GENDER-SPECIFIC PREFERENCES REGARDING URBAN GREEN AREAS

Edyta Bąkowska-Waldmann [1], Witold Piniarski [2]

[1] Department of Urban Systems and Territorial Governance, Adam Mickiewicz University, Poznań, Poland
[2] Landscape Ecology Research Unit, Adam Mickiewicz University, Poznań, Poland

Abstract: Development of urban green areas and awareness of their value among citizens and local authorities is rapidly growing. This trend is not only the result of the coronavirus pandemic, but also reflects a belief in the role of green areas in reducing the negative effects of climate change and supporting overall well-being. As a consequence, more and more local governments are promoting local policies focused on the development of urban green areas with the participation of citizens. Using data collected in Zielona Góra, Poland, this study explores the gender patterns and differences in use and preferences according to the development of urban green areas. The main goals of the study were (1) to evaluate the possible relationship between gender and preferred types of visited green areas and transport modes used to reach them and (2) to explore the differences in expectations regarding the spatial development of green areas among men and women. The result of the study shows that women more often than men visit green areas closer to their place of residence and more often indicate playgrounds and other forms of greenery of an aesthetic function as proposed green areas. Furthermore, there are also differences regarding the means of transport used and preferable distance to green areas. Women visibly prefer green areas within the city centre, mostly use individual means of transport, and are more likely to travel on foot than men. Men prefer more distant green areas and mostly travel longer distances.

Keywords: urban green areas, spatial planning, public participation, gender mainstreaming, geographic information systems

Corresponding author: Edyta Bąkowska-Waldmann, Department of Urban Systems and Territorial Governance, Faculty of Human Geography and Planning, ul. Bogumiła Krygowskiego 10, 61-680 Poznań, Poland; e-mail: edyta.bakowska@amu.edu.pl

Introduction

Green areas in cities are not only places of recreation and aesthetically attractive spaces. They also play an essential role in mitigating the negative effects of climate change through water retention, providing natural protection against the sun and locally maintaining a lower temperature (Alexandri, Jones 2008; Tiwari et al. 2021). The role of urban greenery is also significant from the point of view of the quality of life and mental health. Green areas, including urban green areas, have a great impact on people's well-being (Galindo, Corraliza 2000; Lee, Maheswaran 2010; MacKerron, Mourato 2013; Ambrey, Fleming 2014; Sang et al. 2016; Santos et al. 2016; Seresinhe et al. 2019; Wang et al. 2019; Chen et al. 2021). Access to greenery provides a range of benefits for residents, including opportunities for physical activities or social relations (Lee, Maheswaran 2010; Wu et al. 2020). Also, the impact on mental

well-being is of great importance. However, there are differences in the results of research conducted in different countries. For example, according to studies conducted in Sweden by Annerstedt et al. (2012) and Sang et al. (2016), exposure to greenery was associated with higher mental well-being among women. On the other hand, in an Australian study conducted by Astell-Burt et al. (2014), that type of positive relationship was only among men.

The value of green areas is increasingly understood both by the users themselves (residents and organisations representing their interests) and by local authorities, who must consider the essence of this form of land use in the public debate. From the urban planning point of view, in Poland, the creation of new green areas in cities on a large scale is strongly limited by the financial costs of changing the land use function for the benefit of landowners entitled to compensation. Also, the investment pressure (especially in the rapidly developing metropolitan urban areas in Poland in the last three decades, see: Kaczmarek et al. 2022) constitutes a threat to green areas, as legal regulations in Poland have strong limitations in this regard (Kronenberg et al. 2021; Supreme Audit Office 2022; Legutko-Kobus et al. 2023). As a consequence, public awareness of the importance of green areas and participation in the creation of spatial planning policies might play an important role in the protection of that type of land use and urban biodiversity (Mabelis, Maksymiuk 2009; Biernacka, Kronenberg 2019; Tang, Li 2022). In relation to a strong disproportion of gender representation in public consultations in spatial planning in Poland in favour of men (Wójcicki 2018), attention should be paid to whose voice is presented in the process of urban green areas development and what is missing.

In the face of climatic challenges, the need for urban green areas is undeniable, playing a crucial role in improving living conditions in cities. However, understanding gendered preferences is essential as public input is crucial to securing these necessary green spaces. Different genders have varied preferences and ways of using these areas (Annerstedt et al. 2012; Astell-Burt et al. 2014; Sang et al. 2016), highlighting the importance of public participation processes that accurately capture and consider these differences. This clear understanding of the problem

is pivotal, facilitating not only the planning but also the utilisation of green spaces that cater to everyone's needs and preferences. Thus, increasing the amount of urban green areas seems to be a primary measure aimed at improving living conditions in the cities in the context of torrential rainfalls, high temperatures and the generation of an urban heat island (Bowler et al. 2010). In this light, more and more local governments (and politicians) are promoting policies focused on the development of urban green areas through public participation (Sanesi, Chiarello 2006; Buijs et al. 2016; Fok, Law 2018; Belčáková et al. 2022), which should be inclusive and representative of all genders to ensure the creation of spaces that are truly public and accessible.

During the works on the *Study of conditions and directions of spatial development in Zielona Góra*[1] (Poland) conducted by a city urban planning office, a public consultation on preferences on different aspects of land use was carried out using a public participation geographic information systems (PPGIS) tool, which is a geo-questionnaire. One of the most important issues covered by the study was urban greenery – preferred areas, their accessibility and the development of new urban green areas. The results made it possible to evaluate the possible relationship between gender and preferred types of visited green areas, and to explore the differences among men and women in expectations regarding the spatial development of green areas, providing an insight towards gender mainstreaming policy in the context of urban planning in Polish cities.

Gender mainstreaming is a rapidly growing approach to local development and residents' well-being in cities. The term was established in 1985 during the UN World Conference on Women in Nairobi, Kenya, as an international strategy for equality policy. It is a strategy that is based on the promotion of gender equality, ensuring that the gender perspective is key to all activities and decision-making. Within the Treaty of Amsterdam, adopted by the EU countries in 1997, gender mainstreaming perspective became its official policy approach. It was defined by the Council of Europe (1998: 18) as "the (re)

---

[1] *Study of conditions and directions of spatial development* is the primary planning document in local governments in Poland setting out the spatial development policy.

organisation, improvement, development and evaluation of policy processes, so that a gender equality perspective is incorporated in all policies at all levels and at all stages, by the actors normally involved in policy-making." Gender equality, which is core to gender mainstreaming policy, is one of the UN Agenda for Sustainable Development (2015), supporting equal access to resources, education, policy-making, etc. However, in Poland, there are no nationwide actions that would promote the implementation of gender mainstreaming strategies. There is also a limited scope of local policies promoting gender equality in spatial planning, comparable to Barcelona, Berlin or Vienna, which are leaders in implementing this strategy in Europe.

The gender mainstreaming approach seems to be crucial for urban planning processes, including development of urban green areas, in which perspectives and needs of different gender representatives should be taken into account. Thus, the aim of the study was to investigate whether the habits and preferences of men and women regarding urban green areas in the selected study area in Poland will provide insightful premises for spatial planning policies and whether a stronger focus on the representativeness of different genders in public consultations should be a part of those policies. Thus, the research questions of the study presented in the paper are the following:

1. What are the preferences regarding the types of visited green areas among men and women?
2. What are the preferred means of transport used by men and women to reach the visited green areas?
3. What are the preferences regarding proposing new green areas among men and women?

The data for the study were collected using a PPGIS tool – a geo-questionnaire. The questionnaire included questions about the basic socio-demographic characteristics of respondents, as well as more complex spatial characteristics regarding preferences for urban green areas. A multilevel approach to statistical data analysis was adopted, using descriptive statistics and a clustering algorithm.

Gender and urban green areas

The gender gap in time use patterns may play an important role in connection with the possibility of travelling longer distances to visit green areas and satisfaction with the time spent determining the type of activity. For example, Mattingly and Bianchi (2003) found out that men tended to have more free time than women, while women's free time was more fragmented. The same results were obtained by Rubiano-Matulevich and Viollaz (2019) in their more recent study conducted in 19 countries from different world regions. According to this study, women have 36 minutes less leisure time than men during the day. At the same time, leisure time spent by women has a higher 'positive leisure experience' than by men (Codina, Pestana 2019). It refers to higher satisfaction regarding leisure activities despite less available time and may apply to such activities as walking, which in Poland is more popular among women than men as a transport mode (Jakubiec et al. 2015; Czarnecki et al. 2023). Those findings seem to be relevant in regard to differences in perception and use of urban green spaces between genders (Kaczynski et al. 2009; Schipperijn et al. 2010; Sang et al. 2016). According to a study by Sang et al. (2016), the effect of gender was evident for different activities, with higher importance among women in the following types of activities – relaxing, socialising, experiencing nature, walking, getting fresh air, looking for a place to cool, following the changes in the nature by seasons and studying wildlife. The study shows that, in general, women are more physically active than men in urban green spaces. Also, the level of naturalness of urban green spaces impacts the level of physical activity (Cerin et al. 2008). In the study by Kaczynski et al. (2009) conducted in Canada, living in closer proximity to a higher number of green areas is more correlated with higher physical activity among women than men. However, in the study conducted by Cohen et al. (2007) in the US, women were less present in urban parks than men and were less frequently physically active there.

The activity in urban green areas can also be related to preferences as to urban green area types, design and overall presence. Schipperijn et al. (2010), in their study conducted in Odense, Denmark, showed that women tended to score

the importance of activities in urban green areas higher than men. Similar results were obtained by Tyrväinen et al. (2007) in their study conducted in Helsinki, Finland. According to de Vries et al. (2003), green areas have greater importance to women, which is the result of their preferences for spending their free time near the home environment. Also, preferences as to the level of naturalness (see: Ode et al. 2009) and design of urban green areas differ among men and women. According to Caula et al. (2009), women prefer more natural design.

