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The Methodology for Assessing the 15 Minute Age-Friendly Walkability (AFW) of Urban Public Spaces

Elżbieta Zysk [1,*] and Katarzyna Zalewska [2]

[1] Department of Real Estate and Urban Studies, Faculty of Geoengineering, University of Warmia and Mazury, 10-719 Olsztyn, Poland
[2] Urząd Miasta Ostrołęka Ostroleka City Hall, 07-400 Ostrołęka, Poland; katzal404@wp.pl
* Correspondence: elzbieta.zysk@uwm.edu.pl

Abstract: Recent decades have witnessed noticeable demographic changes around the world. The global population has continued to increase steadily and, according to forecasts, the trend will be maintained in the coming decades. An increase in the 60+ population is yet another important demographic change. These determinants pose new challenges for socio-economic, spatial, and transport policies in most, if not all, cities in the world. These policies should be aligned with the global development paradigm to promote sustainable development and sustainable improvement of the quality of life of the present and future generations. In the coming years, the potential of cities should be recognized, resources should be managed rationally, effective spatial policies should be implemented, and user-friendly spaces should be created to promote the development of effectively managed urban areas. Cities are often compared to living organisms, which is why social mobility is a crucial determinant of urban development and is often used in assessments of cities. To address the above needs, a universal and innovative methodology for assessing the age-friendly walkability (AFW) of urban public spaces was developed and tested in the present study. The methodology was developed based on a review of the current trends in age-friendly cities, a survey of the target population, and a self-designed concept for evaluating the walkability of pedestrian routes in public space. The proposed methodology not only contributes to the existing knowledge but also has practical implications because it was tested in a Polish city to classify the 15 minute walkability of pedestrian routes and to identify Strategic Intervention Areas for the 60+ population (SAI 60+). This innovative approach to walkable urban public spaces is a simple tool for developing senior-friendly planning solutions in cities. The developed paper constitutes a basis for precise spatial planning it is based on reliable data by conducting a full and comprehensive spatial inventory of mobility trajectories of older people walkability. The aim of the undertaken research was to improve the quality of urban residents' lives in the context of Sustainable Development Goal 11 (to make cities and human settlements safe, stable, and sustainable). Above all, the study is congruous with the sustainable urban mobility vision.

Keywords: urban public spaces; age-friendly walkability; age-friendly city; 15 minute city; older people; Strategic Intervention Areas for the 60+ population

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1. Introduction

The last few decades have witnessed noticeable demographic changes around the world, particularly in cities. The implementation of futuristic concepts in cities has the mission of adapting public spaces to society's needs and expectations while assuming their friendliness. Such a concept is 15 minute cities.

The '15-minute' city concept idea is to create cities that are friendly to everyone, i.e., cities that offer the possibility of independence, as the idea is to be able to move along pedestrian routes without having to use public transportation or a car.

New Urbanism (NU) defines the functionality of socially friendly cities by allowing the free movement of the population on pedestrian routes (walking) [1,2] and outdoor activities [3]. NU promotes publicly accessible spaces that are dedicated to diverse recipients and users and are friendly for all social groups [4,5].

According the Kohon [5], the urban public space that is friendly to the elderly will also meet the requirements of other social groups in the city structure.

Therefore, the concept of 15 minute cities should be defined by adequate accessibility criteria dedicated to older people in regard to the pedestrian routes as well.

The present research is particularly relevant because cities form complex systems and population mobility is a key component of the urban environment [6,7]. Complex urban systems require geospatial data and population mobility preference studies to meet the challenges of spatiotemporal data in this new world of tactical experimentation and opportunistic science [8].

The aim of the undertaken research was to improve the quality of urban residents' life in the context of Sustainable Development Goal 11, which states that cities and human settlements should be safe [4] {Citation}, stable, and sustainable. This is particularly important in the context of research on the quality of urban life and the provisions of Standard ISO 37120:2018 "Sustainable cities and communities—Indicators for city services and quality of life" [9,10], with particular emphasis on the safety of movement processes [11]. In the study, two research problems were put forward:

Problem 1. *The 15 minute walkability of the 60+ population should be evaluated and visualized in order to design public spaces in relation to social justice and inclusiveness.*

Problem 2. *Older people's places of residence and 15 minute walkability play a key role in micromobility and are an elementary part of identifying Strategic Areas of Intervention for the 60+ population in the urban public space.*

The proposed methodology has not been studied before in the research literature or in practical textbooks. The identified methodology is a contribution that is not only theoretical but also practical in terms of solutions that can be applied to the design of a friendly walking space [11].

The proposed solution has not been studied before in the research literature or in practical textbooks. The methodology meets an innovative look at the public walking spaces of older people in the city meets the assumptions of age-friendly cities (age-friendly cities [10,12] and the trend of "aging in place" [13] fits into local politics [14–16] and the expectations and needs of the local community [17]).

The identified methodology is a contribution that is not only theoretical but also practical in terms of solutions that can be applied to the design of a friendly walking space.

It is based on a field survey (site visit), a survey conducted in the local community in the city of Olsztyn, Poland, and the use of the landscape assessment method (author's delimitation card) in the context of the age-friendliness of public spaces in the city.

The developed delimitation of age-friendly walkability in urban public spaces offers an innovative approach to designing pedestrian routes that are adapted to the special needs of older citizens and feature the required infrastructure [5]. The needs and expectations of senior citizens can differ in multi-ethnic and multi-cultural cities. Therefore, the proposed method has to be flexible to ensure that it can be easily adapted to the needs of local senior communities and urban spaces [18,19].

Public spaces should be reliably inventoried to create areas that are accessible to disadvantaged groups (older peoples). This goal can be achieved through the delimitation of areas characterized by age-friendly walkability. The results of such inventories can be used to map Strategic Intervention Areas for the 60+ population (SAI 60+), indicating which public spaces need to be adapted to the needs and capabilities of older adults.

The developed paper constitutes a basis for precise spatial planning; it is based on reliable data by conducting a full and comprehensive spatial inventory of the mobility trajectories of older people's walkability.

The final results of this study will contribute to a better understanding of urban processes and will promote the formulation of more realistic conclusions regarding future actions, implementation of innovative solutions, and, above all, creation of senior-friendly public spaces that meet the needs and expectations of the 60+ population. All of the above steps are aimed at creating a model of sustainable and inclusive cities.

2. Literature Review

According to the document The Right to the City concept (UCLG), the future of cities around the world is the '15-minute' city concept. In this concept, 15 minute cities create an arrangement of public space that allows people to access everyday places such as stores, services, and medical and educational facilities within a 15 minute pedestrian walk from their place of living without having to travel by car or public transportation [20]. Included among the goals of 15 minute cities is the creation of a friendly public space [21] for each social group in the urban fabric by eliminating architectural barriers and restrictions in the space. A social group that is successively growing in size worldwide is the elderly.

Public space has been defined by [22] as the space that is a scene of intense social activity and that is accessible to the whole community and outsiders. Accordingly, Kohn [23] has identified three basic attributes of public spaces: ownership (preferably public), wide accessibility, and fostering the communication and interaction of any social group [4,23]. Public space is a challenge in urban planning and should be evaluated in terms of friendliness, especially towards disadvantaged groups (e.g., elderly people) [24–27]. The disadvantaged groups include people at risk of social exclusion due to a disability, people with lower adaptive abilities, those experiencing gender discrimination, people who are more sensitive to external stimuli, or those less mobile and excluded from participating [28] in particular events due to their inability to adapt to the accompanying conditions of urban space, such as having to walk down a dark street, a route requiring crossing a road through an underpass filled with an unpleasant smell, walking through an unguarded park or through an unsafe neighborhood, having to take a longer route due to a lack of ramps or elevators, etc.

