together people concerned about greenery maintenance. The survey was distributed several times over a period of two weeks, targeting personal contacts, thematic groups, and social networks. The link and QR code leading to the survey were sent to those who confirmed their willingness to participate in the study and to further distribute it among their friends.

The collected data were analysed using descriptive statistics and Chi-square analysis to discern trends and motivations behind green space usage. Additionally, mobility analysis was conducted along with qualitative analysis of responses to open-ended questions.

RESULTS AND DISCUSSION

The usage of green spaces in Wrocław as a focal location, this study collected insights into the perception, accessibility, and attributes of urban green spaces before, during, and after the pandemic. A total of 130 respondents participated in the survey, including 102 women (78.46%), 27 men (20.77%), and 1 non-binary person (0.77%). The age distribution was predominantly younger adults with 42.31% aged 18–25 years, followed by 23.08% aged 26–39, and 30.77% aged 40–59. Educational attainment among respondents varied, with 47.69% holding a master degree, 24.62% having completed general secondary education, 20.77% with a bachelor degree, 6.15% having technical secondary education, and 0.77% with vocational training. Regarding their employment status during the pandemic, 66.92% reported no change during the pandemic, while 12.31% found new jobs, and 5.38% started education. Conversely, 3.08% lost their jobs and 1.54% either left education or retired.

Respondents reported living in a variety of housing types: 40% in townhouses or buildings in the city centre, 36.92% in a multi-family residences in apartment blocks, and 23.08% in a single-family houses. Among those living in multi-family

houses, 52.29% has access to a balcony, 22.02% to an allotment, 7.34% to a terrace, while 18.35% lacked access to any these assets. As regards the usage of the assets, 64.71% of respondents used them with the same frequency as before the pandemic, 27.45% used them more during lockdowns, 6.86% used them more recently, and only 0.98% used them more before the pandemic. Among those living in single-family houses, 69.44% reported no difference in usage through the periods concerned, 22.22% used them more during lockdowns, 5.56% are using them more now, and 2.78% used them more before the pandemic. Most of the respondents (82.31%) lived close to a park, 48.46% near embankments on the Oder River, and 46.92% near allotment gardens. Other frequently mentioned green spaces included squares (42.31%), greenery next to traffic and walking routes (38.46%), and undeveloped green areas (37.69%). As for specific types of greenery in the vicinity of their residences, 30% of respondents lived near meadows, 21.54% forests, 16.15% cemeteries, 10.77% near a zoo, 6.92% near a city garden, and 5.38% near irrigation fields. An additional 7.69% indicated other forms of greenery (Fig. 2).

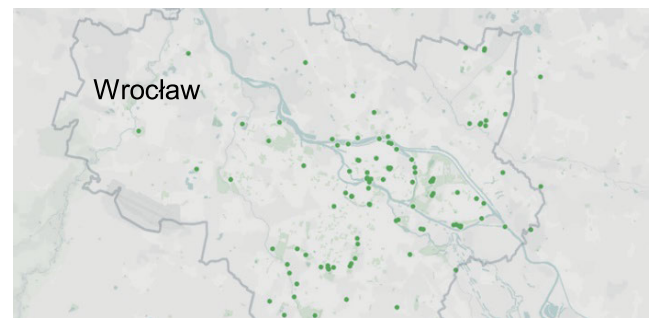


Fig. 2. The distribution of urban green areas in Wrocław according to the respondents; source: own study

The distance respondents need to travel to reach the aforementioned green areas plays an important role in motivating their physical activity. It is well documented that 30 minutes of walking per day can prevent and even reverse chromosomal telomere shortening (Epel *et al.*, 2009). Moreover, adopting lifestyle changes to reduce stress can enhance the body's ability to heal, recover post-infection, and help prevent disease (Engineer *et al.*, 2021). Regardless of the duration of their stay in urban green areas, the walking time to reach those areas is also a crucial factor contributing to overall activity levels. Nearly half of the respondents walk up to 1.5 km to reach an urban green area. However, as the distance increases, respondents reported opting to use a bicycle, and for distances greater than 3 km, they preferred to use a car. After comparing data across the three time periods – before, during, and after the pandemic, it is evident that the proximity of green spaces to residences greatly influences usage patterns. Typically, the most frequented destinations are those that can be reached within 5 minutes from home. Currently, the longer the travel time to these spaces, the less frequently they are used. However, during the pandemic, there was a noticeable shift in behaviour, with respondents more likely to choose destinations that required about 10 minutes to reach, indicating a willingness to walk longer to reach them.