The design of urban green areas is important in relation to the perceived security but also the level of crime (Jorgensen et al. 2002; Mahrous et al. 2018; Balai Kerishnan et al. 2021; Evensen et al. 2021). Among the features that might be connected with the perceived security of its users are visibility, maintenance, cleanliness, external protection, other park users and mobility facilities (see more in Polko, Kimic 2022). In general, perceived safety is greater in green spaces that are highly classified as natural (Maas et al. 2009; Sang et al. 2016). However, in the study conducted among adult park users in Poland (Polko, Kimic 2022), women, more than men, paid attention to factors providing them with a greater sense of security. In public spaces, women have a lower sense of security than men (Sutton, Farrall 2004), and this also applies to green spaces (Jorgensen et al. 2002; Polko, Kimic 2022).

Accessibility is another aspect strongly related to preferences regarding visited green areas. Not only is it strongly determined by geographical distance and potential barriers but also by possibilities and preferences for the use of different transport modes. Together with the development of urban planning concepts focused on shortening the distances to places of everyday importance, different scholars pay attention to the creation of more equitable cities in relation to green spaces accessibility – especially based on active transport modes (William et al. 2020; Guzman et al. 2021; Magrinyà et al. 2023). Gender differences related to travelling affect green exposure. For example, studies by Wu et al. (2022) show that men are more exposed to greenery while travelling as they are less restricted when travelling than women. Those differences are related to preferred and accessible transport modes and distance travelled. Women's everyday travel distances are shorter (Frändberg, Vilhelmson 2011), and at the same time, owing to the more time spent on caring activities, more complex (Scheiner, Holz-Rau 2017). The latter strongly affects the difficulties for women to visit more attractive urban green spaces more frequently and spontaneously (Chidambaram, Scheiner 2021). These restrictions also apply to the still traditional and economically determined role of women in a family in Poland, evidenced, e.g. by the share of women taking a parental leave that reaches 99% (Ministry of Family and Social Policy, 2019; Suwada 2021). Also, the transport modes used play an important role in this regard, as confirmed by numerous studies on gender differences. Women, more often reach their places of destination by walking or using public transport, while car travels are more popular among men (Miralles-Guasch et al. 2015; Sánchez, González 2016). This also applies to the situation in Poland (Nosal-Hoy 2018). However, there are different results in countries where social norms or lack of safe infrastructure limit women's use of public transport (Goel et al. 2023). Those differences are interrelated with urban green areas accessibility. According to studies by Schindler et al. (2022), car ownership increases travel distances to urban green areas. However, according to Ettema et al. (2016), the use of active transport modes (walking, cycling) correlates with higher satisfaction with travel, while for public transport – it is lower. As a consequence, the satisfaction related to travel can affect the overall satisfaction of the time spent in green areas.

The literature review characterised gender differences in spending free time, transport habits of women and men, sense of security in public spaces and preferences regarding the design of green areas. However, there is a lack of discussion in the literature to what extent these issues may be important in terms of visited green areas, means of transport used to reach them, distances covered and preferences in terms of development of new green areas. This research aims to make a contribution to the literature on the importance of gender differences defined in the previous studies in relation to selected aspects of greenery development in Polish conditions.

Methodology

The study was conducted in Zielona Góra (Fig. 1), which is the capital of the Lubuskie region located in western Poland. According to Statistics Poland, in 2021, the city had approximately 139,677 inhabitants. The borders of Zielona Góra expanded in 2015, which was connected with the reduction of development barriers related to lack of investment areas and new residential areas (Dubicki, Kułyk 2018). As a result, Zielona Góra has become one of the most forested cities in Poland, with forest land share reaching 54.6% of the whole area of the city (Statistics Poland). The incorporation of new areas into the city boundaries (primarily forest areas), may be potentially important for better accessibility of green areas (extensive public transport, better-integrated road infrastructure investment in, e.g. bike lanes) and for the promotion of their natural assets among city residents by the local administration. The study covered a whole area of the city.

Owing to the latest expansion of the city administrative area, the efforts to establish a new spatial planning policy were a priority for city officials. It was connected with the integration of new areas into the development strategy, reorganisation of the transport system and protection of valuable spaces in the form of green areas, including natural green areas.

The data used in the study were collected using a geo-questionnaire (Fig. 2), which is an example of a public participation geographic information systems (PPGIS) tool. PPGIS can be defined as a set of methods and tools based on geographic information systems (GIS) supporting public participation in decision-making in spatial planning (Craig et al. 2002; Sieber 2006; Brown, Kytta 2014). The geo-questionnaire is an online questionnaire in the form of a geoweb tool typical of Web 2.0 features allowing public input in the form of geodata (Haklay et al. 2008; Gryl et al. 2010; Henning et al. 2013; Brown, Kytta 2014). Through the geo-questionnaire, respondents can answer standard survey questions (open-ended and closed-ended); however, they also have an opportunity to submit answers using an online map, providing data in geospatial format. While using a location question, it is also possible to supplement it with different types of questions that will be connected to the marked point. This feature is relevant for better understanding of the situation or preferences connected with the location pointed out by the respondent.

The geo-questionnaire used in the study provided features of the online computer-assisted web interview (CAWI) method; it is supplemented, however, by the interactive online map, which made it possible to collect spatial data for further GIS analysis. The software used for the study was LopiAsk. Each participant completed the questionnaire independently at any time during the four-week period in September 2019. The questionnaire included questions about basic socio-demographic characteristics of respondents, i.e. their age, gender and education level, as well as more complex spatial characteristics involving the respondents' transport preferences, their places of residence, urban green areas they are
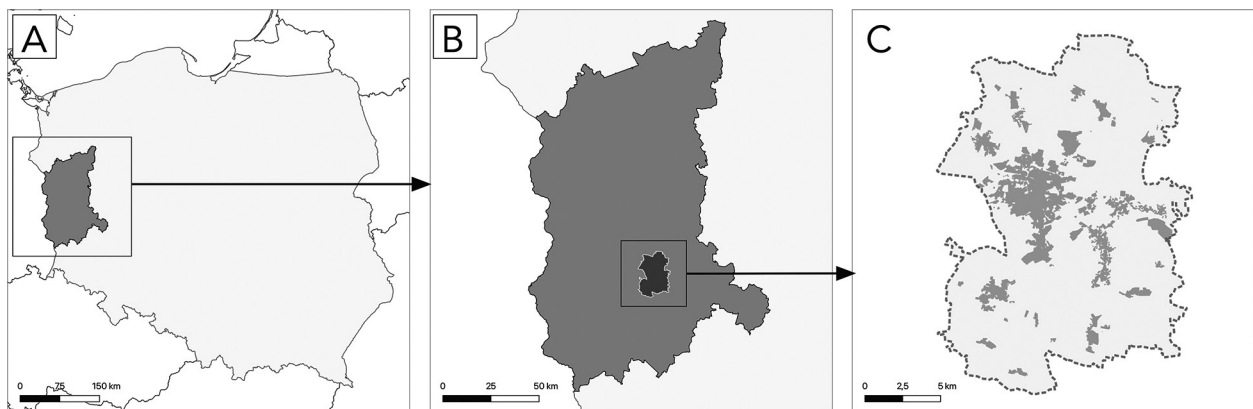

Fig. 1. The area under study (C) in relation to the country (A) and the Lubuskie region (B).
Source: authors' own elaboration.
Reference data: OpenStreetMap contributors (https://www.openstreetmap.org/copyright), Head Office of Geodesy and Cartography, Poland (GUGiK).

visiting, and preferred locations and the types of new green areas in the city (see Appendix 1).

In the study, the selection of the sample was purposive, made by the respondents' place of residence (in the studied area). They were recruited for the study using both the Internet (social media, city website and news web portals) and information in traditional local media, like newspapers. The residents were provided with a link to the website on which the study was conducted. To prevent multiple completions of the questionnaire, access to the website was limited
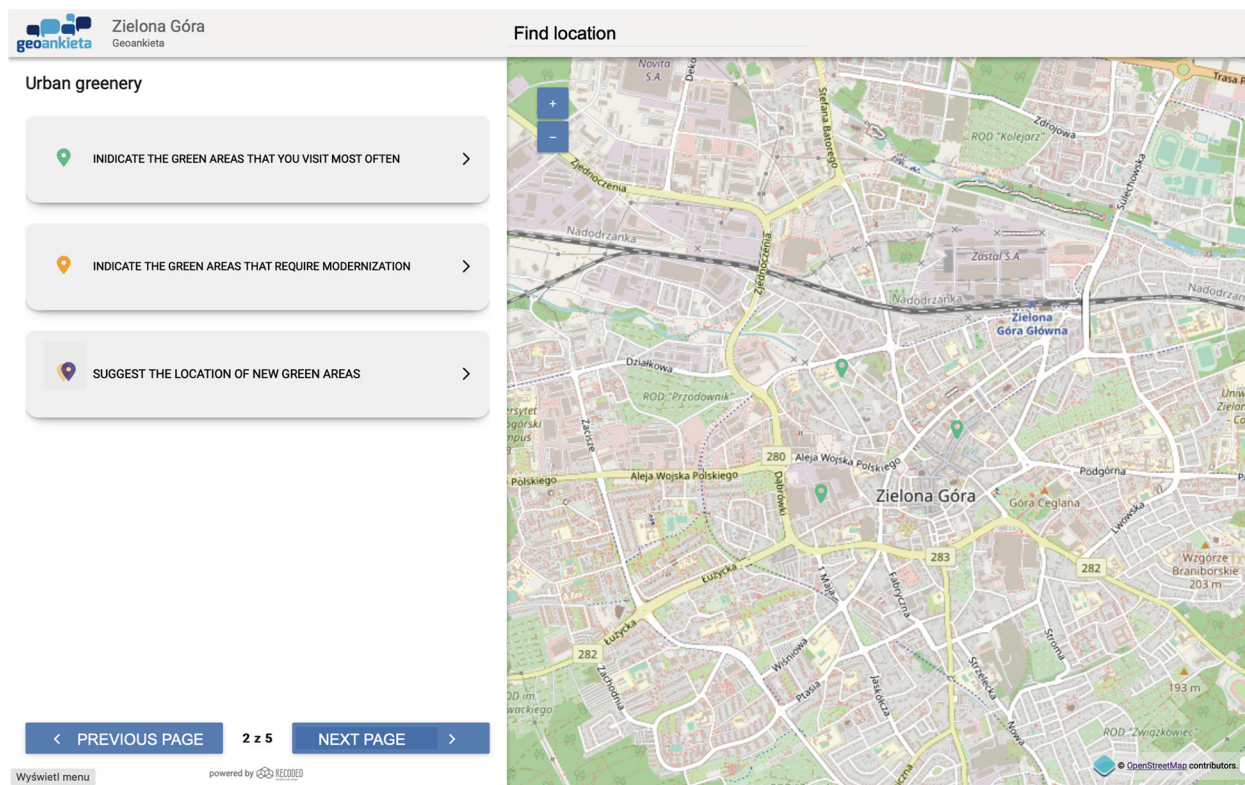

Fig. 2. An exemplary geo-questionnaire page used in the study.
Source: author's own elaboration.

