

Active Aging and Smart Public Parks

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Contributor: João Boavida, Hande Ayanoglu, Cristóvão Valente Pereira, Rodrigo Hernandez-Ramirez

The global population is aging, with the percentage of people over 60 expected to rise from 12% to 22% and 33% residing in developed countries. However, most cities lack the appropriate infrastructure to support aging citizens in active aging and traversing the urban landscape, negatively impacting their quality of life. Studies have shown that public parks and green spaces can contribute to a higher quality of life and wellbeing. Also, smart cities are intended to improve the wellbeing and health of their inhabitants. However, most solutions are typically implemented indoors and tend to overlook the needs of older adults. A smart city should consider the increasing rate of aging and give more importance to outdoor environments as a key aspect of quality of life.

Keywords: active aging ; age-friendly ; smart cities ; smart public parks

1. Introduction

Urbanization, a global trend characterized by the migration of people from rural areas to cities ^[1], has brought about significant changes in lifestyle, including an increase in sedentary behavior. As a result, urban settings face major public health challenges such as obesity and mental illness ^[2]. Research has established a link between low physical activity levels and age-related health issues, emphasizing the impact of urbanization on overall wellbeing (e.g., ^{[3][4][5]}). Moreover, an average of 36% of EU citizens aged 65 and older reported having at least two chronic diseases in 2020 ^[6]. Addressing these challenges requires a focus on population health and the recognition that urban areas not only encompass the built environment but also natural settings, urban green spaces, and public parks. These outdoor spaces have been shown to enhance individuals' quality of life, physical and psychological wellbeing, and autonomy ^{[2][7]}. Furthermore, the concept of urbanization sparks ongoing debate as the boundaries between rural and urban areas become increasingly blurred and inaccessible for some. This recognition underscores the interdependence of urban areas, where components like cultivated fields, which contribute to the city's sustenance, are considered to be part of the urban fabric. Without this interdependency and the scale and automation involved, these fields would not exist in their current form.

The potential benefits of smart public parks within the context of smart cities for older adults are widely acknowledged. However, there is a growing recognition that greater efforts are needed to ensure inclusivity and accessibility for this population ^[8]. Despite incorporating age-friendly design principles and safety-promoting technologies, the challenge of creating inclusive and accessible smart cities and smart public parks remains. This becomes a significant concern as the global older adult population continues to rise, emphasizing the importance of fully considering their needs and perspectives in the design and development of these technologies and spaces. To address this issue, it is crucial to advocate for the needs of older adults and actively involve them in the design and development processes of smart cities and smart public parks, ensuring that their perspectives and requirements are fully integrated and prioritized.

2. Health and Wellbeing

In 1946, the WHO explicitly linked health to wellbeing by defining the former as “a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity” ^[9], whereas Brüssow defines health as “the capacity to adapt to changing external and internal circumstances,” thus making the concept of health broader ^[10]. In 2015, the WHO acknowledged that various social, economic, and environmental factors, individual behaviors, and medical interventions impact health, thus implying that any strategy for improving health and wellbeing should include the physical, mental, and social dimensions of people ^[11].

Wellbeing, encompassing individuals and societies, is a positive state influenced by social, economic, and environmental factors, representing a resource for daily life, quality of life, and the capacity to meaningfully contribute to the world ^[12]. According to Crisp, the term “wellbeing” is most frequently used in philosophy to refer to what is ultimately or non-instrumentally beneficial for an individual, and a person's wellbeing is what is “beneficial” to them ^[13]. Therefore, while being healthy could be considered a component of wellbeing, it is not tenable to assume that it is the only factor.

According to Keyes, wellbeing and illness are measured differently and are not mutually exclusive, highlighting that interventions can be implemented to increase wellbeing for individuals with diagnosed illnesses as well as those without but with low levels of wellbeing ^[14]. Moreover, the subjectivity of wellbeing is also an important aspect.