The importance of forward-thinking and comprehensive city planning has been underscored during crises such as the COVID-19 pandemic. As cities continue to grow, their challenges

and complexities increase. However, new plans often overlook the importance of green areas. According to this survey, the shortest distances to green areas was reported by inhabitants of buildings constructed between 1945 and 1989, while the longest distances were noted in areas developed after 1990 (Fig. 3). This pattern may indicate a shift in the types of development and infrastructure priorities before and after the 1990s. Housing estates from the 1946–1989 period are characterised by mixed structures that integrate service, educational, and residential functions, dominated by building blocks with traffic and non-building zones. Compared to housing estates built after the 1990s, which promote an exclusionary and individualistic model, those built before 1989 foster more participatory and communal spaces (kbb, 2022). The difference in landscaping of these settlements may significantly influence the subjective assessment of accessibility to green spaces. Estates from the 1945–1989 period are characterised by infrastructure and urban planning that encourage social interaction. The informal spaces within these estates are particularly attractive to residents, especially during periods of imposed social distancing.

Responses from respondents living in estates built in 1945–1989 suggested a better adaptation to the pandemic, with the ability to rapidly modify their individual and social practices in response to the challenges posed by the novel coronavirus, which threatened both the physical and psychological health of populations around the world. Most people experienced anxiety, fear of uncertainty, irritability, depression, increased stress levels, household dysfunction, insomnia, and grief from the loss of loved ones. Moreover, they resorted to support systems and/or jobs to deal with post-traumatic stress disorder (PTSD) (Fegert *et al.*, 2020; Engineer *et al.*, 2021). Furthermore, the need for physical distancing and isolation to control the virus have led to loneliness, a condition previously associated with isolation-related diseases (Hawkey and Cacioppo, 2003; Engineer *et al.*, 2021). This has affected their life quality. Interestingly, 47.69% of respondents reported that their life quality neither worsened nor improved. This group is followed by 31.54% of respondents who indicated that their quality of life “rather worsened”. A small percentage of respondents reported improvements in their quality of life during the pandemic: 3.85% stated is has “definitely improved and 9.23% “rather improved”. Conversely, a significant portion expressed a decline in their quality of life, with 7.69% reporting it “definitely worsened” and 31.54% “rather worsened”. Despite 47.69% the percentage of those whose quality of life has remained unchanged is quite high, the cumulative percentage of those experiencing deterioration is notably high at 39.23%. While cross-tabulating these responses by demographic variables, further analysis shows

that women and men had similar patterns, but distinct differences across age groups. In particular, younger people reported a more pronounced deterioration of their quality of life during the pandemic, regardless of their employment status, which may be attributed to disruptions in their social networks (Holmes *et al.*, 2020).

While the questionnaire did not specifically probe immediate causes of decreased well-being, it is noteworthy that 88% of young adults identified green spaces as having crucial social functions, serving as places for local residents to meet and remain active. Although various strategies can mitigate negative impacts of the pandemic, the positive effect of green spaces, which is the primary focus of this study, should not be overlooked. A growing body of research is showing the impact of the environment, including the built environment, on many aspects of both physical health and emotional well-being (Engineer *et al.*, 2021). Besides improving air quality, reducing noise, and enhancing biodiversity, urban green areas promote crucial networking and socio-cultural functions. They are places where social processes can emerge and evolve (Zulian *et al.*, 2019). Their importance varies among residents, influenced not only by personal preferences and identity-related issues but also by observable trends related to age, employment, and gender. However, regardless of any personal preferences or identity issues, awareness of the importance and necessity of green spaces has significantly increased, especially during the COVID-19 pandemic. The survey results show that the respondents are aware of health benefits associated with access to nature. Notably, a vast majority of respondents (91.54%) acknowledged that interaction with urban green areas improves their mental well-being. Additionally, 61.54% of respondents reported the positive effects on their physical health. Further details reveal that 82.31% of respondents view urban green spaces as vital for relaxation and leisure, while 44.62% use those areas to uplift their mood, and 43.85% engage in physical activities there.

