

Examining the Potential of Linear Parks as Sustainable Development Components

Andreas Savvides, Chloe Kadi

Abstract—The objective of this study is to investigate how the planning and design of open parks within neighborhoods and communities can promote physical activity in order to enhance the health of the local population. A review of relevant literature was conducted for studies regarding the relationship between health and physical activity and the park characteristics that can promote physical activity among people. The findings of the literature review were then compared and analyzed, in order to identify the main characteristics of urban parks that can promote physical activity and enhance public health. In order to find out how the characteristics identified in the literature were applied in real life, an analysis of three existing parks in three different countries was conducted. The parks, apart from their geographical location, also vary in size and layout. The parks were chosen because they are urban open parks and they include facilities for physical activity.

Keywords—Urban planning, active living behavior, open parks, sustainable mobility.

I. INTRODUCTION

THE objective of this research is to explore the factors that should be considered when planning and designing open parks in neighborhoods and communities to enhance the quality of life for residents. Due to limitations in time and scope, this study focuses on investigating the features and characteristics that promote physical activity in parks.

A. Rationale

Numerous studies have demonstrated that engaging in physical activity can reduce the risk of various diseases such as heart disease, diabetes, high blood pressure, cancer, depression, anxiety, and obesity, while also benefiting bone structure, skeletal joints, and muscular health [1], [2]. However, physical activity levels have declined in recent years, with more people adopting sedentary lifestyles [3]. Physical inactivity and unhealthy diets are now among the leading causes of premature death, following closely behind tobacco use [4]. To reverse this trend, efforts are needed to address both personal factors, such as individual behaviors, as well as factors associated with the urban design of neighborhoods and cities [1]-[3].

Educational programs targeting behavioral change can influence individuals, but interventions at the community level are also crucial to facilitate physical activity. Such interventions may include designing neighborhoods that promote active transportation, incorporating diverse facilities and infrastructure to accommodate various exercise and leisure activities, and connecting these spaces through park trails [1].

A. L. Savvides & C. Kadi are with the University of Cyprus, Cyprus (e-mail: als@ucy.ac.cy).

Evidence-based approaches and urban design strategies, like the principles of Active Design, have been shown to positively contribute to promoting physical activity and improving the quality of open spaces, such as parks, by encouraging frequent interactions with these facilities and fostering demand for higher quality environments [4]. These strategies can influence people's choices regarding daily transportation, work, and access to services, encouraging them to opt for more active alternatives like walking or cycling [4]. Given sedentary jobs and lifestyles, it is essential to seize every opportunity to promote an active lifestyle for everyday tasks and leisure activities [1], [4]. By integrating green and blue infrastructures into park planning, aligning them with major mobility corridors, commercial centers, educational institutions, and cultural nodes, these amenities can provide physical connectivity and accessibility [5].

This research aims to identify the key features and characteristics that parks should possess in order to promote physical activity and enhance public health within neighborhoods.

1) Study Objectives:

- Investigate the potential positive influence of physical activity on public health.
- Explore how urban design can encourage physical activity and an active lifestyle, with a specific focus on public and communal spaces like open parks.
- Examine the core benefits of parks for their users.
- Identify the park characteristics that encourage people to visit and engage in physical activity.

2) Key Research Questions

- What are the definitions of "Health" and "Public health"?
- Does physical activity have a positive impact on health?
- How can urban design and the built environment effectively encourage physical activity?
- What are the health benefits associated with open parks?
- What specific design and layout characteristics of parks promote physical activity and public health?

II. LITERATURE REVIEW

According to the World Health Organization [6], health is defined as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." Public health is further defined as "the science and art of promoting and protecting health and well-being, preventing ill-

health, and prolonging life through societal efforts" [7].

Further review of the literature has delved on sustainable development principles, as these may be recognized in linear parks. Researchers have looked into the design principles of the architectural space in linear parks [8] and the potential for the transition into a more sustainable future resulting from new investigative directions that may lead to long-term transformative change [9]. Others have attempted to better frame these issues in a framework of learning about sustainable development [10] in the design of linear parks, and they have indicated the importance and the need for a balanced transdisciplinary design approach [11].

Beyond an examination of design principles related to linear parks, other investigators have looked at the critical elements that may affect the adoption of a broad sustainable development toolkit for design. Such elements have included looking the incorporation of cultural and creative activities in the programming of linear parks [12] and they have gone on to assess the performance of these programming decisions for achieving sustainable and resilient urban environments, especially those that integrate open public spaces [13] and they have done so by using a case studies approach. Others have proposed additional definitions of the critical components of the toolkit used in the design of linear and sustainable parks, by proposing additional models of evaluation [14] that examine the quality of sustainable development goals in linear park and open public space design [15], following a similar case studies approach.