Physical health encompasses the overall wellbeing of the body, including its organ systems, immunity, and mobility ^{[11][15]}. The concept of physical health encompasses a wide range of outcomes, including subjective self-reports of symptoms and objective measures like mortality rates, with self-reported outcomes influenced by factors like memory biases, whereas objective disease endpoints provide more concrete and measurable indications of physical health ^[16]. Mental health, as defined by the WHO, is a state of wellbeing that enables individuals to effectively cope with life's stresses, realize their abilities, learn, work, and contribute to their communities ^[17]. It goes beyond the absence of mental disorders and is an integral component of overall health and wellbeing. Mental health encompasses more than the absence of mental illness; it encompasses the presence of psychological wellbeing, which involves optimal psychological functioning and experience ^[18]. Social health pertains to an individual's social wellbeing, including their ability to form and maintain relationships, engage in social activities, and feel a sense of connection to their community. Strong social connections provide emotional support, companionship, and a sense of belonging, making social health an essential aspect of overall health and wellbeing ^{[19][20][21]}.

Urban environments pose significant health risks and increase the prevalence of diseases among older individuals. Exposure to air pollution, a common feature of urban areas, has been linked to cardiovascular disease, which is a leading cause of mortality in older adults ^{[22][23]}. Furthermore, respiratory disorders like Chronic Obstructive Pulmonary Disease (COPD) and asthma are more prevalent among older individuals residing in urban settings, primarily due to the detrimental effects of air pollution ^{[24][25][26]}. The risk of developing type 2 diabetes is also heightened in urban areas due to factors such as chronic stress, unhealthy dietary choices, and sedentary lifestyles ^{[27][28]}. Urban living can contribute to higher rates of depression and anxiety in older individuals because of social isolation, limited social support, and exposure to crime and violence ^{[29][30][31]}. Sedentary behavior, which is common in urban lifestyles, can lead to weight gain and obesity, further increasing the risk of various health issues including heart disease, diabetes, and certain types of cancer ^{[32][33]}.

3. Urban Green Spaces and Benefits

The concept of an urban green space (UGS) does not have a single, consensual definition ^[34]. The industrial revolution's massive urbanization led to the development of the UGS concept in the 19th century ^{[35][36][37]}. The decline in natural landscapes within cities due to urbanization during the 20th century raised public awareness of the need to incorporate natural assets and components into urban contexts. This led to the development of the urban park movement, which was started to enhance urban life ^{[38][39]}. Industrialization was more noticeable in Europe and North America, which led to a greater emphasis on UGS. For instance, the idea of a "Green Lung" to purify city air was first implemented in Central Park, a 19th-century structure in North America.

UGSs, including forests, public parks, and community gardens, are intended to offer a variety of opportunities for any resident to interact with nature and partake in activities like exercise, relaxation, or socializing ^{[40][41]}. Additionally, they are essential for cities because they offer a variety of recreational opportunities, encourage social interaction and integration, and enhance mental and physical health ^{[42][43]}. Although parks are essential, most UGS planning thus far has been seen as being closely related to urban and garden design, rather than as a matter of public health ^[38]. The social role of UGS is, therefore, typically highlighted in relation to two main sets of concerns: first, those related to the practice of physical activity and relaxation, and second, those related to enhancing social and intergenerational cohesion ^[44].

UGSs may not only make cities more pleasant to live in but also serve social, cultural, aesthetic, practical, economical, and ecological purposes ^{[44][45]}. Consequently, the importance of UGS is closely related to a person's level of self-care. Body mass index, subjective health assessments, and longevity can benefit from physical activity, relaxation, and good mental health ^[44].

Studies have shown that green spaces can positively affect older adults' health. For instance, older people who lived close to green spaces in the Netherlands reported better health than those who did not ^[44]. Additionally, it has been discovered that green spaces can strengthen social ties and a sense of community while encouraging physical activity in seniors aged 60 and older ^[34].