Responses to a multiple-choice question regarding the usage of urban green spaces during the pandemic reveal how participants value these areas. Specifically, 29.23% of participants use those areas for walking, playing, and engaging in activities with children, while 26.15% use urban green spaces for walking their dogs. Additionally, 25.38% of them gather in these areas for socialising, and 23.08% use them as quiet refuges from urban noise. A significant portion of participants (43.85%) recognise urban green spaces as vital for regulating local temperature and microclimate. Meanwhile, 16.15% of them perceive urban green spaces as crucial for biodiversity, 10% appreciate them for their aesthetic contribution to the city, and a small fraction (0.77%)

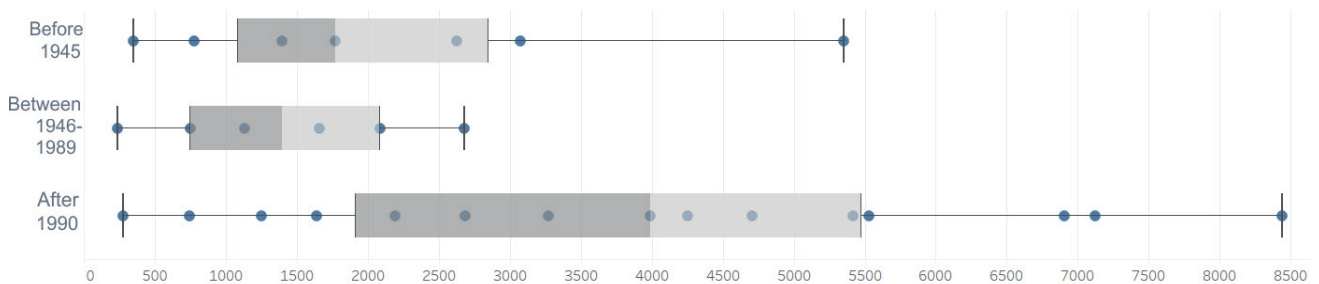


Fig. 3. The distance to green areas and construction period of buildings (shades of grey areas show the interquartile range – IQR, which contains the middle 50% of the data); source: own study

considers them important for children education about nature. Survey results show that 40.77% of the respondents felt the variety of the green spaces was adequate during the pandemic. However, a significant portion (33.84%) believed the diversity of these urban green areas was insufficient. These perceptions also extended to the availability of urban green spaces during the pandemic. For instance, 43.08% of the respondents found that the availability of green areas was sufficient during pandemic, while 32.31% reported them as inaccessible, potentially due to national restrictions (Yang *et al.*, 2021).

Figure 3 depicts a relationship between the distance respondents had to travel to reach green areas and the construction period of their residences. As previously mentioned, inhabitants of buildings constructed between 1945 and 1989 reported the shortest distance to green spaces, while those living in building constructed after 1990 experienced the longest distances. This pattern may reflect differences in lifestyle and the development of infrastructure. Further analysis correlating the availability of green spaces during the pandemic with the construction year of respondents' buildings revealed a discernible trend. Residents living in buildings constructed after 1990 reported a more negative perception of urban green space availability during the pandemic, describing it as "rather insufficient" or "definitely insufficient". As several studies highlighted (Coombes, Jones and Hillsdon, 2010; Zhang *et al.*, 2017; Yang *et al.*, 2021), there is a positive correlation between physical activity and the proximity, access, and size of urban green spaces. Thus, the quantity and quality of these areas play a crucial role in shaping public perception. For instance, nearly half of the respondents (49.23%) found green areas attractive during the pandemic, which correlates with an increased frequency of visits as the appeal of urban green spaces increases (Astell-Burt, Feng and Kolt, 2014).

According to the survey responses, there has been a shift in how frequently people use green spaces before the pandemic, during lockdowns, and currently (Fig. 4). Respondents reported an increase in the frequency of visits categorised as "daily" and "more than once a week"; while "occasional" visits have decreased. There are no respondents who currently do not use green spaces at all. However, during isolation, the number of non-users tripled compared to pre-pandemic levels.

Ensuring walkable, well-connected streets and a fair distribution of public green spaces is crucial to encourage physical activity in neighbourhoods across all socioeconomic levels (GCPH, 2013). Approximately 70% of respondents declared that urban green spaces near their residences to be very important,

advocating for an increase in these spaces. Moreover, a significant majority (96.21%) believe that every inhabitant of their city should have access to an urban green area located within a 5–10 minute walk from their home. Additionally, 78.46% emphasise the importance of maintaining existing green spaces in Wrocław, and 95% support the need to protect urban greenery. Respondents are aware of the importance of a well-designed built environment in supporting and enhancing integrative health, which can passively boost physical and emotional health. By reducing stress and increasing resilience, such an environment enhances the immune system's capacity to fight infection and reduce the severity of viral infections. Additionally, it can increase the efficacy of vaccinations (Engineer *et al.*, 2021). The pandemic has also revealed the importance of designing built environments to reduce stress and enhance occupants' resilience (Engineer *et al.*, 2021). It is thus essential to develop and manage these environments not only to reduce the transmission of deceases but also to mitigate stress and enhance resistance to severe symptoms following exposure to infectious diseases (Engineer *et al.*, 2021).