The literature has also been informative at looking at the practice of urban design as a tool and primer for meeting smart growth goals, dealing with higher urban densities, improving accessibility and alternative urban mobility (especially with regard to route choice alternatives) and promoting mixed-use development in communities adjacent to linear parks [16]. The role of green space for sustainable landscape development is becoming a key consideration for urban horticulture in cities [17], as well as for generating greening frameworks from the conceptual stage to project implementation [18]. Such considerations are important and relevant to people of all ages, and especially for children and the elderly, as has been seen in the case of Montreal and reported by Reyes et al. [19] in a series of case studies dealing with accessibility and walking and their impact on public health. In such a way, relevant policies meet the double goal of both creating more livable and equitable communities, as well as for providing viable alternatives for a sustainable transition of urban areas in harmony with nature [20].

A further benefit associated with linear parks has to do with the promotion of sustainable urban regeneration. A number of relevant reports note this model of green development as a feasible enhancement of the urban environment, with Rovati and Murgia [21] presenting case studies from around the globe. Other researchers make the connection to the positive economic impacts of linear parks in relation to the adjacent businesses [22], while others note similar socioeconomic advantages as derived from city design initiatives that use greenways as the catalysts for sustainable development and regeneration [23].

An ecosystem enrichment and diversification approach is another aspect of sustainable urban development attributed to linear greenways with researchers instigating park size parameters for the provision of ecosystem benefits to urban flora and fauna [24]. Others have reflected on the implementation of urban ecology enhancements through eco-generated park redevelopments [25] and also on the stimulation of sustainable development in mixed-use parks [26]. Yet others have revisited the creation of linear parks as zones of defense against climate change by mitigating the impacts of floods in urban areas through the incorporation therein of bioswales, retention ponds and overflow discharge channels [27].

Another important sustainable development goal achieved by linear parks has to do with both aspects of recreation and leisure in densely populated urban areas and how these may be conveniently coupled to the conservation of culturally significant landscapes. Kryakhtunov et al. [28] have worked on a systems approach for the conservation of specially protected natural areas as a constituent element of sustainable development, but also as a byway towards sustainable landscape synergism [29] community related development [30] by assigning these protected areas a recreation component where appropriate.

A. Physical Activity and Health

Physical activity and its relationship to park design and infrastructure play a vital role in economic performance and indicators. Proximity to green spaces has been associated with increased property values and reduced poverty levels, leading to more resilient and socially cohesive communities across diverse cultures [31].

The continuous objective of international organizations is to encourage individuals, particularly urban residents who lead predominantly sedentary lives, to adopt activities associated with the presence of parks near their homes and workplaces [5]. These activities aim to improve the quality of life and potentially extend its duration through enhanced health [7]. The World Health Organization (WHO) has developed a strategy for Physical Activity (PA) in the European Region for the period 2016-2025, targeting sedentary lifestyles that contribute to non-communicable diseases (NCDs), which are among the leading causes of death in Europe [5].

In the United States alone, an estimated 200,000 to 300,000 deaths are attributed to insufficient physical activity [2]. Addressing the top seven risk factors, including physical inactivity, can significantly reduce disability-adjusted life-years lost in the European Region and high-income European countries by nearly 60% and 45%, respectively [31].

According to the WHO, physical activity is a fundamental aspect of lifelong health. In addition to its well-known benefits in preventing NCDs, it has positive effects on mental health by reducing stress reactions such as anxiety and depression, potentially delaying the onset of conditions like Alzheimer's disease and dementia. Physical activity also plays a vital role in achieving energy balance and controlling weight [5]. Among older individuals, physical activity helps maintain health, agility, functional independence, and social participation. It can

also contribute to balance, stability, and rehabilitation for chronic diseases, making it a crucial component of a healthy lifestyle [5].

Physical activity is effective at all stages of chronic disease management, from prevention to treatment and rehabilitation, resulting in improved quality of life and reduced healthcare costs [32]. Recommended guidelines for physical activity include frequency, duration, type, and intensity [1]. There are various forms and levels of intensity, such as fundamental movement skills, active play, leisure activities like walking, dancing, hiking, and biking, sports, and structured exercise [5]. Physical activity is categorized into four domains: leisure/recreation/exercise, occupation/school, transportation, and household, each influenced by different features and policies in the built environment [32].