Table 1. The characteristics of the sample.

Variable	N		%	
Gender*	Women (W) = 96 Men (M) = 165		Women (W) = 36.78% Men (M) = 63.22%	
	W	M	W	M
Age	18–29 = 18 30–44 = 59 45–59 = 15 ≥60 = 4	18–29 = 30 30–44 = 96 45–59 = 33 ≥60 = 6	18–29 = 18.75% 30–44 = 61.46% 45–59 = 15.62% ≥60 = 4.17%	18–29 = 18.18% 30–44 = 58.18% 45–59 = 20.00% ≥60 = 3.64%
Education	primary education = 5 secondary education = 14 higher education = 77	primary education = 9 secondary education = 35 higher education = 121	primary education = 5.21% secondary education = 14.58% higher education = 80.21%	primary education = 5.46% secondary education = 21.21% higher education = 73.33%
Mobility (means of transport used to access greenery – unlimited number of choices per respondent)	on foot = 65 bicycle = 33 car = 25 bus = 8	on foot = 92 bicycle = 69 car = 49 bus = 14	on foot = 67.71% bicycle = 34.38% car = 26.04% bus = 8.33%	on foot = 55.76% bicycle = 41.81% car = 29.70% bus = 8.49%

* Respondents selected for the study identified themselves as woman or man. No other gender identities were selected among respondents.
Source: authors' own elaboration.

to a single occasion. Table 1 presents the sample characteristics.

Owing to the varied quality and correctness of data collected among the respondents, the database was checked before it was spatially and statistically analysed. The analysis consisted of the deletion of responses not related to the study area, exclusion of incomplete questionnaires (e.g. without the demographic characteristics of a respondent) and spell-checking of answers to open questions. As a result of the qualitative database assessment, the number of the respondents was reduced from 477 to 261.

Following the data preparation, the spatial (GIS) and statistical analysis was performed regarding the demographic characteristics of the respondents, spatial representation of urban green areas visited by the respondents, gender differences in preferences regarding visited places and the preferences regarding the development of urban greenery.

The methodological approach to the statistical analysis of Zielona Góra inhabitants' transport preferences was based on Partitioning Around Medoids (PAM) clustering (Kaufman, Rousseeuw 1987). Unsupervised data clustering on the dataset containing numeric data mixed with coexisting categorical features is a complex task that was the concern of many previous studies for >50 years (Gower 1967; Struyf et al. 1997; Rodrigues Lopes dos Santos, Zárate 2012; Bektas, Schumann 2019). It required using the daisy function to manage mixed data types and simultaneously calculate dissimilarity matrices for numeric and non-numeric variables (Kaufman, Rousseeuw 1990), even when a few different variable types occur in the same dataset. The expression of the dissimilarity with PAM is crucial for later clustering. Furthermore, for mixed data, it is also required to use the appropriate metric for computing the pairwise distance between all the records of various data types, i.e. so-called Gower's similarity coefficient (Gower 1971). As one of many unsupervised learning strategies, the PAM algorithm requires a precise number of clusters to be specified before the actual clustering process (Reynolds et al. 2004).

The silhouette score helps to estimate the number of clusters. It falls within the range from − one to one, i.e. from more matched with neighbour clusters (which is less optimal) to well matched to

the particular cluster itself (which is a better solution), where the results <0 indicate incorrect, overlapping clusters (Rousseeuw 1987). Estimating the optimal solution relates to determining minimum dissimilarities within every single cluster and inversely maximising dissimilarities between them (Shahapure, Nicholas 2020).

A multilevel approach to statistical data analysis was conducted using descriptive statistics and a clustering algorithm, which was largely described in the previous paragraph. First, through data exploration, it was possible to discover similarities in the gender structure of the respondents and their spatial preferences. Second, it was crucial to investigate the spatial representation of urban green areas visited by the respondents and their preferences towards the future development of specific green space types. Finally, an essential part of the research was the comparative analysis to identify gender differences in visited places and preferences towards creating new urban green areas that was supported by GIS analyses and visualisations.

Results

Preferences regarding visited green areas

The collected data on the most frequently visited green areas that were indicated in the questionnaire were divided into two groups with locations indicated by men and women. Each respondent could indicate up to three places. Among men, the number of points was 332, which gives 2.01 points per respondent. Women marked 202 points on the map, which gives 2.10 points per respondent. Among the locations indicated by men, it was possible to identify 15 places indicated by at least 3.0% of the respondents. Among the locations indicated by women, it was possible to identify 22 places indicated by at least 3.0% of the respondents. Locations indicated by men and women are presented on density maps with highlighted areas of highest differences between the genders (Fig. 3).

Comparative analysis of men's and women's responses allowed the identification of eight places where differences in the share of all indications among men and women were the most significant, i.e. the share of indications of one of
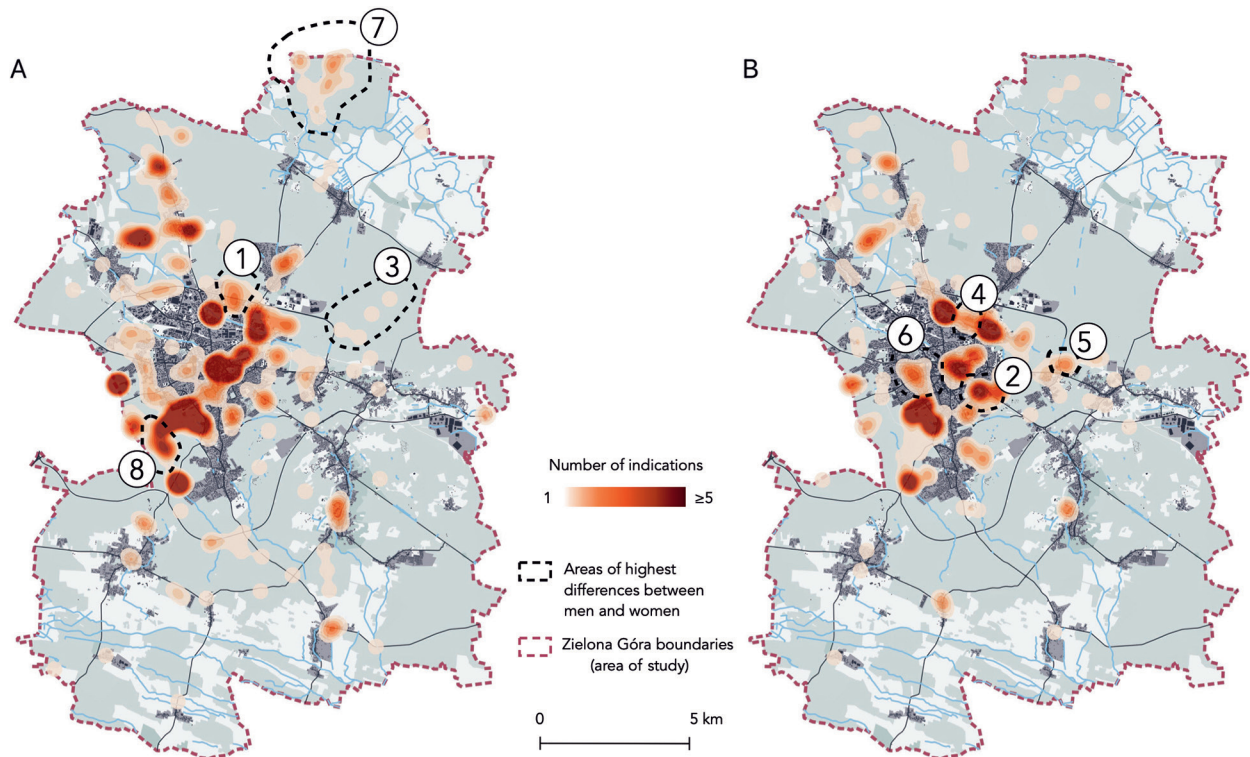
Fig. 3. The most often visited green areas in Zielona Góra among men (A) and women (B). Numbers on maps refer to the place's IDs in Table 2.
Source: authors' own elaboration.
Reference data: OpenStreetMap contributors (https://www.openstreetmap.org/copyright).

the genders reached at least 75.0%. The results of comparative analysis are presented in Table 2.

The areas indicated by men were much less often or not at all indicated by women. It included undeveloped green areas, such as forests (including arable forests) or sports and recreation areas. They were also further away from the city centre. Among the locations indicated by women, which were not significantly reflected in men's answers, were maintained green areas equipped with basic recreational facilities. These places were located in built-up areas or in their close vicinity. Apart from the differences, there are strong similarities in most often (by both genders) visited green areas. It refers to highly maintained urban green areas like the Botanical Garden (23% of men and 27% of women), Gęśnik Valley (13% of men and 16% of women), green areas near the municipal swimming pool (6% of men and 8% of women), or Vineyard Park with a Palm House (6% of men

Table 2. Differences in visited green areas indicated by men and women.

| Place ID	No. of indications	Men [%]	Women [%]	Characteristics of the area
1	9	100.0	0.0	Forest cultivation located north of Northern Route (*Trasa Północna*)
2	5	100.0	0.0	Forest cultivation located east of express road S3
3	3	0.00	100.0	Part of Gęśnik valley with recreational facility
4	3	0.00	100.0	Park Mazurski (Mazuria Park) – semi-naturally maintained urban green area with recreational facilities
5	6	16.7	83.3	Women Rights Square – maintained urban green area with recreational facilities
6	5	20.0	80.0	Green areas in multi-family housing area
7	15	80.0	20.0	Las Nadodrzański (Odra Forest) – natural green area, forest and oxbow lake of Oder River
8	18	77.8	22.2	Pustelnik stream located in natural green area