Survey information reveals that respondents living in buildings constructed after the 1990s are more likely to report insufficient greenery visible from their windows. Specifically, those who view the presence of greenery as essential to their well-being predominantly expressed a desire for more greenery to be seen from their windows, with 53.08% advocating for "definitely more" and 11.54% for "rather more" greenery. Those living in townhouses and downtown apartments noted the scarcity of greenery, considering it a luxury. Moreover, individual with access to balconies, terraces, and allotments reported more positive quality of life during the pandemic compared to those without such amenities (Tab. 1). An analysis of the usage frequency before, during, and after the pandemic reveals increased visits to allotment sites. Additionally, the Chi-square analysis ($X^2 = 151.8345$, degree of freedom = 12) with a *p*-value of 0 indicates a statistically significant and strong association between possessing a balcony, terrace, or allotment and the quality of life.

Responses to a question about creating new urban green spaces in Wrocław help clarify why many respondents view those spaces as insufficient and inaccessible. A significant majority of respondents (84.61%) believe that new urban green spaces should be developed. Additionally, over half of the respondents consider these spaces to be accessible for people with disabilities, and 80% find them accessible for elderly people. However, it should be stressed that the urban green spaces in Wrocław need further

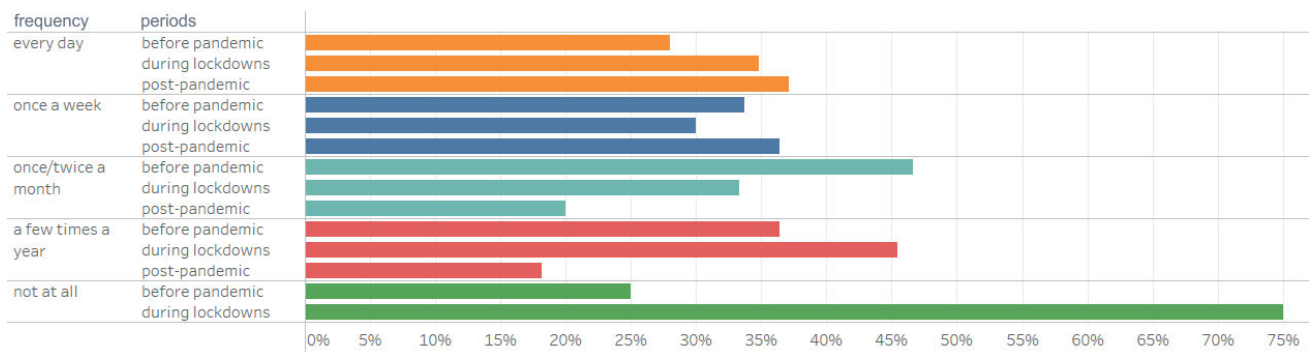


Fig. 4. The frequency visits to urban green spaces before, during and after pandemic; source: own study

Table 1. The comparison of life quality among respondents with access to balconies, terraces or allotments

Asset declaration	Quality of life for residents of a multi-family houses or blocks of flats				
	definitely improved	rather improved	unchanged	rather worsened	definitely worsened
	%				
I have a balcony	1.75	7.02	47.37	33.33	10.53
I have a terrace	25.00	12.50	37.50	25.00	
I have an allotment		12.50	62.50	16.67	8.33
N/A		16.67	16.67	33.33	33.33

Source: own study.

Explanation: N/A = not applicable.

improvements to make them more accessible for disabled people. Respondents identified multiple reasons for rating these spaces as insufficient and unavailable, which discourage visits: 62.31% cite lack of time, 37.69% mention litter, 30% lack of lighting after dark, 29.32% are concerned with vandalism and damaged benches, 21.54% point to the lack of security, and 20% allergies. Noise from other users discourages 13.08% of respondents, while only 6.92% are concerned with the low aesthetic value of these spaces. Gender differences in perception are evident: women are more concerned with aspects like lighting, cleanliness, and aesthetic qualities (Tab. 2).