The WHO recommends that adults and older individuals engage in at least 150 minutes of moderate-intensity aerobic physical activity per week, while children and young people should accumulate at least 60 minutes of moderate to vigorous-intensity physical activity daily. However, even small amounts of physical activity are beneficial [5]. Moderate-intensity aerobic physical activity can be as simple as brisk walking, while vigorous-intensity activity includes activities like jogging [33]. To promote and maintain good health and physical independence, adults should also engage in activities that maintain or increase muscular strength and endurance at least twice a week, incorporating major muscle groups [33]. Climbing stairs is a suitable activity among others to maximize strength development [33].

B. The Impact of the Built Environment on Physical Activity and Public Health

The built environment encompasses all human-made structures and spaces, including buildings, surrounding grounds, community facilities, transportation infrastructure, parks, and trails [32]. According to Troped [34], it includes the man-made settings that can be utilized for engaging in a more active lifestyle and may entail different urban components, such as: entire areas or city districts, circulation corridors and rights-of-way, individual buildings or building complexes, as well as infrastructural networks pertaining to mobility or urban furniture. The design of the built environment plays a crucial role in improving public health [4]. Various characteristics of the built environment, including transportation systems, have been linked to chronic disease rates, mental health, and risk factors [32], [35].

Additionally, creating an accessible built environment can encourage individuals with disabilities to be physically active and socially integrated within their communities [35]. Designing spaces and streets that promote walking, cycling, and active transportation, as well as establishing facilities like trails, swimming pools, parks, courts, greenways, soccer fields, picnic areas, open spaces, and playgrounds [1], [32], can foster physical activity and meet the requirements for active engagement.

Research exploring the relationship between the built environment and health has predominantly focused on housing,

transportation, and neighborhood characteristics [37]. Pate et al. [36] point out that the environment often poses significant barriers to physical activity participation, including a lack of bicycle trails and pedestrian paths away from traffic, inclement weather, and unsafe neighborhoods. Other studies consistently demonstrate a connection between a deteriorated physical environment and higher crime rates, making neighborhoods less safe for walking and sometimes leading to increased social isolation [37].

The literature consistently highlights the implications and importance of the built environment in promoting physical activity and public health. Although this study focuses solely on the effects of park design on physical activity, it is worth providing a brief summary of the role of the built environment in public health and other elements that can encourage physical activity.

III. PARKS AND PUBLIC HEALTH

Local parks are easily accessible facilities and services that are available at little or no cost. Studies [38] indicate that people and communities derive various benefits from local parks and organized recreation programs and facilities. These benefits can take different forms, including:

- Personal benefits, which are relevant to an individual's health, physiological well-being, and mental well-being. They involve finding a balance between active and sedentary pastimes, with exercise promoting physical health while relaxation and leisure activities in natural environments contribute to overall well-being.
- Environmental benefits, which focus on the health of entire ecosystems and aim to strike a balance between flora, fauna, and human presence.
- Social benefits, which emphasize the collective and enhance community resilience and acceptance by providing spaces for community interaction and cohabitation. These benefits are characterized by diverse locations that cater to a diverse community.
- Economic benefits, which consider the reciprocal and multiplying effects resulting from proximity to park facilities and complementary uses that enhance commercial activities. Parks can contribute to the economic value of the surrounding area and attract business activity.
- Cultural benefits, which view parks not only as spaces for relaxation, leisure, and physical activity but also as venues for education and the production of culture. They host a range of activities that transform them into outdoor classrooms.

Local parks also play a critical role in preserving natural resources, protecting open spaces, and connecting children to nature. They contribute to improving the overall health and wellness of the community by promoting social equity [38]. By offering universally accessible programs that appeal to and bring together diverse groups of people, parks act as social levelers.

Furthermore, the National Recreation and Park Association [39] adds that parks play a key role in the physical and mental

development of youth and young adults. Through organized activities, parks help develop social skills, foster interaction and collaboration in natural settings, and teach individuals how to analyze and overcome challenges, thereby nurturing responsible and informed citizens. In general, park programs can assist youth in building optimism, self-confidence, and a sense of autonomy [39]. Fig. 1 depicts the factors influencing park usage frequency and non-use, illustrating the relationship between parks, physical activity, and the benefits of park utilization.

A. Physical Health Benefits

Conveniently located parks are associated with physical activity, which in turn brings about various health benefits. Engaging in physical activity in beautiful natural settings can elevate the human spirit and provide a sense of enjoyment while leading a more active lifestyle [1], [37]. The scenic beauty of natural environments enhances the overall experience of physical activity.

B. Psychological Health Benefits

Engaging in physical activity in natural settings can also have positive effects on psychological well-being. Merely looking out a window at community parks can be uplifting. Studies have shown that park visitors experience improved mood and lower levels of anxiety, stress, and sadness after visiting parks [1]. The combination of physical and emotional engagement in natural settings allows individuals to temporarily escape from daily stresses, reduce depressive feelings, and adopt a more positive outlook towards life's challenges [1], [5], [37].