It is of crucial importance that the planning process is based on criteria that account for the needs and expectations of different social groups. These criteria should be taken into account in the urban management process to guarantee the high quality of the activities conducted by the local authorities—consistent with the Right to the City concept (UCLG). Local diagnoses play an important role in this process because the notion of an age-friendly city [12] is strongly correlated with the "ageing in place" concept that accounts for the specific needs of various social groups and calls for the implementation of mainstream ageing policies [29] (Figure 1). According to the WHO, "in all countries, and in developing countries in particular, measures to help older people stay healthy and active are a necessity, not a luxury" [30]. This is supported by the work in [31,32], which states that the local environment provides health and mental health benefits to seniors [33,34].

According to a report from the Global Network for Age-friendly Cities and Communities [35], which reviews the network's development in the last decade and outlines strategies for the next decade, "creating age-friendly cities and communities can go a long way in creating environments that both promote health and build and maintain physical and mental capacity across the life-course; and enable people, even when experiencing capacity loss, to continue to do the things they value".

Research on the mobility of the 60+ population in urban public spaces is correlated with the main assumptions of the European Innovation Partnership on Healthy and Active Ageing [36]. Physical activity is regarded as one of the primary determinants of maintaining the long-term health of the population. Regular exercise is one of the key activities that can be undertaken by older adults to maintain health and physical fitness. Healthy ageing is active ageing [37,38].



Figure 1. Age-friendly city (AFC) topic areas. Source: own elaboration based on WHO data [12].

Walking is one of the preferred forms of physical activity among older adults [38]. Walking 10,000 steps daily (5–6 km on foot; taking an average of just over an hour) delivers measurable health benefits, including lower glucose levels and weight loss. This activity can be performed by older adults in any latitude. Walking can be practiced by any age group, including seniors, and it does not require money [39]. Research has suggested that 15 minute of walking per day has a positive impact on the health of seniors [38–40]. In the context of 15 minute cities, conducting research while taking into account the positive aspects of elderly movement and the availability of public spaces is crucial.

The proposed thematic range and research tools have not been addressed by the scientific literature or practical manuals to date. The developed methodology offers an innovative approach to evaluations of safe pedestrian spaces for older people in 15 minute cities. The WHO Age-Friendly Cities Framework [12,15,16,31,36] accounts for the "ageing in place" concept [13] that should be incorporated into local policies [14] and should meet the expectations and needs of local communities [41], including in the context of the social logic of space theory that analyzes the ordered spatial patterns in cities [42]. The present study is an original and novel project in this field that aims to promote the safe mobility of seniors. Similar approaches to assessing the walkability of the urban environment for the 60+ population have never been proposed or applied in practice.

For the needs of this study, it was assumed that old age begins at 60 years in both genders. Reference [10] provides four basic categories of old age: (90+)—oldest-old-lifelong pre-old age; (75–89)—old-old and the oldest-old; (60/65–74)—the young old; (45–59) early old age. In Poland, the statutory retirement age differs between genders and it is set at 60 years for women and 65 years for men. In Polish statistical studies, older people are defined as the population aged 60 and over. The surveyed senior population was divided into the following age groups: 60–74 years, 75–89 years, and over 90 years [43].

The added value of the research conducted is to complete the required knowledge of the necessary architectural elements [34] and technical conditions of a walkable public space while identifying the components that are most relevant and requested by older people in the city's public space.

The verification of the methodology was conducted by testing on a medium-sized Polish city—Olsztyn. The city of Olsztyn fits in with the trend of a growth in the elderly population over the last several years.

3. Research Methods

Various methods and techniques were applied in this study. The first method was a historical analysis of research studies published in recent decades. Research studies and expert reports dedicated to senior-friendly policies, including inventories of public spaces to assess the needs of older adults, were reviewed.

The literature review was followed by a questionnaire survey to identify the needs of the local community and rank the significance of various factors in a mobility delimitation card for every indicator identified in public space.

The proposed methodology applies to the needs of cities with an ageing population. The degree to which urban areas are friendly for elderly citizens is determined by the city's spatial layout, the quality and availability of the urban infrastructure, and the presence of barriers that compromise seniors' daily life activities. These spatial components and their interactions have to be optimized to create senior-friendly urban spaces, in particular pedestrian routes [44].

The results of the survey were validated qualitatively in a field study during which selected pedestrian routes in public spaces were inventoried. The field study involved the service safari technique, which enables the participant to experience a service from a first-person perspective. A camera was used for this purpose. The photographs taken during the field study of urban spaces were used to identify senior-friendly walking routes.

The results were used to analyze public spaces, assign ranks, and determine the walkability of the studied routes. The research stages and the applied methods are presented in Figure 2.

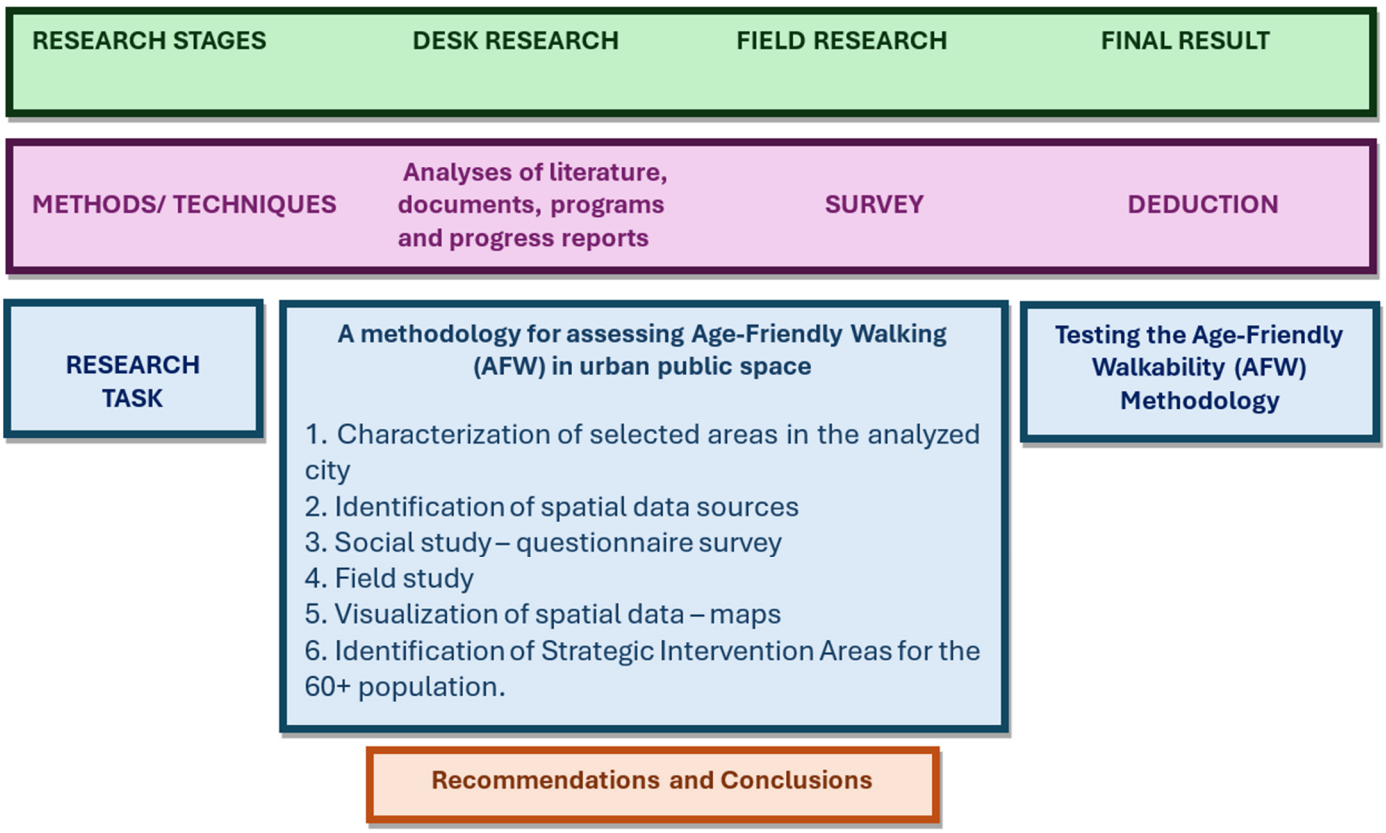


Figure 2. Research stages. Source: own elaboration.