Source: authors' own elaboration.
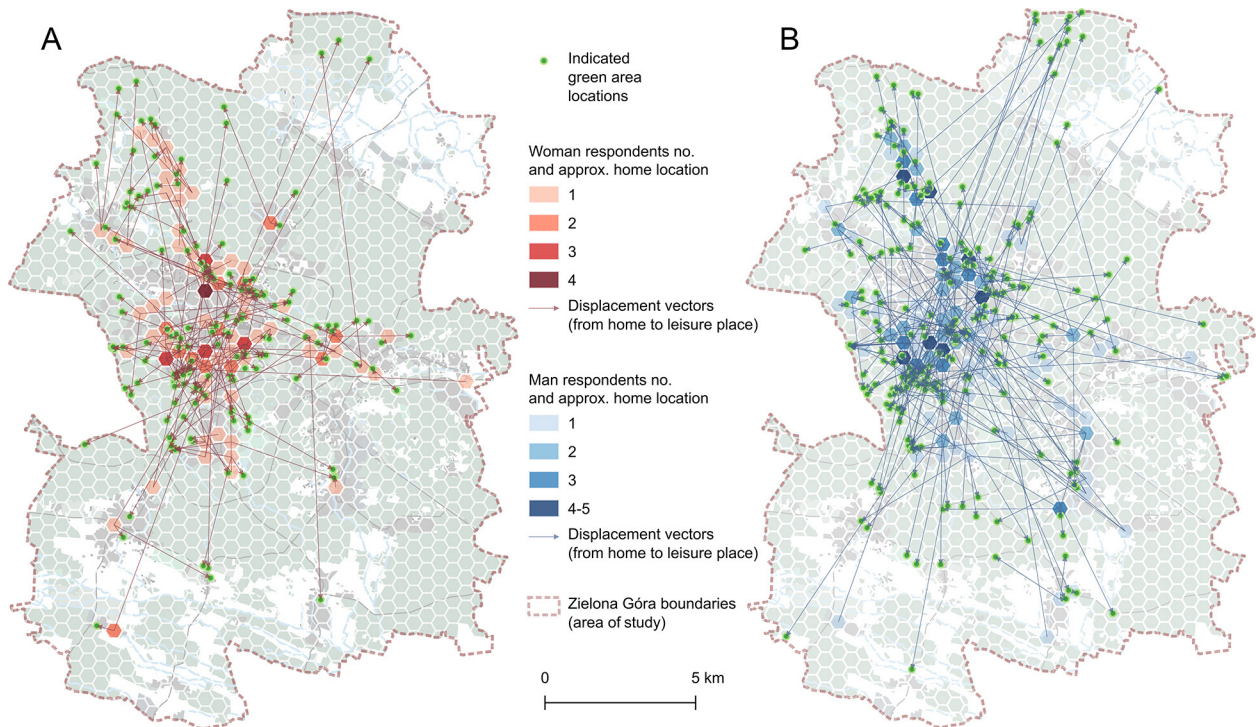
Fig. 4. Displacement vectors from the respondents' homes to selected green areas (A – men, B – women).
Source: authors' own elaboration.
Reference data: OpenStreetMap contributors (https://www.openstreetmap.org/copyright).

and 5% of women). This indicates that differences occur mostly in less popular urban green areas in Zielona Góra and thus, refer to people who may have more specific needs and possibilities for spending free time. More specifically, the differences will concern men who prefer to spend time in more natural green areas, i.e. those perceived as closer to a natural stage of vegetation (Sang et al. 2016) farther from the city centre, and in the case of women – maintained urban green areas equipped with an infrastructure conducive to passive rest or children's play.

The mean value of all displacement vectors, from home to the selected green areas, is 2.18 km for female respondents in comparison to 2.72 km for male respondents, which is close to a 20% difference (Fig. 4). Generally, it proves higher mobility of male respondents, who were much more willing to travel longer distances and preferred more distant green spaces, frequently located in previously rural (administrative) areas.

Preferred means of transport used to reach the visited green areas

According to the clustering results, there are four distinct groups of Zielona Góra inhabitants,

in correlation with the gender of the respondents, with similar preferences for means of transport and specific average distance to their favourite green areas, as places of free time spending. The dataset used, acquired from the presented geo-questionnaire, with an average silhouette width score close to 0.5, outputs a reasonable number of groups for the survey population of 261 respondents, which was estimated as four distinct clusters, with 33–84 respondents in each of them. All the separated clusters, with the data points concentration limited to four distinct groups, can be shown in two-dimensional space as the scatter plot (Fig. 5), with the usage of t-SNE (Van der Maaten, Hinton 2008).

Within the analysis, the idea was to identify all the respondent groups, concerning their gender, and following the distance and their preferred means of transport. Later verification, i.e. the clustering results, showed that the respondents' genders were relevant, and groups were obtained according to the gender of the respondents. As stated in Table 3, there are two homogenous clusters of just one gender, i.e. clusters 2 and 3, while the rest two were mixed and, simultaneously, less numerous. This statement was not assumed from the beginning but eventually appeared

Table 3. Statistical characteristics of the designated clusters of transport preferences.

Cluster	Gender		Descriptive statistics	Mean range/ Average distance [km]	Transport preferences Each value is independent and varies individually for each means of transport from 0.00 to 1.00			
	Women [no.]	Men [no.]			On foot	Bicycle	Car	Bus
1	11	53	Min.	0.14	0.00	0.50	0.00	0.00
			1st Qu.	1.42	0.00	1.00	0.00	0.00
			Median	2.79	0.00	1.00	0.00	0.00
			Mean	3.24	0.06	0.92	0.02	0.01
			3rd Qu.	4.65	0.00	1.00	0.00	0.00
			Max.	9.26	1.00	1.00	0.50	0.33
2	0	84	Min.	0.01	0.00	0.00	0.00	0.00
			1st Qu.	0.49	0.50	0.00	0.00	0.00
			Median	1.41	1.00	0.00	0.00	0.00
			Mean	1.91	0.73	0.06	0.08	0.09
			3rd Qu.	2.27	1.00	0.00	0.00	0.00
			Max.	12.71	1.00	0.50	0.50	1.00
3	80	0	Min.	0.20	0.00	0.00	0.00	0.00
			1st Qu.	0.63	0.33	0.00	0.00	0.00
			Median	1.12	0.67	0.00	0.00	0.00
			Mean	1.63	0.62	0.16	0.14	0.05
			3rd Qu.	2.38	1.00	0.33	0.08	0.00
			Max.	8.92	1.00	1.00	1.00	1.00
4	5	28	Min.	1.60	0.00	0.00	0.50	0.00
			1st Qu.	2.52	0.00	0.00	0.67	0.00
			Median	4.73	0.00	0.00	1.00	0.00
			Mean	4.87	0.55	0.02	0.90	0.02
			3rd Qu.	7.34	0.00	0.00	1.00	0.00
			Max.	9.35	0.50	0.33	1.00	0.50

Source: authors' own elaboration.

within the analysis; all gender respondents' data were part of the same dataset with no exclusiveness. The basic analytical concept was based on PAM because of cluster analysis of a relatively complex dataset containing numeric data mixed with coexisting categorical features derived from the survey.

The descriptive statistics for every cluster parameter were determined as follows in Table 3, where all the background colours correspond to the colours of the data points in the previously described scatter plot (Fig. 5). All the designated clusters were also precisely characterised in the following paragraphs.

The 1st cluster can be defined as a group of mostly men (83%) and some women (17%) travelling almost exclusively by bicycle. In total, it consists of 64 respondents, i.e. 53 men and 11 women, using mainly individual means of transport (98%), who choose cycling (92%) or eventually just walking (6%), all in a mean range of 3.24 km

from their living place to the green area of their choice (later referred to as the average distance, which is determined separately for each cluster). In this group, public means of transport are used very occasionally (2%).

The 2nd cluster, i.e. the group of only men (84 men, no women), preferably walking and occasionally using motorised transport. The average distance for this group is lower by 59% than for the 1st cluster, i.e. 1.91 km in comparison to 3.24 km, probably because of the preferences for walking (73%) instead of cycling (6%), which was typical within the 1st cluster (with 92% share). Another unique characteristic of the 2nd cluster is the significant share of both individual and public motorised transport within all the designated clusters. However, despite preferences for using cars (8%) and buses (9%), the average distance for this group is relatively short (1.91 km).

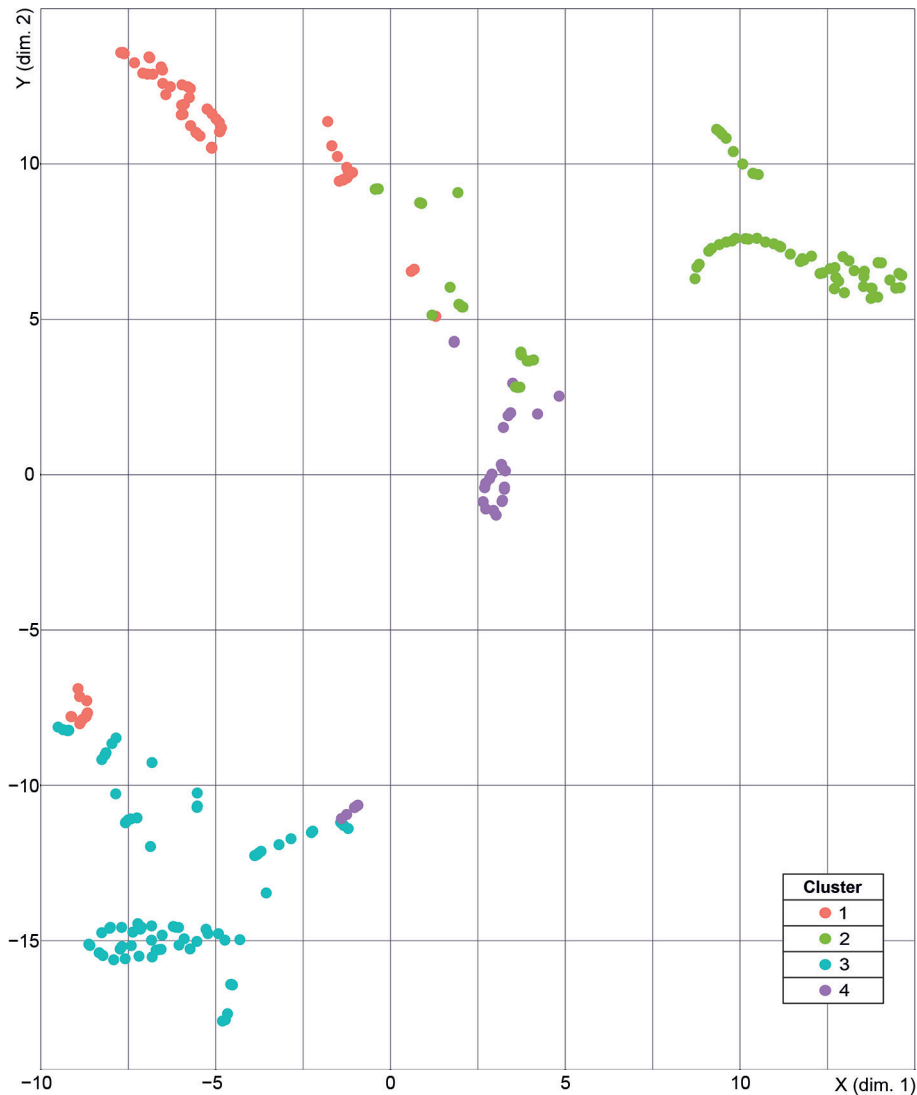The 3rd cluster includes only women (80 women, no men) who prefer walking (62%), the