It is vital to consider the advantages of vigorous and moderate physical activity when discussing the advantages of green spaces for older adults and the general public. Studies from different countries have demonstrated that having access to

and using green spaces can increase physical activity, reduce sedentary time, and promote leisure walking [34].

The benefits associated with UGS can only be fully realized when individuals have the necessary resources and time, as well as a balanced quality of life. This includes factors such as having the opportunity to engage in UGS activities and achieving a satisfactory work–rest balance. One crucial aspect that enables the realization of these benefits is the presence of a proper retirement system. With a well-planned retirement, individuals can take advantage of the benefits of UGSs and enjoy a higher quality of life.

Green spaces in neighborhoods are essential for long, leisurely walks [46]. Therefore, it is essential to develop green spaces that motivate seniors to engage in moderate physical activity if you want to advance public health. This is crucial because many older people struggle to maintain moderate physical activity levels [34].

Moreover, inactivity affects the global population's overall health and the prevalence of non-communicable diseases [47]. Research has shown that green spaces and physical activity levels are related [48]. Physical activity in green spaces is particularly beneficial for urban dwellers with a mental illness [49]. Other demographics or subgroups may also experience similar benefits from green space, which makes outdoor activities enjoyable and convenient and promotes less sedentary lives.

4. Active Aging and Cities

The aging process refers to the biological changes that occur over time, resulting in a gradual loss of physiological integrity, diminished function, and increased mortality risk [50]. Aging involves the deterioration of bodily functions and a decline in physical and mental capacity, primarily driven by cellular damage [50]. While aging is a primary risk factor for various diseases, including cancer, diabetes, cardiovascular disorders, and neurodegenerative diseases, it is important to recognize that aging itself is not a disease but a natural phenomenon [50][51][52].

There is no widely accepted concrete definition of active aging. The concept of 'Active Aging' was initially introduced by Kalache who established a correlation between engagement in activities and the promotion of health in later life [53]. From Kalache's perspective, the essentiality of providing older individuals with ample opportunities to maintain an active lifestyle is emphasized, as good health, acting as a catalyst for individual and societal contributions, is dependent on both personal efforts and societal support. Consequently, sustaining activity and embracing an active life significantly enhance the likelihood of attaining optimal health in older age [53].

According to the WHO, active aging is the process of maximizing opportunities for health, participation, and security to improve quality of life as people age [51]. It is linked to various life transitions and involves maintaining health through activities that align with individuals' goals, capacities, and community opportunities [54]. Healthy habits, such as a balanced diet and regular exercise, are emphasized as important components of active aging, reducing the risk of diseases, and enhancing physical and mental wellbeing. Determinants of active aging include economic, health, social service, behavioral, individual, physical environment, social, cultural, and gender factors, highlighting the need for localized studies and information gathering to develop effective strategies for older adults.

Promoting healthy aging and ensuring a high quality of life in an aging population are significant concerns in society, emphasizing the importance of maintaining wellbeing and healthy aging. Personal traits and environments play a crucial role in determining healthy aging, with research highlighting their greater influence compared to external factors [55]. Studies indicate that health is influenced by physical and social environments, as well as rewards and obstacles that affect opportunities, decisions, and health behavior (e.g., [56][57][58][59]). Multiple dimensions, including physical, cognitive, and social factors, are considered in defining healthy aging.

In addition, it is essential to identify and eliminate barriers that hinder older adults from engaging in the community and ensure that their voices are heard [60]. The same study notes that in 2020, the number of adults aged 60 and above exceeded the population of children under the age of five. Therefore, as the population ages, it is crucial to prioritize age-friendly cities that enable older adults to maintain an active lifestyle.

4.1. Age-Friendly Cities

Older residents are a valuable resource, but our cities must ensure their inclusion and full access to urban spaces, structures, and services in order to fully realize their potential for continued human development [61]. A comprehensive guide by the WHO outlined criteria for cities to be classified as "age-friendly", drawing upon the WHO's framework for active aging [55]. The guide focused on eight key areas, including housing, outdoor spaces and buildings, social

participation, respect and social inclusion, civic engagement, employment, communication and information, and community support and health services.