The idea of the indicated methodology is to establish a transparent and objective approach to identifying age-friendly walkability.

Re 1. Characterization of selected areas in the analyzed city

The characteristic features of the analyzed city should be described in the first stage of the study. The following parameters should be identified: location, population density, and general information (natural features, availability of infrastructure, local economy, culture, religion). The identified features are applied to determine the local community's needs, and they are used in successive stages of the analysis [44].

Re 2. Inventory of spatial data sources.

The sources of spatial data should be identified in the delimitation process to determine urban areas that are inhabited by older citizens. High-quality spatial data contribute to the precision of the analysis. According to the literature [13], analyses of specific locations in urban public spaces (such as buildings and focal points) produce the most accurate results. Assessments of senior-friendly public spaces are least accurate when based on entire districts. Therefore, direct inventories of walkability conducted during field studies should account for specific locations (focal points) in urban public space (Figure 3).

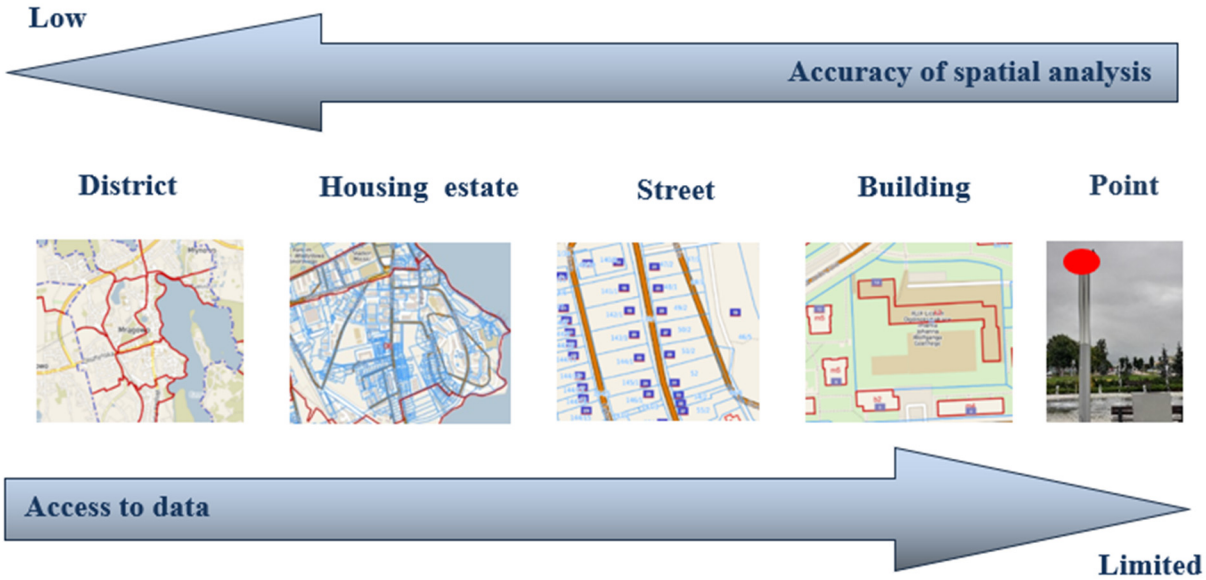


Figure 3. Access to data and precision of spatial analysis. Source: own elaboration.

Re 3. Social study—questionnaire survey.

A questionnaire survey is an effective method for exploring the opinions and characteristic features of the studied population. Questionnaire surveys play an important role in research because they actively engage local community members who are reliable sources of information and can accurately diagnose their place of residence. The problems and challenges faced by the local inhabitants can be effectively identified during social consultations.

3.1. Mobility Delimitation Card

The mobility delimitation card was designed by the authors based on a review of the literature [45–50] and international documents [12,31,36,51]. The proposed mobility delimitation card is a universal solution that can be freely modified and adapted to the needs and expectations of urban communities. The mobility delimitation card includes the items: esthetic appeal and cleanliness, safety, resting places, vibration and noise, trees and landscape, pedestrian routes, and visual and acoustic signals.

The factors selected by seniors from different age groups were ranked as follows: very important (rank 3), important (rank 2), less important (1), not important (rank 0). The ranks should be determined on the basis of a weighted average for each of the diagnosed factors and analyzed groups of seniors.

3.2. Identification of Points of Interest along Pedestrian Routes

The needs of seniors have to be evaluated to identify points of interest along pedestrian routes. The needs of older adults were identified based on the guidelines of the WHO Age-Friendly Cities Framework, aging markers, and research studies on local senior communities conducted by Engineer's and Master's degree students [52–55]. The above guidelines were used to identify points of interest in urban space. These points (buildings, facilities, areas) mark the locations that are most frequently visited by seniors during walking trips to urban public spaces. The identified points of interest, the sources of spatial data, and their locations on a map are presented in Table 1.

Table 1. Seniors' needs, points of interests, data sources, and locations on a map.

Seniors' Needs	Points of Interest	Data Sources
Social integration	Senior clubs and associations, dance venues, cafes, restaurants, parks, botanical gardens, tourist agencies	Cadaster, Land-use plan
Physical fitness	Gyms, swimming pools	Cadaster, Land-use plan
Culture	Cinemas, theaters, museums, galleries, libraries, concert halls, festivals	Land-use plan
Healthcare	Clinics and healthcare centers, outpatient specialist care, hospitals, sanatoria, rehabilitation centers	Land-use plan
Contact with nature	Parks, pocket parks, green infrastructure	Land-use plan, Cadaster
Public amenities	Town hall, social welfare center, housing administration, bank (paying the bills), post office, police station	Land-use plan
Transport	Public transport (bus stops), private car, bike paths, taxi	Land-use plan
Worship	Churches, cemeteries, other objects and places of worship	Land-use plan
Shopping	Supermarkets, local groceries, shops with a specialized product range, such as pharmacies, revenue office	Land-use plan

Source: own elaboration.

3.3. Identification of Senior Residential Areas

The residential areas characterized by the highest proportions of the 60+ population should be identified in the analyzed city. Most seniors age in their place of residence [32,56]. Therefore, the identification of urban districts inhabited by seniors plays an important role in the context of age-friendly walkability. Residential districts with a high share of the senior population can be determined based on information from population databases.

Re 4. Field study.

A field study is a very important part of the undertaken research. Areas that meet the following criteria should be identified during a field study:

a. Areas indicated in the questionnaire survey (housing estate and street);
b. Areas with the highest senior populations in the city;
c. Areas with the highest number of senior activity centers.

Along with the above description, the technical and architectural elements of the pedestrian space that are important from the point of view of the elderly should be identified based on the table delimitation card prepared and developed (Table 2).

Table 2. Walking mobility delimitation card for different age groups.

Items	Previous Studies	No.	Factors—General Description
Esthetic appeal and cleanliness	Sang [57]	1	Cleanliness of pedestrian routes
		2	Trash cans
Safety	WHO, [12,36]	3	Streetlights
		4	Acoustic signals (location)
		5	Sign boards, pictographs, graphic signs
		6	Tactile signs (in Braille)
		7	Direction signs and visual signs
Resting places	Szewczenko [58]	8	Benches and street furniture
		9	Parklets
		10	Canopied shelters
Vibration and noise	Kang [59]	11	No traffic noise
Trees and landscape	Yang [60]	12	Trees
		13	Vegetation, lawns
Pedestrian routes	Yang [60] Kang [59]	14	Non-slip pavement surfaces
		15	Pavements accessible to wheelchairs
		16	No curbs
		17	Pedestrian pavements are adjacent to roads
		18	Pedestrian pavements with matching street furniture (materials, color scheme)
Visual and acoustic signals	WHO, [12,36]	19	Traffic light phasing adapted to senior needs
		20	Acoustic signals and structures adapted to the needs of visually impaired pedestrians

Source: own elaboration.