Fig. 5. Scatter plot of the designated clusters.
Source: authors' own elaboration.

same as men from the 2nd cluster. Nevertheless, their average distance is lower by nearly 15%, i.e. 1.63 km compared to 1.91 km within the men-only group. Women from the 3rd cluster have a visibly higher share in other individual means of transport, i.e. non-motorised bicycles (16%) and motorised cars (14%). At the same time, their share in means of public transport is relatively small, i.e. almost twice lower compared to the 2nd, i.e. the man-only group, and just 5% of women choose bus transport compared to 9% of men from the 2nd cluster.

The 4th cluster includes 33 inhabitants, mostly men (85%), with the highest average distance in all the designated clusters, i.e. 4.87 km. Again, they prefer individual over public transport, i.e. 90% of the inhabitants from the 4th cluster choose

cars while buses share in their transport preferences equals only 2%. Furthermore, in this group, the share of non-motorised transport is relatively high, and 55% of members also prefer walking. Nevertheless, in opposition to other designated clusters, only 2% of the 4th cluster members use bicycles to get to the green areas of their choice.

Thus, four types of users can be distinguished regarding means of transport used by the respondents and the distance travelled. Two clusters consist of representatives of one gender only (clusters 2 and 3), and another two (clusters 1 and 4) have a significant advantage of representatives of one of the genders. This indicates that, in contrast to the rather similar (with the exceptions indicated earlier) types of green areas visited by men and women, the differences in the means of

transport used and the distance of the places visited are the more differentiating factors.

Preferences regarding the development of urban green areas

The analysis of male and female expectations regarding the spatial development of green areas shows both similarities and differences in the proposed types of new green spaces (Table 4). Green playgrounds, parks and green roofs/walls were among the most often proposed types of urban greenery by both genders. However, apart from the regular park, which was indicated with similar frequency by men and women, the other two were significantly more often indicated by women. The highest difference in indications per person was responses regarding green playgrounds – and this rate was almost two times higher for women than for men's selections. In general, women, more often than men, indicated types of greenery that can be connected with upgrading the aesthetic value of the space. It refers to pocket parks, green squares, or green roofs/walls. On the other hand, more often than women, men proposed green areas connected with infrastructure – green parking lots or water retention ponds.

Table 4. Points indicated per respondent regarding proposed green areas.

	Average number of indicated points per respondent*		Total number of indicated points	
	Men	Women	Men	Women
Green parking lot	0.46	0.39	76	37
Green playground	0.72	1.38	118	132
Green roof/wall	0.55	0.82	91	79
Green square	0.48	0.64	79	61
Park	0.87	0.85	143	82
Pocket park	0.39	0.58	64	56
Rain garden	0.34	0.79	56	76
Retention pond	0.33	0.18	55	17

* Respondents could indicate a maximum of three locations in each category.
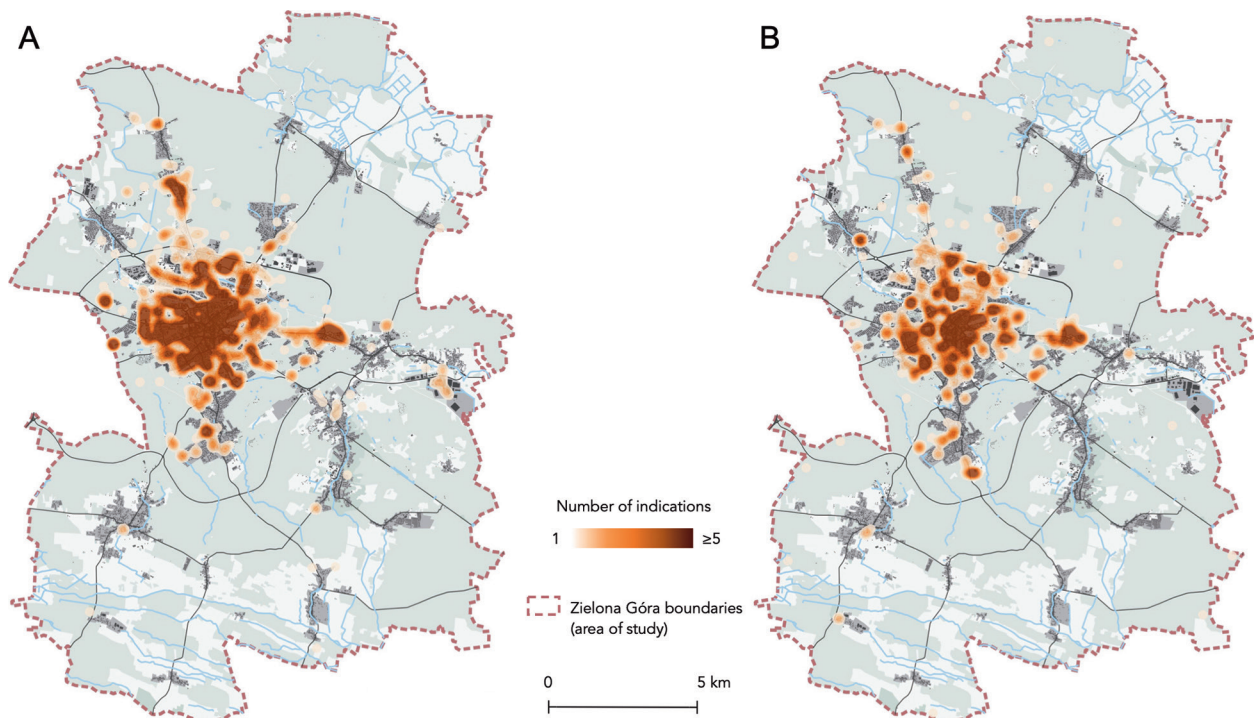Source: authors' own elaboration.

Fig. 6. Proposed locations of new green areas in Zielona Góra: A – men, B – women.
Source: authors' own elaboration.
Reference data: OpenStreetMap contributors (https://www.openstreetmap.org/copyright).

Given the differences in preferred locations for new green spaces, those indicated by women were concentrated closer to the city centre (Fig. 6). Simultaneously, sites selected by men seem to be more widely spread and scattered. Therefore, the Nearest Neighbor Index (NNI) was used as an additional tool to measure the spatial distribution of all the respondents' indications and see if it is regular, random or clustered (Clark, Evans 1954). Again, the data distribution proved to be clustered. At the same time, the respondents' gender appeared within the clustering results as an essential grouping characteristic (see Table 3). The NNI values for both women (0.73) and men (0.63) were <1, which once more indicated the existence of clusters, and a slightly more clustered data distribution for men, which appeared to be a more internally consistent group.

Importantly, all the measures used do not relate directly to the respondents' places of residence but only indicate their transport preferences and characteristics of green spaces of their choice.

Discussion and conclusions

The research reveals commonalities and differences among men and women in preferences regarding visited green areas that were raised in research questions related not only to types of visited green areas, but also mobility patterns of reaching them and preferences on the development of new urban greenery. In general, there were fewer preferred locations indicated by men than women that were assumed as relevant regarding the share of indications. It can be justified by differences in the nature of the places visited that were characterised by the largest difference between men and women. Despite the similarities regarding the most representative and highly maintained urban green public spaces, there were also differences with respect to the level of naturalness (higher level was more popular among men), equipment for rest and children (more popular among women), and distance from the place of living (shorter for women). As a result, green areas that were more popular among men were at the same time larger in size, with a high level of naturalness and more distant from the city centre. On the other hand, women more often chose green areas closer to their place of living, which may affect higher diversity of indicated places. However, it should be noted that according to Wang et al. (2015), the imagined availability of urban green areas is more important than the geographical one. It concerns, e.g. available time and ability to cover certain distances, motivation to visit them and ease of access (Lachowycz, Jones 2013).

According to Van den Berg et al. (2003), adequate accessibility to green spaces within walking distance is important for mental health (see also: Kaplan 2001; Sullivan et al. 2004; Lee, Maheswaran 2010; Bratman et al. 2012; Wood et al. 2017). It relates to stress reduction and overall regeneration in contact with nature and being physically active in the natural environment (Lee, Maheswaran 2010; Ward Thompson et al. 2012). Also, social interactions can be facilitated by the availability of green areas (Kaźmierczak 2013; Wolch et al. 2014). As the result of our study, it can be assumed that despite the similar supply of green areas among men and women, individual choices may also play an important role regarding the exposure to benefits provided by green areas. Research conducted in Sweden has shown that women are more likely to undertake activities in urban green areas (Sang et al. 2016) and contact with greenery has a more significant impact on their mental well-being than it is the case with men. At the same time, as evidenced by research conducted in Canada by Kaczynski et al. (2009), the proximity of green areas is conducive to physical activity among women. Green areas are of great importance for people's well-being, and research by Van den Berg et al. (2014) showed that natural greenery had the most considerable influence. However, according to the results obtained by the authors, natural green areas in Zielona Góra were visited mainly by men. In Zielona Góra, it could be associated with a greater distance of such areas from residential districts, requiring car travel and more free time, which can be linked to previous research on the most popular mode of transport among men and women (Miralles-Guasch et al. 2015; Sánchez, González 2016; Nosal-Hoy 2018) and leisure time availability (Rubiano-Matulevich, Viollaz 2019). Specific interpretations of the higher popularity of natural green areas among men can also be found in the results of earlier research conducted

by Polko and Kimic (2022), which showed that women's sense of security in green areas of a disordered or poorly maintained nature was lower than that of men's. It may suggest that natural green areas that are not maintained in an organised manner may be less comfortable spaces for women.