Our cities must prioritize including older residents and giving them full access to urban spaces, structures, and services in order to fully realize the potential for continued human development among older residents [61]. The comprehensive guide provided by the WHO offers valuable suggestions and criteria for cities to become “age-friendly,” drawing upon the WHO’s framework for active aging [55]. This guide focuses on key areas such as housing, outdoor spaces and buildings, social participation, respect and social inclusion, civic engagement, employment, communication and information, and community support and health services, serving as a valuable resource for cities to enhance their age-friendliness and ensure the wellbeing of older residents.

As highlighted by the WHO document, government policies have been shaped by the analysis and expression of the older adult population’s circumstances, leading to their active involvement in decision making [55]. The endorsement of this approach by the United Nations in 2007 signifies the recognition of older individuals’ ability to contribute to society. Key factors such as outdoor spaces and buildings, transportation, and housing, which are closely linked to personal mobility, safety, health behavior, and social participation, are considered to have the most significant impact on an age-friendly city, according to the WHO [55].

According to the WHO, the presence of safe and accessible public buildings, transportation systems, and pedestrian-friendly spaces exemplifies supportive environments that can enhance the preparedness of cities [62]. Age-friendly cities are not only designed to cater to people of all age groups but they have a particular focus on the older population. These cities encompass policies, services, and infrastructure that foster healthy and active aging, empowering older individuals to contribute to society and ensuring that they can live with dignity, security, and enjoyment. Key features of age-friendly cities often include the accessibility of facilities for senior citizens and their active participation as valued members of the community (e.g., [63][64]).

One piece of research conducted analyses on multiple reports at different levels of governance, including district, city, state, and federal governments [65]. This variability highlights that the WHO guidelines provide principles that can be adapted and applied across various levels and regions [55]. It is important to categorize the key features of different elements within a city. For instance, buildings and outdoor spaces play a crucial role in public parks.

4.2. Age-Friendly and Smart Cities

Modern technology has radically changed how we think about cities. The concept of a “Smart City” was first introduced in the book “The Technopolis Phenomenon: Smart Cities, Fast Systems, Global Networks,” which marked the beginning of the study of “Technological Cities” in the early 1990s [66]. Nevertheless, the idea of a smart city was not studied until the late 2000s. A smart city can be characterized in many ways.

Different definitions of smart cities are available nowadays; bodies such as the European Commission, the Institute of Electrical and Electronics Engineers (IEEE), and the United Nations have different views on what constitutes a smart city. According to the European Commission, smart cities are places where technological innovations are applied to improve urban management and productivity, whereas the European Commission defines a “smart city” as a location where traditional networks and services are improved to benefit its citizens and businesses using digital and telecommunication technologies [67].

Hammons and Myers have a more technological approach to the smart city concept, defining it as a place that “brings together technology, government, and society and includes but is not limited to the following elements: a smart economy, smart energy, smart mobility, a smart environment, smart living, and smart governance” [68]. The United Nations characterizes smart cities through the definition of the International Telecommunication Union (ITU).

The ITU defines a smart city as “an innovative city that uses ICTs and other means to improve quality of life, the efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations concerning economic, social, environmental, as well as cultural aspects” [69].

In summary, the IoT and ICT underpin most conceptualizations of smart cities, serving as the main drivers in enhancing citizens’ quality of life and facilitating decision making.

Smart cities and age-friendly cities share some common features, including the following:

- A focus on technology: In smart cities, technology aims to improve efficiency, sustainability, and economic development. In age-friendly cities, technology supports healthy aging and provides access to services and opportunities.
- Livability: Enhancing the physical environment to make the community more habitable for residents. Providing access to services and amenities. Creating opportunities for social engagement.
- Accessibility and inclusion: ensuring that all residents, especially those with disabilities, older adults, and other marginalized groups, can participate in the community.
- Collaborative approach: facilitating collaboration and partnerships between government, community organizations, and the private sector to achieve their goals.
- Data-driven decision making: relying on data from various sources, such as sensors and surveys, to make informed decisions and track progress toward their goals.