The mobility delimitation card includes parameters that should be used to determine areas with a high proportion of senior residents and, in the following stage, to identify pedestrian routes that are most often frequented by older adults in the city. The identified pedestrian routes should be linked with the points of interest indicated by the respondents in the questionnaire survey. Each route should be divided into segments characterized by specific focal points to increase the accuracy of the spatial inventory. The length of each section should be determined by the precision of spatial delimitation, and inventories where focal points are separated by a distance of 100 m are most accurate [58,61]. The walkability of the identified segments is assessed in each focal point, separately for the right and left side of the footpath, and the results are recorded in the mobility delimitation card. In each focal point, the observers rank the surrounding space by assigning 1 point or 0 points to each item in the card. One point is awarded if a given item is present, and zero points are awarded if a given item is not present or a given criterion is not met.

In the next stage of the study, a weighted average is calculated for each pedestrian route based on the ranks in each age category and the scores allocated by the participants in each focal point. Weighted averages should be calculated by modeling cumulative values with the use of statistical software. For the needs of this study, the median was adopted as the value that is most resistant to deviation and weights were assigned to each observation. The walkability of the examined pedestrian routes for different senior groups (60–74 years, 75–89 years, over 90 years) was assessed, and the relevant recommendations were proposed based on the total score of each segment of the examined pedestrian routes.

The scale for assessing the degree of friendliness of the space for the elderly was refined by identifying each of the components specified and describing the space in detail through a scale (Table 3).

Table 3. Scale and friendliness rating the walkability of pedestrian areas.

Scale	Identification
Very unfriendly	Space does not offer special conditions for seniors to meet their needs
Unfriendly	Space only poorly provides basic conditions for seniors, but has no advanced facilities
Indifferent	Space offers basic amenities for seniors, but lacks initiative in further development
Friendly	The space offers many amenities and services for the oldest age group, but there may be some spaces that need many improvements
Very friendly	The space offers very good amenities and conditions for seniors, meeting their needs
Perfectly friendly	The space offers exceptional conditions for seniors, with a large number of innovative solutions and amenities to meet their needs at every level

Source: own elaboration.

Re 5. Data visualization—map illustrating the walkability of pedestrian areas for seniors.

Visualization is a fundamental element for analyzing the phenomena and processes existing in urban public spaces. The use of generally available statistical software (such as Microsoft Excel; Microsoft 365) together with spatial visualization software, i.e., ArcGIS and QGIS, allows a range of relevant information and direct data from urban areas to be implemented into an open map portal. In Poland, the Geoportal Open Spatial Data application (https://polska.e-mapa.net (accessed on 30 July 2023)) is an open portal that brings together the available spatial data within the national spatial data infrastructure. The performed visualizations based on the functioning open GIS systems can supplement missing data and information in open geo-information portals, so that up-to-date decision-making models based on these results can be constructed.

Re 6. Identification of Strategic Intervention Areas for the 60+ population.

Strategic Intervention Areas for the 60+ population are selected areas with potential social, spatial, and economic implications for older people. These areas should be identified in cities because they play a priority role in the context of activities within the framework of the sustainable socio-economic development of the city [9]. Strategic Intervention Areas for the 60+ population are consistent with the Sustainable Development Goals (SDGs) [30]. They are particularly relevant for SDG 3 (Ensure healthy lives and promote wellbeing for all at all ages) and SDG 11 (Make cities and human settlements inclusive, safe, resilient, and sustainable), especially in the context of research on the quality of urban life and the provisions of standard ISO 37120:2018 "Sustainable cities and communities—Indicators for city services and quality of life" [9].

Strategic Intervention Areas for the 60+ population provide vital information for the local authorities, and the conducted delimitation supports the implementation of senior-friendly infrastructure and solutions in cities. These areas should be identified based on the results of questionnaire surveys, demographic data, and the provisions of local zoning plans.

The formulated recommendations can be incorporated into a local development plan and the local authorities' planning policies.

The primary reason for proposing the methodology is the lack of universal approaches to identifying age-friendly walkability in the city, as revealed by the analysis of the literature and thematic studies.

The proposed solution has not yet been the subject of discussion in any international and national scientific publications or policy strategic documents, which indicates the innovative perspective and novelty of the proposed study.

4. Study Area

The subject of the study is Olsztyn in Poland, a country located in Central and Eastern Europe. The history of Poland was shaped by wars and also by the communist regime, that finally collapsed after 1989. The totality of historical events shaped the space of Polish cities as well as is the mental foundation of Polish society, especially the older people.

Therefore, the good practices developed in Poland can serve as an example to be applied in other European countries and beyond.

Olsztyn is the capital of Warmia and Mazury. Olsztyn is the northernmost urban area in Poland, situated near the border with Kaliningrad Oblast, Lithuania, and Belarus (Figure 4).



Figure 4. Map of Europe and a map of Poland with a division into voivodeships. The city of Olsztyn is marked in blue Source: own elaboration.

The implementation of the main aim is closely related to the residents of the city of Olsztyn. Accordingly, local data were collated and compared to nationwide data, as illustrated in Table 4.

Table 4. Demographic data for Poland and Olsztyn.

Description	Poland	Olsztyn
Population	38,265,013	171,249
Area (km^2)	312,679	88.3
Population density people/km^2	123	1951.3
Population (%):		
Working age	59.2	57.9
Minors	18.2	17.6
Retired	22.6	24.5
Population by sex (%):		
Women	51.7	53.5
Men	48.3	46.5

Source: own elaboration based on [62].

Olsztyn lies in a region known as the Green Lungs of Poland. This region is characterized by unspoiled nature, and it is subject to strict environmental protection regulations. There are 23 districts within the administrative boundaries of the city of Olsztyn: Dajtki, Brzeziny, Grunwaldzkie, Generałów, Gutkowo, Kętrzyńskiego, Jaroty, Kortowo, Kormoran, Mazurskie, Kościuszki, Likusy, Pieczewo, Nad Jezioro Długim, Nagórki, Podleśna, Podgrodzie, Pojezierze, Śródmieście, Redykajny, Zatorze, Wojska Polskiego, and Zielona Górka (Figure 5).

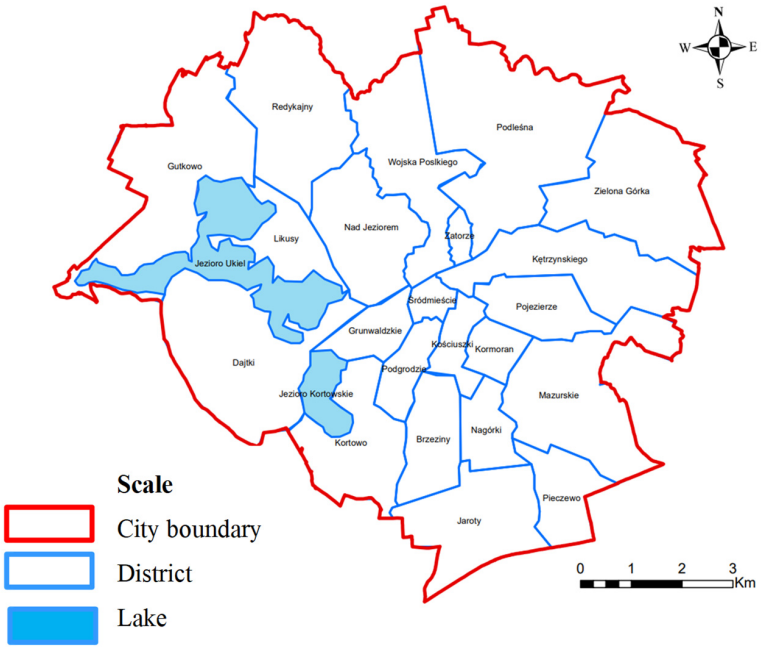


Figure 5. Administrative division of the city of Olsztyn. Source: own elaboration.