An essential aspect of minimising the disadvantages of urban green spaces is involving residents in participatory activities. For instance, a successful joint planting project can empower residents, enabling them contact with authorities, and lead to further actions for the benefit of the local community and economy (TEEB, 2011; Gójska and Środoń, 2018). Thus, participatory processes should be inclusive (Westphal, 2003);

Table 2. Gender differences and reasons for not using urban green spaces

Reason	Women	Men	Non-binary
	%		
Lack of time	24.51	26.98	50
Littered and dirty	16.34	11.11	
Lack of lightening	13.23	7.94	
Due to vandalism	10.89	15.87	
Lack of a sense of security/ insecurity	7.39	12.70	50
Allergy to plants or insects	8.56	6.35	
Noisy children and young people	5.06	6.35	
Other	2.72	6.35	
Lack of care and grooming	2.72	3.17	
Barriers for disabled	2.33	1.59	
No opinion	1.95		
Unsafe surface	1.56	1.59	

Source: own study.

however, despite increased environmental awareness due to the pandemic, feedback from open-ended questions shows a continued lack of involvement. One respondent expressed, “we all have a duty to protect and care for nature in the city because it is extremely important, but I feel I have no influence on anything so I do not get involved in any activities”. In the other sets of responses, a distinct correlation emerges: individuals who are strongly convinced that their actions have no effect on the creation, care, and protection of green areas tend to have the least knowledge about these activities in their neighbourhood. The awareness of personal agency helps counteract ignorance. A similar correlation is also evident in the education level, where knowledge about activities undertaken by neighbours and organisations increases with the awareness of personal agency, which in turn rises the level of knowledge. The degree of engagement among young adults is lower, but it increases with age and level of education. There is an inverse relationship between awareness of individual agency over urban greenery and their willingness to engage in social or environmental activities.

The results of this study may have limitations, mainly due to the relatively small sample size which cannot cover all possible perceptions and views of the residents of Wrocław. Conducted in difficult conditions of the COVID-19 pandemic and lockdowns, the survey was limited to residents of Wrocław who were active on the internet. Therefore, the results focus on a specific period of isolation and are based on data collected during low mobility and online contact only. Another limitation is the survey’s restricted accessibility to people over the age of 60. Only five people from this age group, which is 3.85% of all survey participants, took part in the survey. This low participation rate may be related to digital exclusion, particularly affecting seniors and unemployed women over 50, or to other reasons such as the absence of elderly people in online groups and networks where the survey was distributed through random sampling.

CONCLUSIONS

The COVID-19 pandemic has drastically changed daily life, rendering public spaces temporarily unusable. Consequently, green spaces have become an essential part of our daily lives. Investigating the use of green spaces during the isolation period has become crucial, focusing on the perceived urban green space characteristics and the impact of contact with nature on well-being, quality of life, and social participation. Local

greenery, as an element of urban space, not only serves pro-social and gentrifying function but also influences the well-being of inhabitants and improves the city's overall climatic efficiency. By elaborating on the aforementioned notions, this study highlights a shift in practices and lifestyles towards enhanced appreciation of urban green spaces in Wrocław. One critical finding is the importance of proximity to green spaces; residents prefer to access green spaces easily and quickly. The study also notes partial modification of social behaviour and a rise in social and ecological awareness. More frequent visits to green spaces suggest the formation of new daily habits. At the beginning of the pandemic, people felt discomfort. Then they showed adaptive behaviours, changed their daily routines, and modified their previous leisure routines. With the help of this study's results, especially results about availability and sufficiency, green spaces in cities should be arranged in such a way as to meet the diverse needs of the inhabitants. As an important element of urban compositions, green spaces have ecological, health, recreational, and leisure functions. Looking after the well-being of people should be one of the guiding principles for local governments in undertaking development plans and urban management. Incorporating ecosystem services into these processes would allow for positive changes and benefits that are important for both cities and their residents, such as: lowering the cost of municipal services, strengthening the local economy, creating secure, stable jobs, and increasing the quality of life for residents.

Understanding and integrating ecosystem services into local government operations is fundamental to modern sound environmental management. At the same time, as residents of this city, the authors recognised the signs of change in terms of problems with urban greenery, as well as increased interest among residents for green spaces and the discontinuation of existing solutions that would satisfy stakeholders. It is hoped that the results of this study will support and complement future local participatory actions. The results can provide a realistic picture of the ecological awareness of residents, their involvement in local processes, and their opinion of urban green spaces as important places on the social, cultural, and geographical map of the city. With the health and satisfaction of residents in mind, the availability and convenient location of urban green spaces seem to be a strategic element in the planning and revitalisation of urban areas.

ACKNOWLEDGMENTS

This research was carried out as the first author's master's thesis under the supervision of the second author at University of Wrocław under the supervision of W.P.

CONFLICT OF INTERESTS

All authors declare that they have no conflict of interests.

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