4.3. Smart Public Parks

Public parks play a vital role in cities as they comprise various elements like streets, buildings, and open spaces, necessitating attention for the development of smart cities' "2.0 version" of smart parks. The concept of integrating smart devices and technologies in public parks holds significant potential, transforming them into smart parks that provide a multitude of benefits and services. However, there is a need for a clearer understanding of the exact definition and features of smart parks, despite their promising prospects.

Lele and Lihua propose that smart parks aim to transform interactions between the government, enterprises, and residents by offering abundant smart services and enabling intelligent park operations [70]. They identify three key features for smart parks: perception, interconnection, and intelligence. Perception involves accurately monitoring critical objects using IoT technologies, interconnection establishes networks to connect park systems and departments, and intelligence focuses on autonomous management systems with data integration and analysis for informed decision making.

While the majority of smart services in domestic and overseas parks have primarily focused on urban efficiency, such as safety, crime prevention, and environmental maintenance, Lee argues that parks are natural spaces that require services aimed at nature, human wellbeing, and community recovery [71]. Therefore, the application of technology in smart parks should prioritize restoring these elements rather than merely showcasing the technology itself.

It is important to note that smart parks are still in the early stages of development and are considered to be a crucial component of strategic planning for smart cities. In conclusion, the development of smart parks represents a significant opportunity for cities in their journey toward becoming smart cities. By integrating smart devices and technologies, public parks can offer a multitude of benefits and services to enhance urban efficiency, promote community wellbeing, and foster environmental sustainability. The concept of smart parks encompasses key features such as perception, interconnection, and intelligence, aiming to transform park operations and provide abundant smart services. However, further research and collaboration between park planners, IT experts, and the community are essential in ensuring the effective planning, implementation, and user awareness of smart park initiatives. With ongoing advancements in technology and a focus on restoring nature, enhancing user experiences, and achieving sustainability goals, smart parks have the potential to optimize benefits for individuals, communities, and the surrounding environment within the broader context of smart city development.

5. Conclusions

Aiming for an improvement in the quality of life of older adults through smart public parks is a significant endeavor. By integrating advanced technologies and thoughtful design, these parks could offer a range of benefits tailored to meet the unique needs and preferences of older adults. Therefore, the involvement of older adults in the entire process, from inception to implementation, is crucial. Smart features such as smart lighting, automated seating, and interactive exercise equipment can improve safety, accessibility, and convenience. Multidisciplinary teams should be formed to explore and implement new solutions. It is important to ensure that the technology itself does not burden older adults. For instance, health tracking can be seamlessly integrated into the park environment without requiring the older adult to carry wearables or smartphones. Utilizing non-intrusive sensors and intelligent infrastructure, the smart park system could gather health data discreetly and autonomously, albeit in a manner that respects privacy. This approach ensures that older adults can enjoy the benefits of health tracking without feeling burdened by additional responsibilities or equipment. By considering

human factors and adopting a bottom-up approach, technological solutions can be designed to complement the lifestyles of older adults in smart public parks.

The field of smart public parks research presents numerous opportunities, but it remains highly dependent on investments and commitment from decision-makers. Integrated solutions and a framework for low-level implementations are required to facilitate progress. Overall, smart parks could offer a holistic approach to promoting the wellbeing, physical activity, and social engagement of older adults, ultimately enhancing their quality of life in a vibrant and inclusive environment. An approach grounded in systemic design principles may prove instrumental in tackling this multifaceted challenge, which necessitates the collaboration of individuals across various disciplines and sectors while keeping both people and the planet at the forefront of the process [72][73][74].

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