The study results show that specific groups of respondents, defined through data analysis and clustering, have specific preferences associated with their gender. For example, when visiting urban green areas, most women prefer individual means of close-range transport, while men are more likely to choose public transport and travel longer distances. Travelling by car during leisure time is rare for both genders. However, it is noticeably more common among men, which can be related to general preferences for using that mode of transport (Nosal-Hoy 2018). Notably, using public transport for recreational purposes is marginal for men and women who visit green spaces. Bicycle riding is highly preferable; a large group of cyclists, among men and women, use bicycles almost exclusively as their preferred means of transport. Two distinct groups of women-only and men-only prefer to travel on foot (in relatively close range) and visibly share their preferences for other means of transport.

The study revealed both similarities and differences between men and women with respect to the last research question on preferences for the development of new urban green areas. There are similarities in relation to the most often proposed types of new areas; however, there is a difference in the level of their importance for the representatives of the surveyed genders. The difference in this regard was in relation to green playgrounds and green roofs or walls. We can refer first of all to the consequences of the traditional caring role of women in the family (Ministry of Family and Social Policy, 2019; Suwada 2021), and other studies by, e.g. Sonti et al. (2020), whereby women more often than men visit green areas with children. Second of all, women pay more attention to the maintenance of space (Polko, Kimic 2022), and such investments or interventions as green walls or roofs in the case of disorder (e.g. damaged building facade) affect the aesthetic value of the area.

According to Labus (2015), spatial planning often neglects different ways in which women and men utilise urban space, which also concerns green areas. Efforts to create equal conditions for the use of green areas are pivotal, as outlined in the UN's 2030 Sustainable Development Goals Agenda (United Nations 2015). In the Polish context, highlighting the distinct needs of women and men and opportunities regarding leisure in green areas is crucial—taking into consideration various roles they play in family life and their implications. Given the absence of gender parity in decision-making at various governmental levels in Poland (Europe Institute for Gender Equality 2023), there is a need for greater emphasis on gender representativeness to address the needs of all genders effectively. Tools that help identify various needs are necessary, as pointed out by Carpio-Pinedo et al. (2019), and the geo-questionnaire used in our research may be significant in this regard.

Considering the aforementioned, our study significantly highlights the necessity of recognising and understanding gender differences in preferences related to urban green spaces. These identified distinctions are imperative for public participation processes in Poland, warranting increased awareness and sensitivity towards varied needs and expectations of both men and women. These differences not only illuminate divergent female and male expectations and ways of using urban green spaces but also emphasise the importance of inclusivity and representation in public participation. These findings make it clear that for more effective and inclusive public participation and decision-making processes in the realm of urban planning in Poland, genuine effort is required to acknowledge and incorporate these gender-based preferences and needs. Furthermore, our insights are crucial for enhancing the gender mainstreaming process in Poland, providing valuable data that can be instrumental in developing policies and strategies that are truly reflective of and responsive to the diverse needs of the population, thereby fostering a more inclusive and participatory approach to urban green space planning and management.

In conclusion, our study emphatically highlights the necessity of acknowledging gender-based distinctions in preferences pertaining to urban green spaces. In the light of our findings, we propose the following considerations for spatial planning policies regarding green areas:

1. Efforts should be made to create multifunctional green areas of various types, resulting in a greater diversity of their users as preferences differ. This approach not only accommodates the diverse needs and preferences of both genders but also ensures that urban green spaces are inclusive and accessible to all.

2. Preferences in terms of visited green areas are related to the distance from the place of residence. For this reason, the priority seems to be to create as many publicly accessible green areas as possible and not only to increase the total area of greenery in the city (e.g. by enlarging the existing ones). This approach aims to plan green areas to increase their accessibility for people (especially women) who, more often than men, visit areas closer to their place of residence.

3. Particular attention should be paid to improving accessibility of both closer and more distant green areas to appeal to both genders. The development of a well-connected network of bicycle paths and convenient public transport options is essential for improving access to green spaces located farther from the city centre, catering to the preferences and needs of both genders.

It is imperative to acknowledge that there is a noted similarity in the preferences and urban green space usage patterns between women and elderly individuals, as evidenced by previous studies. This parallel suggests that the insights gleaned from women's preferences might be extrapolated and applied to broader demographic groups (de Vries et al. 2003). Concurrently, the universal appeal of well-maintained, accessible areas that offer a myriad of activities underscores the need for these spaces to be prioritised in urban planning initiatives. Moving forward, future research endeavours should cast their net wider in terms of socio-demographic factors examined, including but not limited to marital status and parental status. This broader approach will yield more comprehensive and nuanced insights into the intricate interplay between familial roles and green space usage patterns. Despite the acknowledged limitations of our study, chiefly the non-random participant selection and significant gender representation disparity, our preliminary findings provide a valuable foundation for further discourse and study on the gender perspective in urban greenery. More importantly, these initial insights offer tangible, actionable recommendations for spatial planning processes in Polish cities, with a spotlight on enhancing gender representation in public consultations. The primary takeaway from our study is the unveiling of new premises pivotal for the actualisation of gender mainstreaming policies within local governmental structures in Poland.

References

Alexandri E., Jones P., 2008. Temperature decreases in an urban canyon due to green walls and green roofs in diverse climates. *Building and Environment* 43(4): 480–493. DOI 10.1016/j.buildenv.2006.10.055.

Ambrey C.L., Fleming C.M., 2014. Public greenspace and life satisfaction in urban Australia. *Urban Studies* 51(6): 1290–1321. DOI 10.1177/0042098013494417.

Annerstedt M., Östergren P.O., Björk J., Grahn P., Skärbäck E., Währborg P., 2012. Green qualities in the neighbourhood and mental health – results from a longitudinal cohort study in Southern Sweden. *BMC Public Health* 12: 337. DOI 10.1186/1471-2458-12-337.

Astell-Burt T., Mitchell R., Hartig T., 2014. The association between green space and mental health varies across the lifecourse. A longitudinal study. *Journal of Epidemiology and Community Health* 68: 578. DOI 10.1136/jech-2013-203767.

Balai Kerishnan P., Maruthaveeran S., 2021. Factors contributing to the usage of pocket parks – A review of the evidence. *Urban for Urban Greening* 58: 126985. DOI 10.1016/j.ufug.2021.126985.

Bektas A., Schumann R., 2019. How to optimize gower distance weights for the k-Medoids clustering algorithm to obtain mobility profiles of the Swiss population. In: *6th Swiss Conference on Data Science (SDS)* 51–56. DOI 10.1109/SDS.2019.000-8.

Belčáková I., Slámová M., Demovičová Z., 2022. Importance of urban green areas in the context of current and future global changes: Lessons learned from a case study in Bratislava (Slovakia). *Sustainability* 14(22): 14740. DOI 10.3390/su142214740.

Biernacka M., Kronenberg J., 2019. Urban green space availability, accessibility and attractiveness, and the delivery of ecosystem services. *Cities and the Environment (CATE)* 12(1): 5.

Bowler D.E., Buyung-Ali L., Knight T.M., Pullin A.S., 2010. Urban greening to cool towns and cities: A systematic review of the empirical evidence. *Landscape and Urban Planning* 97(3): 147–155. DOI 10.1016/j.landurbplan.2010.05.006.

Bratman G.N., Hamilton J.P., Daily G.C., 2012. The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences* 1249: 118–136. DOI 10.1111/j.1749-6632.2011.06400.x.

Brown G., Kyttä M., 2014. Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. *Applied Geography* 46: 122–136. DOI 10.1016/j.apgeog.2013.11.004.

Buijs A., Mattijssen T.J.M., Van der Jagt A.P.N., Ambrose-Oji B., Andersson E., Elands B.H.M., Steen Møller M., 2016. Active citizenship for urban green infra-structure: Fostering the diversity and dynamics of citizen contributions through mosaic governance. *Current Opinion in Environmental Sustainability* 22: 1–6. DOI 10.1016/j.cosust.2017.01.002.

Carpio-Pinedo J., de Gregorio Hurtado S., de Madariaga I.S., 2019. Gender mainstreaming in urban planning: The potential of geographic information systems and open data sources. *Planning Theory and Pratice* 20(2): 221–240. DOI 10.1080/14649357.2019.1598567.

Caula S., Hvenegaard G.T., Marty P., 2009. The influence of bird information, attitudes, and demographics on public preferences toward urban green spaces: The case of Montpellier, France. *Urban Forestry & Urban Greening* 8: 117–128. DOI 10.1080/14649357.2019.1598567.

Cerin E., Vandelanotte C., Leslie E., Merom D., 2008. Recreational facilities and leisure-time physical activity: An analysis of moderators and self-efficacy as a mediator. *Health Psychology* 27(2), Suppl: 126–135. DOI 10.1037/0278-6133.27.2.

Chen K., Zhang T., Liu F., Zhang Y., Song Y., 2021. How does urban green space impact residents' mental health: A literature review of mediators. *International Journal of Environmental Research and Public Health* 18(22): 11746. DOI 10.3390/ijerph182211746.

Chidambaram B., Scheiner J., 2021. Work-trip mode choice in Germany – Affected by individual constraints or by partner interaction? *Travel Bahaviour and Society* 24: 231–244. DOI 10.1016/j.tbs.2021.04.007.

Clark P. J., Evans F. C., 1954. Distance to nearest neighbour as a measure of spatial relationships in populations. *Ecology* 35: 445–453.

Codina N., Pestana J.V., 2019. Time matters differently in leisure experience for men and women: Leisure dedication and time perspective. *International Journal of Environmental Research and Public Health* 16(14): 2513. DOI 10.3390/ijerph16142513.