5. Results Testing the Age-Friendly Walkability (AFW) Methodology

5.1. Identification of Senior Citizens' Places of Residence

Districts and housing estates with the highest proportions of senior residents were identified based on demographic data on the GeoPortal website of Olsztyn. The housing estates with the highest senior populations were: Jaroty, Kormoran, Nagórki, Pojezierze, Pieczewo, Podgrodzie, and Podleśna. The identified housing estates with a high proportion of senior residents are marked with the darkest color in the adopted color gradient (Figure 6).

5.2. The Questionnaire for Seniors

The questionnaire for seniors was designed based on a review of the literature, EU directives [41], and policy papers targeting the elderly [53]. The questionnaire was validated by experts involved in the elaboration of the document "Senior Policy of the Warmińsko-Mazurskie Voivodeship for 2021–2027" (Office of the Marshal of the Warmińsko-Mazurskie Voivodeship in Olsztyn) and employees of the University of the Third Age in Poland. Based on the experts' opinions, the designed questionnaire was adapted to the needs and expectations of the surveyed population group.

The questionnaire was distributed evenly within the administrative boundaries of Olsztyn and in housing estates inhabited by the 60+ population. The proportions of differently aged seniors who completed the questionnaire survey was as follows: 60–74 years—55%, 75–89 years—25%, 90 years and older—20%. The questionnaire contained demographic questions and 13 open-ended and closed-ended questions. The survey was conducted between June 2022 and June 2023. The respondents were selected randomly, and the questionnaire was completed by a total of 251 seniors, including 98 men and 153 women. The sample size was adequate to obtain reliable results. In the reviewed literature, surveys of

local communities have been conducted on similarly sized population samples of 60 [61] and 121 persons [13] in cities with a population similar to Olsztyn.

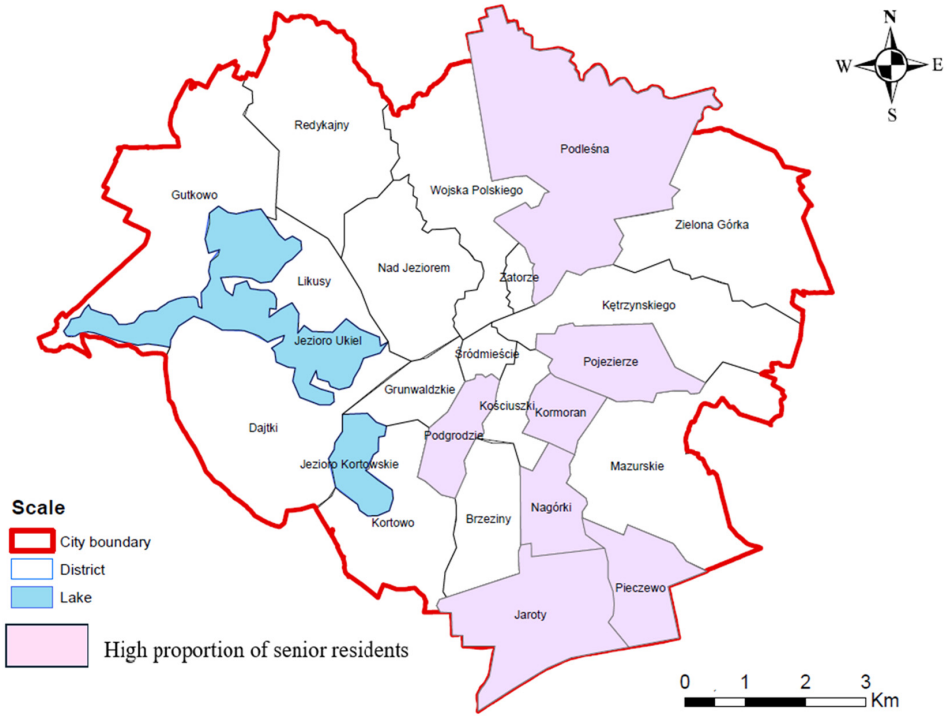


Figure 6. Districts with the highest percentage of older people in the city of Olsztyn. Source: own elaboration.

Seniors' needs and expectations regarding urban public spaces were identified in the survey, and the results were used in subsequent stages of the study to determine the walkability of urban public spaces.

5.2.1. Identification of Points of Interest along Pedestrian Routes

The survey questionnaire included questions to indicate the points of interest and activity centers that are visited by seniors in urban public spaces. Most seniors actively used public spaces and visited the indicated points of interest several times a week. The indicated points of interest were used to identify the pedestrian routes that are traversed by seniors (Table 5).

Table 5. Points of interest.

Points of Interest, Infrastructure	Examples	Percentage of Answers
Social integration	Senior clubs	31%
Recreation	Swimming pools	44%
Culture	Libraries	34%
Health	Clinics and healthcare centers	48%
Urban green spaces	Parks	65%
Worship	Churches	43%
Shopping	Supermarkets, local groceries	62%
	Pharmacies	57%
Public facilities	Banks	51%
Transport infrastructure	Public transport (bus stops)	49%

Source: own elaboration.

The most frequently visited points of interest were parks (including urban green spaces), supermarkets, local grocery stores, and pharmacies.

5.2.2. Walking Mobility Delimitation Card for Different Age Groups in Urban Public Spaces

The walking mobility delimitation card was presented in the questionnaire. The respondents were asked to indicate factors that play the most important role in urban public spaces. The factors selected by seniors from different age groups were ranked as follows: very important (rank 3), moderately important (rank 2), and not important (rank 1). The ranks were assigned by calculating the median values in an ordered series of responses. The responses given by participants from different age groups and the corresponding ranks are presented in Table 6.

Table 6. Walking mobility delimitation card for different age groups with a determination of ranks.

Items	No.	Factors—General Description	Age Groups/Ranks		
			60–74	75–89	Older than 90
Esthetic appeal and cleanliness	1	Cleanliness of pedestrian routes	2	2	2
	2	Trash cans	2	2	2
Safety	3	Streetlights	1	1	1
	4	Acoustic signals (location)	1	2	2
	5	Sign boards, pictographs, graphic signs	1	2	2
	6	Tactile signs (in Braille)	1	1	2
	7	Direction signs and visual signs	1	2	3
Resting places	8	Benches and street furniture	1	3	3
	9	Parklets	1	3	3
	10	Canopied shelters	1	1	3
Vibration and noise	11	No traffic noise	3	3	3
Trees and landscape	12	Trees	1	2	2
	13	Vegetation, lawns	1	1	1
Pedestrian routes	14	Non-slip pavement surfaces	1	2	3
	15	Pavements accessible to wheelchairs	2	2	3
	16	No curbs	2	2	3
	17	Pedestrian pavements are adjacent to roads	3	2	3
	18	Pedestrian pavements with matching street furniture (materials, color scheme)	1	2	3
Visual and acoustic signals	19	Traffic light phasing adapted to senior needs	2	2	3
	20	Acoustic signals and structures adapted to the needs of visually impaired pedestrians	2	3	3

Source: own elaboration. According to the surveyed seniors, public spaces were most deficient in the following infrastructure components. Age group 60–74: Sign boards, pictograms, graphic signs; Tactile signs (in Braille) on public buildings; Benches and street furniture; Non-slip pavement surfaces. Age group 75–84: Sign boards, pictograms, graphic signs; Tactile signs (in Braille) on public buildings; Benches and street furniture; Non-slip pavement surfaces; Pavement width adapted to the needs of wheelchair users; Urban green spaces, trees; Curb-free pavements. Age group over 90: Sign boards, pictograms, graphic signs; Tactile signs (in Braille) on public buildings; Benches and street furniture; Non-slip pavement surfaces; Pavement width adapted to the needs of wheelchair users; Greater availability of trash cans; Urban green spaces, trees.

5.3. Field Study

The results of the survey with the walking mobility delimitation card were verified during the field visit. In the field survey, the pedestrian routes in the public space indicated by the respondents were inventoried using the walking mobility delimitation card. For this purpose, the service safari technique was used, which allows the participant to experience the service from the perspective of the user of the pedestrian routes.