Cohen D.A., McKenzie T.L., Sehgal A., Williamson S., Golinelli D., Lurie N., 2007. Contribution of public parks to physical activity. *American Journal of Public Health* 97: 509–514. DOI 10.2105/AJPH.2005.072447.

Council of Europe, 1998. *Gender mainstreaming: Conceptual framework, methodology and presentation of good practices*. Online: https://www.unhcr.org/3c160b06a.pdf (accessed 16 January 2023).

Craig W.J., Harris T.M., Weiner D., 2002. *Community participation and geographic information systems*. Taylor & Francis, London.

Czarnecki D., Skalski D.W., Kreft P., Kaszowska M., Nikolenko O., 2023. Aktywność fizyczna kobiet i mężczyzn w czasie wolnym od pracy (Physical activity of women and men in the time off work). *Rehabilitation and Recreation* 14: 151–157. DOI 10.32782/2522-1795.2023.14.17.

de Vries S., Verheij R.A., Groenewegen P.P., Spreeuwenberg P., 2003. Natural environments—healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment and Planning A* 35: 1717–1731. DOI 10.1068/a35111.

dos Santos T.R.L., Zárate L.E., 2012. GCA: An algorithm based on the gower similarity for clustering of categorical variables. XXXVIII *Conferencia Latinoamericana En Informatica* (CLEI), 1–6. DOI 10.1109/CLEI.2012.6427180.

Dubicki P., Kułyk P., 2018. Proces integracji miasta z gminą miejską. Przykład Zielonej Góry (The process of urban–rural integration. Using the example of Zielona Góra). *Studia Miejskie* 32: 113–124. DOI 10.25167/sm2018.032.08.

Ettema D., Friman M., Gärling T., Olsson L.E., 2016. *Mobility, sociability and well-being of urban living*. Springer Berlin Heidelberg, Berlin, Heidelberg: 129–150. DOI 10.1007/978-3-662-48184-4_7.

Europe Institute for Gender Equality, 2023. Gender Statistics Database. Online: https://eige.europa.eu/gender-statistics/dgs/browse/wmidm/wmidm_pol/wmidm_pol_gov (accessed 12 April 2023).

Evensen K. H., Hemsett G., Nord H., 2021. Developing a place-sensitive tool for park-safety management experiences from green-space managers and female park users in Oslo. *Urban Forestry & Urban Greening* 60: 127057. DOI 10.1016/j.ufug.2021.127057.

Fok K.W.K., Law W.W.Y., 2018. City re-imagined: Multi-stakeholder study on branding Hong Kong as a city of greenery. *Journal of Environmental Management* 206: 1039–1051. DOI 10.1016/j.jenvman.2017.11.045.

Frändberg L., Vilhelmson B., 2011. More or less travel: Personal mobility trends in the Swedish population focusing gender and cohort. *Journal of Transport Geography* 19(6): 1235–1244. DOI 10.1016/j.jtrangeo.2011.06.004.

Galindo M.P.G., Corraliza J.A., 2000. Environmental aesthetics and psychological wellbeing: Relationships between preference judgements for urban landscapes and other relevant affective responses. *Psychology in Spain* 4: 13–27.

Goel R., Oyebode O., Foley L., Tatah L., Millett Ch., Woodcock J., 2023. Gender differences in active travel in major cities across the world. *Transportation* 50: 733–749. DOI 10.1007/s11116-021-10259-4.

Gower J.C., 1967. A comparison of some methods of cluster analysis. *Biometrics* 23(4): 623–637. DOI 10.2307/2528417.

Gower J.C., 1971. A general coefficient of similarity and some of its properties. *Biometrics* 27: 857–874. DOI 10.2307/2528823.

Gryl I., Jekel T., Donert K., 2010. Geoinformation and spatial citizenship. *Learning with Geoinformation* V: 2-11.

Guzman L.A., Arellana J., Oviedo D., Moncada Aristizábal C.A., 2021. COVID-19, activity and mobility patterns in Bogota. Are we ready for a '15-minute city'? *Travel Behaviour and Society* 24: 245–256. DOI 10.1016/j.tbs.2021.04.008.

Haklay M., Singleton A., Parker C., 2008. Web mapping 2.0: The neogeography of the geoweb. *Geography Compass* 2(6): 2011–2039.

Head Office of Geodesy and Cartography (GUGiK), 2022. *Państwowy Rejestr Granic – jednostki administracyjne 2022* (State Register of Borders administrative units 2022). Online: https://opendata.geoportal.gov.pl/prg/granice_archiwalne/PRG_jednostki_administracyjne_2022.zip (accessed 31 January 2023).

Henning S., Vogler R., Gryl I., 2013. Spatial education for different user groups as a prerequisite for creating a spatially enabled society and leveraging SDI. *International Journal of Spatial Data Infrastructures Research* 8: 98–127.

Jakubiec D., Kornafel D., Cygan A., Górska-Kłęk L., Chromik K., 2015. Lifestyle of students from different universities in Wrocław, Poland. *Roczniki Państwowego Zakładu Higieny* (Yearbooks of the National Institute of Hygiene) 66(4): 337–344.

Jorgensen A., Hitchmough J., Calvert T., 2002. Woodland spaces and edges: Their impact on perception of safety

and preference. *Landscape Urban Planning* 60(3): 135–50. DOI 10.1016/S0169-2046(02)00052-X.

Kaczmarek T., Kołodziejczak A.K., Mikuła Ł., 2022. Transformation of the urban and rural system. In: Churski P., Kaczmarek T. (eds), *Three decades of Polish socio-economic transformations: Geographical perspectives*. Cham, Springer International Publishing: 279–304. DOI 10.1007/978-3-031-06108-0_12.

Kaczynski A.T., Potwarka L.R., Smale B.J.A., Havitz M.E., 2009. Association of parkland proximity with neighborhood and park-based physical activity: Variations by gender and age. *Leisure Sciences* 31: 174–191. DOI 10.1080/01490400802686045.

Kaplan R., 2001. The nature of the view from home: Psychological benefits. *Environment and Behavior* 33: 507–542. DOI 10.1177/00139160121973115.

Kaufman L., Rousseeuw P.J., 1987. Clustering by means of medoids. In: Dodge Y. (ed.), *Statistical Data Analysis Based on the L1-norm and Related Methods*. North-Holland: 405–416.

Kaufman L., Rousseeuw P. J., 1990. *Finding groups in data: An introduction to cluster analysis*. Wiley, New York.

Kaźmierczak A., 2013. The contribution of local parks to neighbourhood social ties. *Landscape and Urban Planning* 109: 31–44. DOI 10.1177/00139160121973115.

Kronenberg J., Łaszkiewicz E., Sziło J., 2021. Voting with one's chainsaw: What happens when people are given the opportunity to freely remove urban trees? *Landscape and Urban Planning* 209: 104041. DOI 10.1016/j.landurbplan.2021.104041.

Lachowycz K., Jones A.P., 2013. Towards a better understanding of the relationship between greenspace and health: Development of a theoretical framework. *Landscape and Urban Planning* 118: 62–69. DOI 10.1016/j.landurbplan.2012.10.012.

Labus A., 2015. Strategie równości płci w kontekście zrównoważonego planowania przestrzeni publicznych (Gender mainstreaming strategy in the context of sustainable planning of public spaces). In: Klasik A., Kuźnik F. (eds), Rozwój obszarów miejskich w polityce regionów (Development of urban areas in regional policy). *Studia Komitetu Przestrzennego Zagospodarowania Kraju PAN* 164. Polish Academy of Sciences PAN, Warsaw: 362–382.

Lee A.C.K., Maheswaran R., 2010. The health benefits of urban green spaces: A review of the evidence. *Journal of Public Health* 33(2): 212–222. DOI 10.1093/pubmed/fdq068.

Legutko-Kobus P., Nowak M., Petrisor A., Bărbulescu D., Craciun C., Gârjoabă A., 2023. Protection of environmental and natural values of urban areas against investment pressure: A case study of Romania and Poland. *Land* 12(1): 245. DOI 10.3390/land12010245.

Maas J., Spreeuwenberg P., van Winsum-Westra M., Verheij R.A., Vries S., Groenewegen P.P., 2009. Is green space in the living environment associated with people's feelings of social safety? *Environmental Planning* 41: 1763–1777. DOI 10.1068/a4196.

Mabelis A.A., Maksymiuk G., 2009. Public participation in green urban policy: Two strategies compared. *International Journal of Biodiversity Science & Management* 5(2): 63–75. DOI 10.1080/17451590902978251.

MacKerron G., Mourato S., 2013. Happiness is greater in natural environments. *Global Environtal Changes* 23: 992–1000. DOI 10.1016/j.gloenvcha.2013.03.010.

Magrinyà F., Mercadé-Aloy J., Ruiz-Apilánez B., 2023. Merging green and active transportation infrastructure towards an equitable accessibility to green areas: Barcelona green axes. *Land* 12: 919. DOI 10.3390/land12040919.

Mahrous A.M., Mustafa Y.M., Abou El-Ela M.A., 2018. Physical characteristics and perceived security in urban parks: Investigation in the Egyptian context. *Ain Shams Engeneeiring Journal* 9(4): 3055–66. DOI 10.1016/j.asej.2021.04.016.

Mattingly M.J., Bianchi S.M., 2003. Gender differences in the quantity and quality of free time: The U.S. experience. *Social Forces* 81(3): 999–1030.

Ministry of Family and Social Policy, 2019. *Urlopy dla rodziców w 2019* (Parental leave in 2019). Online: https://www.gov.pl/web/rodzina/urlopy-dla-rodzicow-w-2019-najnowsze-dane (accessed 12 April 2023)

Miralles-Guasch C., Melo M.M., Marquet O., 2015. A gender analysis of everyday mobility in urban and rural territories: From challenges to sustainability. *Gender, Place & Culture* 23(3): 398–417. DOI 10.1080/0966369X.2015.1013448.

Nosal-Hoy K., 2018. Czynnik płci w zachowaniach komunikacyjnych (The gender factor in communication behaviours). *Transport Miejski i Regionalny* 5: 5–11.

Ode A., Fry G., Tveit M.S., Messager P., Miller D., 2009. Indicators of perceived naturalness as drivers of landscape preference. *Journal of Environmental Management* 90: 375–383. DOI 10.1016/j.jenvman.2007.10.013.