The site visit included the pedestrian routes identified by the respondents in each district of the city of Olsztyn. The pedestrian routes were inventoried based on delimitation cards during 15 minute walks. The field study was supplemented by photographic documentation from the field research. The results of the field study were used to develop thematic maps relating to the friendliness of space for seniors in three age groups.

5.4. Visualization of Spatial Data—Maps

Making an inventory of the senior-friendly 15 minute pedestrian routes using geographic information system (GIS) software was carried out in ArcGIS (10.7.1) and QGIS software (QGIS 3.16.13) on an underlay of a publicly available topographic map of the study area (the city of Olsztyn). The data were then verified and updated based on the current open-access map portal of Poland displayed using the "Raster Topographic Map of Poland" WMTS service [63]. The next step was the development of thematic maps in three age categories: 60–74 years, 75–89 years, and over 90 years on the underlay topographic map.

Surveys conducted together with the inventory of space by field surveys (delimitation card) indicated that for people in the age category 60–74 years, 15 minute walking paths are the most friendly in the city of Olsztyn in the settlements Kortowo, Grunwaldzkie, Śródmieście, and Nad Jeziorem. The least friendly, according to the respondents in the settlements, were Kormoran and Kościuszki (Figure 7).

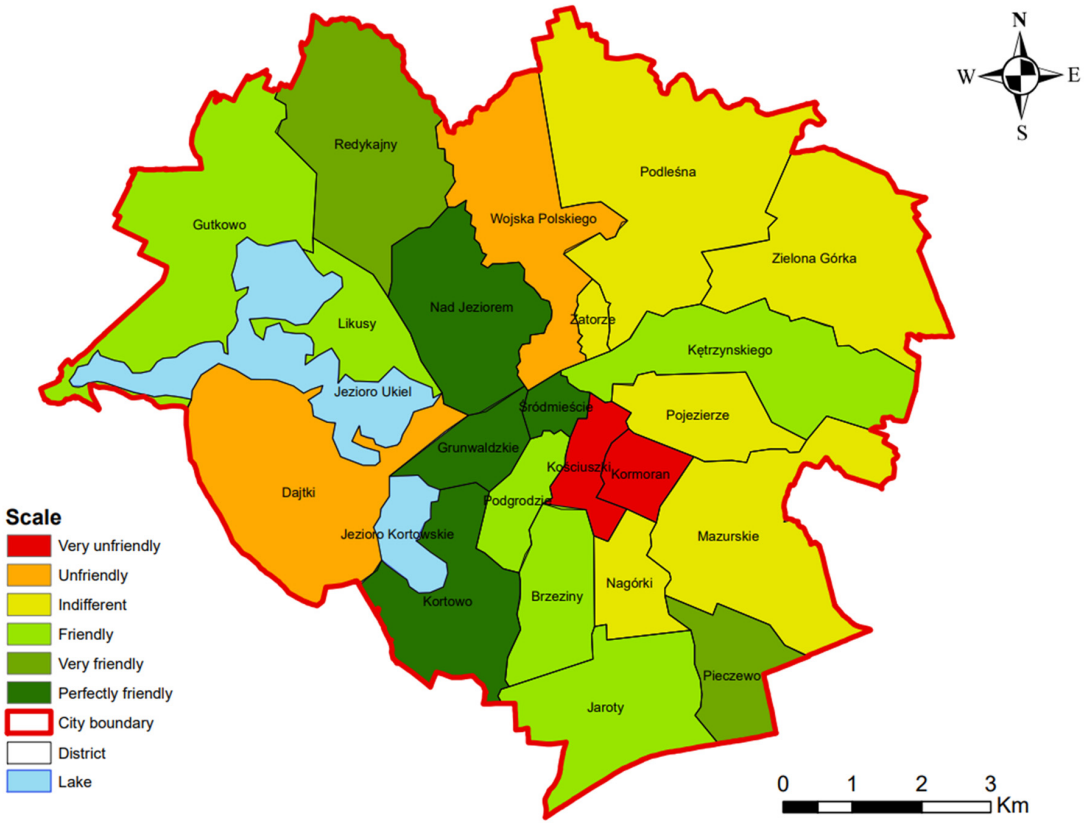


Figure 7. Degree of friendliness of walkable areas for seniors 60–74 years old. Source. Own study.

The next survey addressed the evaluation of the friendliness of 15 minute walking paths for the 75-to-89 age category. Walking routes for this social group should be better designed and planned, as seniors face many difficulties in moving around in public spaces. According to the field survey and the delimitation sheet, this group needs sign boards, pictograms, graphic signs; tactile signs (in Braille) on public buildings; benches and street furniture; non-slip pavement surfaces; pavement width to be adapted to the needs of wheelchair users; urban green spaces and trees; and curb-free pavements.

In the remaining settlements, the respondents identified a number of inconveniences in the spaces of pedestrian routes. The vast majority of the settlements are unfriendly and indifferent. The Pieczewo, Jaroty, and Śródmieście settlements as were considered very friendly or friendly (Figure 8).

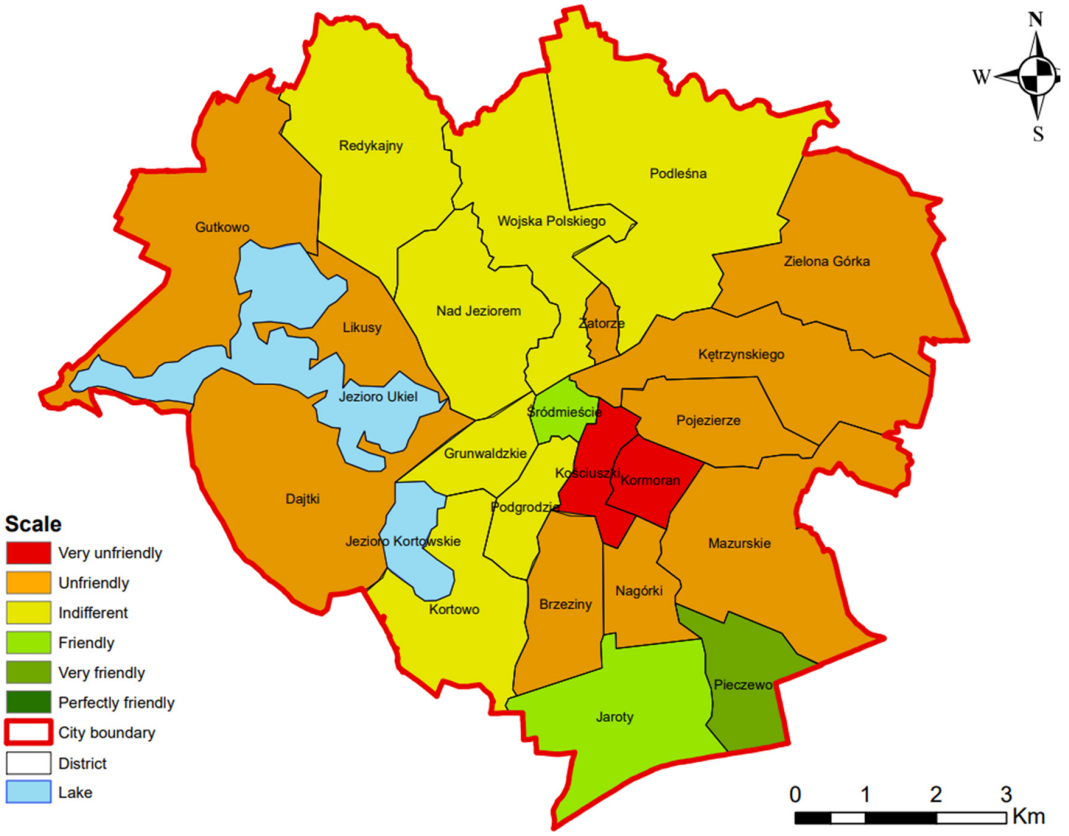


Figure 8. Degree of friendliness of walkable areas for seniors 75–89 years old. Source. Own study.

The lowest degree of friendliness for the 15 minute pedestrian routes in the city of Olsztyn in relation to public spaces occurred in the over-90 age group (Figure 7). At this age, more and more people have mobility problems and need more assistance than seniors at younger ages. The diagnosed pedestrian space lacked sign boards, pictograms, graphic signs; tactile signs (in Braille) on public buildings; benches and street furniture; non-slip pavement surfaces; pavement widths being adapted to the needs of wheelchair users; trash cans; and urban green spaces and trees. From the results of the survey and field inventory (delimitation card), it appears that senior-friendly spaces for seniors over 90 years of age exist to a small extent only in the district of Śródmieście. The remaining districts only provide for the basic needs of seniors and they have been classified as unfriendly and indifferent. Very unfriendly areas for seniors exist in the settlements Wojska Polskiego, Zatorze, Pojezierze, Kormoran, Nagórki, and Kościuszki (Figure 9).

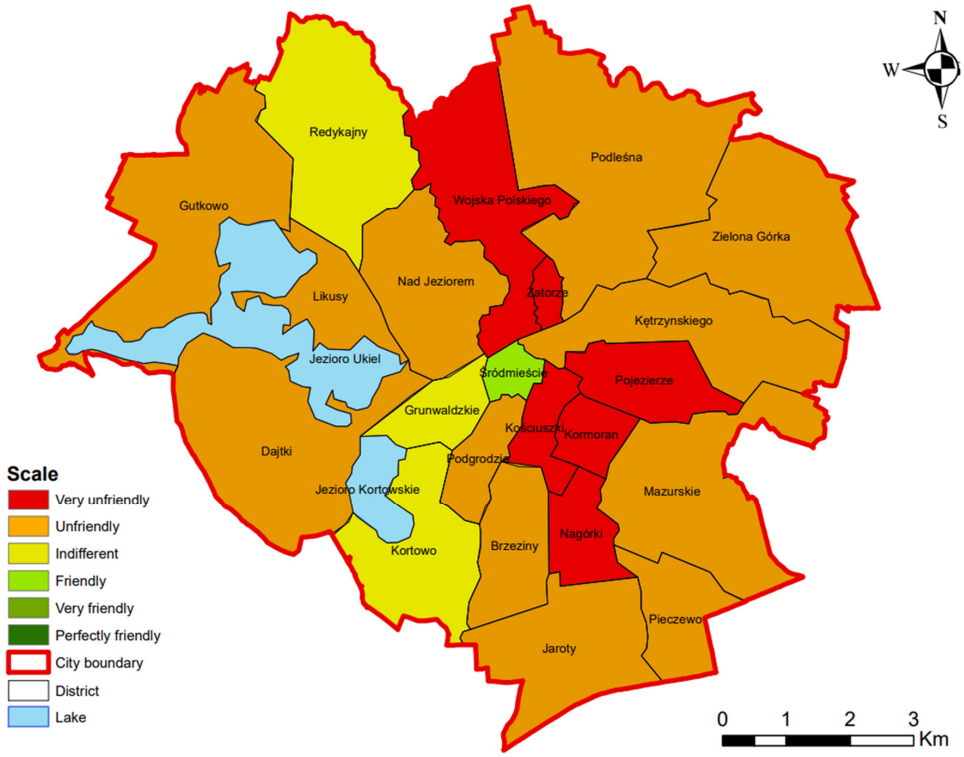


Figure 9. Degree of friendliness of walkable areas or seniors over 90 years old. Source. Own study.

5.5. Identification of Strategic Intervention Areas for the 60+ Population

Strategic Intervention Areas for the 60+ population (SIA 60+) provide vital information for the local authorities. SIA 60+ population were determined based on the results of the questionnaire survey, demographic data, and the local visit carried out (Figure 10).

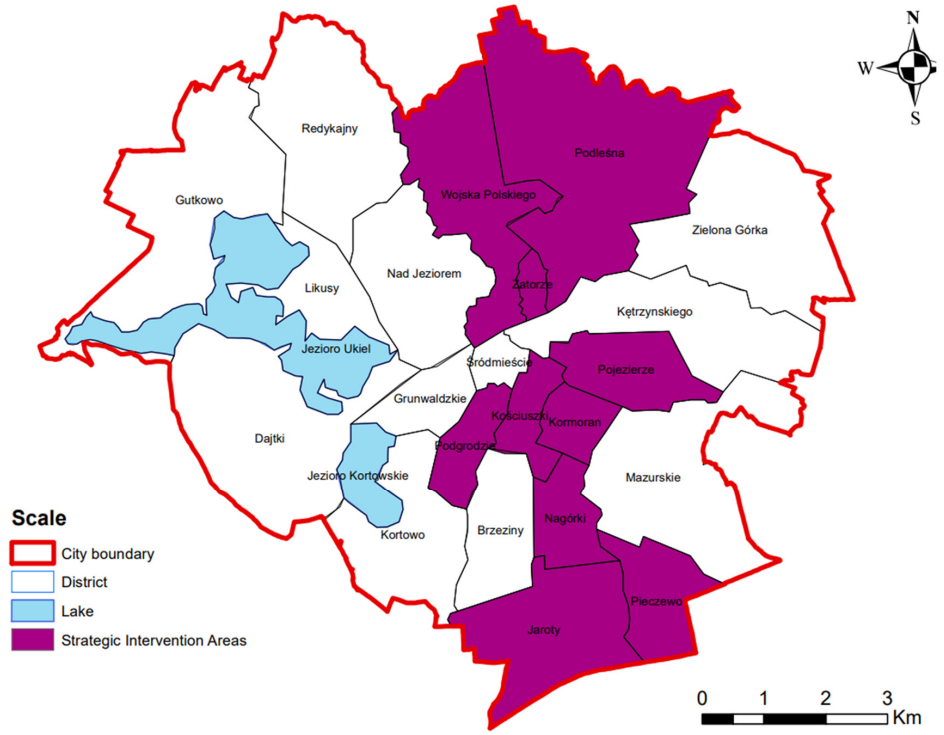


Figure 10. Strategic Intervention Areas for the 60+ population in the city of OlsztynSource. Own study.

The visualization of SAI 60+ on a map of Olsztyn supports urban planning policies, contributes to the implementation of age-friendly solutions in the city, and facilitates revitalization projects in urban public spaces. The lowest level of friendliness to old people in the city of Olsztyn turned out to occur in the districts of Jaroty, Pieczewo, Kormoran, Nagórki, Pojezierze, Podgrodzie, Podleśna, WojskaPolskiegoZatorze, and Kościuszki. It is in these districts that revitalization measures to improve the quality of public spaces, especially pedestrian paths, should be implemented first. By identifying detailed elements of the architectural infrastructure in the city's public spaces, we give clues to local authorities on what should be done to improve the comfort of the lives of local residents. In the future, the identified architectural elements, along with the indicated SAI 60+, will be able to be assessed with the help of the advanced technology used by AI algorithms.

6. Discussion and Results

Population ageing is a strategic problem in many countries. The World Health Organization defines ageing as "the process of optimizing opportunities for health, participation, and security in order to enhance quality of life as people age". Seniors should have easy access to urban public spaces where they can spend their free time, integrate with other members of the senior community, and participate in various outdoor activities. These spaces should be senior-friendly, i.e., they should be adapted to the needs, capabilities, and expectations of elderly inhabitants.

Research on senior-friendly solutions plays an important role in urban development in 15 minute cities. The proposed methodology for assessing the 15 minute age-friendly walkability in urban public spaces has several strengths but also some limitations. The main weakness of this study was that the designed methodology was tested in only one location. Olsztyn is a city with a largely homogeneous culture and social customs [64]. In larger cities, a higher number of pedestrian routes would need to be mapped and more residents would need to be surveyed, which could be problematic. The main strength of the proposed methodology is that constitutes a universal tool that can be applied in all urban areas and can be easily adapted to local needs.