OpenStreetMap Contributors, 2023. *OpenStreetMap Data*. Online: https://planet.openstreetmap.org (accessed 31 January 2023).

Polko P., Kimic P., 2022. Gender as a factor differentiating the perceptions of safety in urban parks. *Ain Shams Engineering Journal* 13: 101608. DOI 10.1016/j.asej.2021.09.032.

Reynolds A.P., Richards G., Rayward-Smith V.J., 2004. The application of K-Medoids and PAM to the clustering of rules. In: Yang Z.R., Yin H., Everson R.M. (eds), *Intelligent Data Engineering and Automated Learning – IDEAL 2004. Lecture Notes in Computer Science*, vol 3177. Springer, Berlin, Heidelberg. DOI 10.1007/978-3-540-28651-6_25.

Rousseeuw P.J., 1987. Silhouettes: A graphical aid to the interpretation and validation of cluster analysis. *Journal of Computational and Applied Mathematics* 20: 53–65. DOI 10.1016/0377-0427(87)90125-7.

Rubiano-Matulevich E.C., Viollaz M., 2019. Gender differences in time use: Allocating time between the market and the household. *Policy Research working paper*, WPS 8981, World Bank Group. Online: http://documents.worldbank.org/curated/en/555711565793045322/Gender-Differences-in-Time-Use-Allocating-Time-between-the-Market-and-the-Household (accessed 5 April 2023)

Sanesi G., Charello F., 2006. Residents and urban green spaces: The case of Bari. *Urban Forestry and Urban Greening* 4(3–4): 125–134. DOI 10.1016/j.ufug.2005.12.001.

Sang A.O., Knez I., Gunnarsson B., Hedblom M., 2016. The effects of naturalness, gender, and age on how urban green space is perceived and used. *Urban Forestry & Urban Greening* 18(1): 268–276. DOI 10.1016/j.ufug.2016.06.008.

Santos T., Mendes R.N., Vasco A., 2016. Recreational activities in urban parks: Spatial interactions among users. *Journal of Outdoor Recreation and Tourism* 15: 1–9. DOI 10.1016/j.jort.2016.06.001.

Sánchez M.I.O., González E.M., 2016. Gender differences in commuting behavior: Women's greater sensitivity. *Transportation Research Procedia* 18: 66–72. DOI 10.1016/j.trpro.2016.12.009.

Scheiner J., Holz-Rau C., 2017. Women's complex daily lives: A gendered look at trip chaining and activity pattern entropy in Germany. *Transportation* 44: 117–138. DOI 10.1007/s11116-015-9627-9.

Schindler M., Le Texier M., Caruso G., 2022. How far do people travel to use urban green space? A comparison of three European cities. *Applied Geography* 141: 102673. DOI 10.1016/j.apgeog.2022.102673.

Schipperijn J., Ekholm O., Stigsdotter U.K., Toftager M., Bentsen P., Kamper-Jørgensen F., Randrup T.B., 2010. Factors influencing the use of green space: Results from a Danish national representative survey. *Landscape and Urban Planning* 95: 130–137. DOI 10.1016/j.landurbplan.2009.12.010.

Seresinhe C.I., Preis T., MacKerron G., Moat H.S., 2019. Happiness is greater in more scenic locations. *Scientific Reports* 9(1): 1–11. DOI 10.1038/s41598-019-40854-6.

Shahapure K.R., Nicholas C., 2020. Cluster Quality Analysis Using Silhouette Score. In 2020 IEEE 7th International Conference on Data Science and Advanced Analytics (DSAA), Sydney, NSW, Australia: 747–748. DOI 10.1109/DSAA49011.2020.00096.

Sieber R., 2006. Public participation geographic information systems: A literature review and framework. *Annals of the Association of American Geographers* 96(3): 491–507. DOI 10.1111/j.1467-8306.2006.00702.x.

Sonti N.F., Campbell L.K., Svedsen E.S., Johnson M.L., Auyeung D.S., 2020. Fear and fascination: Use and perceptions of New York City's forests, wetlands, and landscaped park areas. *Urban Forestry & Urban Greening* 49: 126601. DOI 10.1016/j.ufug.2020.126601.

Statistics Poland, n.d. *Local Data Bank*. Online: https://bdl.stat.gov.pl/bdl/start (accessed 16 January 2023).

Struyf A., Hubert M., Rousseeuw P.J., 1997. Integrating robust clustering techniques in S-PLUS. *Computational Statistics and Data Analysis* 26: 17–37. DOI 10.1016/S0167-9473(97)00020-0.

Sullivan W.C., Kuo F.E., Depooter S.F., 2004. The fruit of urban nature: Vital neighborhood spaces. *Environment and Behavior* 36: 678–700. DOI 10.1177/0193841X04264945.

Supreme Audit Office (Najwyższa Izba Kontroli), 2022. Zachowanie i zwiększanie terenów zielonych w miastach. LLU.410.003.03.2021 Nr ewid. 172/2021/P/21/074/LLU. https://www.nik.gov.pl/plik/id,25648,vp,28421.pdf (accessed 3 April 2023).

Sutton R.M., Farrall S., 2004. Gender, socially desirable responding and the fear of crime: Are women really more anxious about crime? *The British Journal of Criminology* 45(2): 212–24. DOI 10.1093/bjc/azh084.

Suwada K., 2021. *Parenting and work in Poland: A gender studies perspective*. Springer Nature, Switzerland: 107.

Tang J., Li S., 2022. Can public participation promote regional green innovation? — Threshold effect of environmental regulation analysis. *Heliyon* 8: 11157.

Tiwari A., Kumar P., Kalaiarasan G., Ottosen T., 2021. The impacts of existing and hypothetical green infrastructure scenarios on urban heat island formation. *Environmental Pollution* 274: 115898. DOI 10.1016/j.envpol.2020.115898.

Tyrväinen L., Mäkinen K., Schipperijn J., 2007. Tools for mapping social values of urban woodlands and other green areas. *Landscape and Urban Planning* 79(1): 5–19. DOI 10.1016/j.landurbplan.2006.03.003.

United Nations, 2015. *Transforming our world: The 2030 agenda for sustainable development*. Online: https://sdgs.un.org/2030agenda (accessed 16 January 2023).

Van den Berg A.E., Jorgensen A., Wilson E.R., 2014. Evaluating restoration in urban green spaces: Does setting type make a difference? *Landscape and Urban Planning* 127: 173–181. DOI 10.1016/j.landurbplan.2014.04.012.

Van den Berg A.E., Koole S.L., Van Der Wulp N.Y., 2003. Environmental preference and restoration: (How) are they related? *Journal of Environmental Psychology* 23: 135–146. DOI 10.1016/S0272-4944(02)00111-1.

Van der Maaten L., Hinton G., 2008. Visualizing data using t-SNE. *Journal of Machine Learning Research* 9: 2579–2605.

Wang D., Brown G., Liu Y., Mateo-Babiano I., 2015. A comparison of perceived and geographic access to predict urban park use. *Cities* 42: 85–96. DOI 10.1016/j.cities.2014.10.003.

Wang R., Helbich M., Yao Y., Zhang J., Liu P., Yuan Y., Liu Y., 2019. Urban greenery and mental wellbeing in adults: Cross-sectional mediation analyses on multiple pathways across different greenery measures. *Environmental Research* 176: 108535. DOI 10.1016/j.envres.2019.108535.

Ward Thompson C., Roe J., Aspinall P., Mitchell R., Clo A., Miller D., 2012. More green space is linked to less stress in deprived communities: Evidence from salivary cortisol patterns. *Landscape and Urban Planning* 105: 221–229. DOI 10.1016/j.landurbplan.2011.12.015.

Williams T., Logan T.M., Zuo C.T., Liberman K.D., Guikema S., 2020. Parks and safety: A comparative study of green space access and inequity in five US cities. *Landscape and Urban Planning* 201: 103841. DOI 10.1016/j.landurbplan.2020.103841.

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'. *Landscape and Urban Planning* 125: 234–244. DOI 10.1016/j.landurbplan.2014.01.017.

Wood L., Hooper P., Foster S., Bull F., 2017. Public green spaces and positive mental health – investigating the relationship between access, quantity and types of parks and mental wellbeing. *Health & Place* 48: 63–71. DOI 10.1016/j.healthplace.2017.09.002.

Wójcicki M., 2018. *Formy i zakres partycypacji społecznej w procesie planowania przestrzennego w Poznaniu* (Forms and scopes of public participation in spatial planning in Poznań city). Biblioteka Aglomeracji Poznańskiej 31, Bogucki Wydawnictwo Naukowe, Poznań.

Wu J., Xu Z., Jin Y., Chai Y., Newell J., Ta N., 2022. Gender disparities in exposure to green space: An empirical study of suburban Beijing. *Landscape and Urban Planning* 222: 104381. DOI 10.1016/j.landurbplan.2022.104381.

Wu W., Dong G., Sun Y., Yun Y., 2020. Contextualized effects of park access and usage on residential satisfaction: A spatial approach. *Land Use Policy* 94: 104532. DOI 10.1016/j.landusepol.2020.104532.

Appendix 1. Geo-questionnaire questions

Dimension	Questions
Characteristics of respondent	What is your gender? (closed-ended) 1 = Woman 2 = Man 3 = Non-binary 4 = Prefer not to answer What is your age? • Selection from a list What is your education level? (closed-ended) 1 = Primary 2 = Lower secondary 3 = Vocational 4 = Secondary 5 = Higher Please mark on the map your approximate place of residence. Indication on the map
Visited urban green areas	Please mark on the map the urban green areas you visit most often. You can mark up to three locations. • Indication on the map Which means of transport do you usually use to visit urban green areas? Choose one. (closed-ended) 1 = On foot 2 = Bicycle 3 = Car 4 = Bus (public transport) 5 = Other
Preferred new urban green areas	Please mark on the map the locations of the new urban green areas you propose to create. You can mark up to three locations. • Indication on the map What type of urban green area would you like to be created in this place? (closed-ended) 1 = Green parking lot 2 = Green playground 3 = Green roof/wall 4 = Green square 5 = Park 6 = Pocket park 7 = Rain garden 8 = Retention pond 9 = Other: …