A strength is the local surveys conducted in each of the districts of the city of Olsztyn. The separation into districts and verification of 15 minute walking routes is in line with the concept of 15 minute cities. This is the first pioneering research in this area, and it allows verification of detailed walking spaces in three age categories of the senior population. The strong point of this study is its flexible composition and the possibility of to apply it to each settlement unit and age group of the population.

At the same time, the following research indicates that a key determinant for research on prospective urban development is the identification of places (i.e., districts with the highest percentage of elderly people).

The field surveys carried out using the service safari method allow us to reproduce the essential elements of the space so that a reliable assessment could be made through a scoring classification adapted to the preferences of each social group. The elaborated mobility delimitation card with a breakdown of older age groups and a list of parameters are important elements that should be taken into account in the spatial evaluation of urban areas in 15 minute cities.

The proposed methodology has practical implications for research on public space, in particular studies dedicated to spatial planning, sustainable mobility, and the identification of Strategic Intervention Areas for the 60+ population. Research on senior mobility in public spaces is important due to global population ageing, the increasing participation of the elderly, and actions to eliminate barriers in the urban public spaces [65]. The developed method is relatively cheap to implement and has been designed as a cost-effective approach that does not put excessive strain on the local budget.

The proposed methodology for assessing the 15 minute age-friendly walkability (AFW) of urban public spaces and Strategic Intervention Areas for the 60+ population are consistent with the age-friendly cities concept and can be implemented even in small cities. In the present study, an attempt was made to identify the needs and preferences of seniors residing in Olsztyn, and the results were used to optimize the existing architectural solutions and improve the quality of life of the senior population. The identification of Strategic Intervention Areas for the 60+ population based on demographic data can help the local authorities to implement age-friendly solutions and improve the walkability of pedestrian routes that are frequently traveled by seniors (walking mobility delimitation card).

The walkability of public spaces should be visualized on maps to promote the implementation of revitalization solutions that improve the urban infrastructure and urban planning. As a result, public spaces can be adapted to the needs of the senior members of local communities. The developed tool will minimize the social alienation of older people by increasing transport accessibility to senior activity sites. At the same time, the proposed solution will support the identification of factors that contribute to friendly routes, including safe pedestrian infrastructure [66].

Summarizing the subsection discussion and results, we prepared Table 7 to indicate the weaknesses and strengths in each stage of the methodology for assessing the 15-minute age-friendly walkability (AFW) of urban public spaces.

Table 7. The strengths and weaknesses of the methodology for assessing the 15 minute age-friendly walkability (AFW) of urban public spaces.

No.	Stage of the Study	The Discussion		The Results	
		The Strengths	**The Weaknesses**	**The Strengths**	**The Weaknesses**
1.	Characterization of selected areas in the analyzed city	Lets in-depth analysis get to know the city	Problems with data collection	An important element of strategic city development activities	Problems with data collection
2.	Identification of spatial data sources	Data selection can be adapted to local characteristics	Scattering of data in registries, difficulty in collecting data	Collected data can also be used for other research on the needs of society	Scattering of data in registries, difficulty in collecting data.
3.	Social study—questionnaire survey	Acquire new knowledge about the needs and expectations of residents and users of urban public space	Difficulty in reaching local respondents	Understanding the needs and expectations of residents and users of urban public space	High cost of the surveys conducted
4.	Field study	Obtaining new knowledge about urban public space	Difficulty in reaching specialists	Direct spatial diagnosis—expanding the scope of data and information on urban public space	Problems in diagnosing and evaluating urban public space
5.	Visualization of spatial data—maps	Selection of GIS tools	Requires employment of GIS specialists	Development of precise thematic maps	Problems in interpreting the maps obtained
6.	Identification of Strategic Intervention Areas for the 60+ population.	Identify the city in terms of social needs and take action	Too large an area to revitalize and adapt the space to the needs of local users	Taking action on the diagnosed areas in the framework of the city development strategy and revitalization processes	High costs of adapting the space to the needs of users

Source. Own study.

The results of this study can be used to implement innovative infrastructure solutions in urban public spaces that meet the needs and preferences of senior citizens and also are friendly to other social groups in the city.

7. Recommendations

In the concept of 15 minute cities, walkable routes have to be identified in urban public space, as does the availability of user-friendly infrastructure solutions. The rec-

ommended solutions should improve the quality of local life. The results of the present study can be applied to implement a program that is consistent with the concept of an age-friendly city and that will address the identified infrastructure deficiencies in public spaces. Recommendations for creating friendly spaces in 15 minute cities were proposed and included Eco-Age-Friendly Smart Green Benches (Figure 11). *Eco-Age-Friendly Smart Green Benches* satisfy the expectations of the population and are in accordance with the goals of the sustainable development of public space because they are:

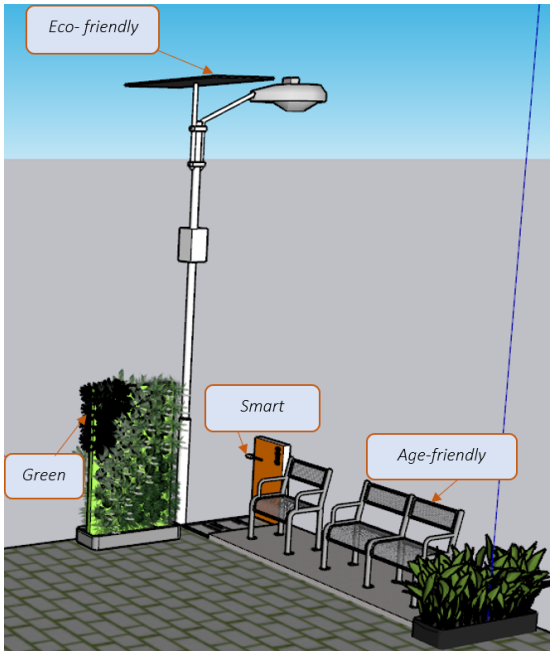


Figure 11. Eco-Age-Friendly Smart Green Benches. Source: own elaboration on program SketchUp 2022.

Eco-friendly—benches will be powered by solar panels;
Age-friendly—benches will be designed to meet the needs of older adults;
Smart—benches will feature advanced technological solutions;
Green—benches will be surrounded by hedges or panels with climbing plants to create urban green spaces.

The designed benches will be used for rest and relaxation. They will feature solar-powered speakers that will provide users with information about the current time and location. Benches will be surrounded by hedges or panels with climbing plants and they will constitute urban green spaces. The designed benches will enable senior citizens to relax in natural surroundings.

8. Conclusions

The first research problem was verified and solved, as the 15 minute walking mobility of the 60+ population was assessed and visualized by developing thematic maps. This is crucial in the context of participatory and inclusive cities.

The second problem was solved with an assessment of the friendliness of the 15 minute walking mobility of the 60+ population and indicating Strategic Intervention Areas for the 60+ population in urban public space in Olsztyn city.

The proposed methodology was tested in a Polish city, but it relies on universal principles, criteria [10,12] from international regulations and recommendations [67,68], and can be easily implemented in other cities in Europe and other regions of the world. The questionnaire can be freely designed or modified, and the proposed mobility delimitation card can be adapted to the needs and preferences of local senior communities.

The results of the study can be used to recommend practical solutions for improving senior mobility in urban areas, to improve the accessibility and quality of pedestrian routes, to identify infrastructure components, and also to determine which elements of urban space are essential to improve the quality of seniors' life and make urban public spaces more friendly for the elderly [69,70].

The survey showed that in the urban space of the city there were no objects of small urban architecture, e.g., benches. As a recommendation to create friendly public spaces, the author suggested Eco-Age-Friendly Smart Green Benches.

The proposed author's indication of the Strategic Intervention Areas for the 60+ population will contribute to precise spatial planning and sustainable urban development and enable the local authorities to plan and implement solutions that improve seniors' quality of life and make public spaces friendly for older adults.

In conclusion, the developed methodology for assessing the age-friendly walkability of urban public spaces is an innovative approach that has not been proposed in the available scientific literature or practical guides to date.

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