C. Social Benefits

The presence of well-maintained parks can enhance community pride, especially when the creation and upkeep of these parks involve collective efforts and participatory activities. Parks become shared assets that foster social cohesion, common social activities, and the pursuit of common social goals. They serve as settings where healthy behaviors, such as physical activity, are modeled, and where crime, aggression, and violence are deterred, promoting social interaction among individuals [1], [3], [38].

D. Economic Benefits

Proximity to parks or natural features such as reservoirs, which are considered green and blue infrastructures, has been found to correlate positively with the real estate value of neighboring properties [1], [38]. Parks contribute to the desirability and attractiveness of an area, enhancing its overall economic value.

E. Environmental Benefits

The presence of trees in parks contributes to environmental benefits. Trees help combat air pollution, including emissions from vehicle exhaust, by reducing air pollution and providing shading and cooling effects [1], [38]. They also play a role in shaping the microclimate of the park and its surrounding areas.

IV. PARK CHARACTERISTICS & RELATIONSHIP TO PHYSICAL ACTIVITY

Parks have played an essential role in providing open spaces for congregations, events, and leisure activities throughout history. They have served as places where people can escape the dense and crowded conditions of their work and living environments, offering a proximity to nature and cleaner surroundings that counteract perceived moral decay in urban areas [40]. In addition to these historical reasons, parks today continue to be important for various purposes.

Parks are now seen as places for leisure, recreation, learning, and cultural activities. They cater to a diverse community, regardless of age, gender, mobility, or ethnic background, as emphasized by Healthy People 2020 and the Institute of Medicine [1], [32]. It is crucial for parks to be flexible in the types of activities they can accommodate, addressing the negative effects of stress on human physiology and psychology, and promoting community well-being. These behaviors and considerations should inform urban planning and design strategies, and be incorporated into guidelines and bylaws governing park development and community initiatives [1]. While there are demographic and social variations in park and outdoor recreation behaviors based on factors such as age, gender, race/ethnicity, socioeconomic status, and residential location [1], [3], [40], [41], this study focuses more on the environmental characteristics that encourage physical activity within parks.

Figs. 1 & 2 [1] illustrate the six conceptual areas of environmental characteristics and four geographic areas that influence physical activity within parks.

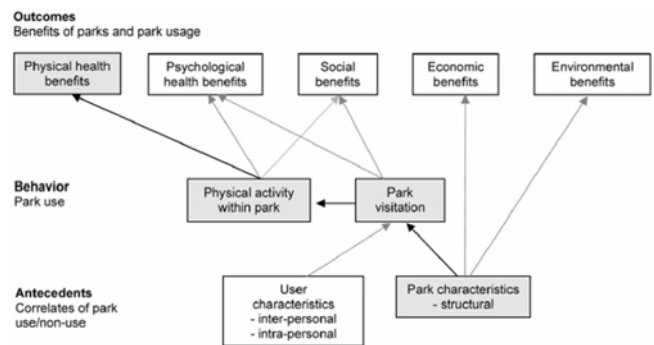


Fig. 1 The relationship between park and physical activity [1]

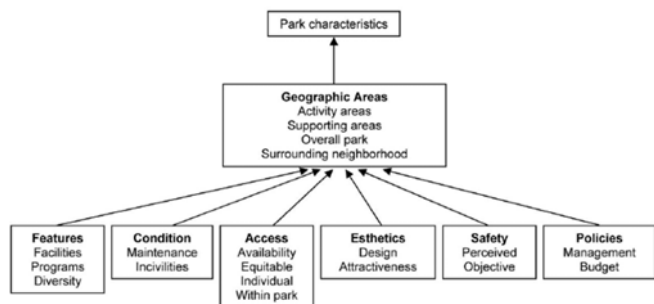


Fig. 2 Environmental classification of park attributes [1]

V.CONCLUSION

In conclusion, extensive research has been conducted on the impact of urban design on physical activity levels and public health. Insufficient physical activity is associated with various non-communicable diseases and premature deaths, making it crucial to promote active lifestyles. While previous studies have primarily focused on housing, transportation, and neighborhood characteristics, this study specifically examined the design and layout of parks and their potential to promote physical activity and public health.

It is evident that park maintenance and safety play significant roles in attracting visitors. People are more likely to visit well-maintained parks that offer a safe environment. Additionally, the size of the park and the presence of trails connecting smaller parks can encourage physical activity and increase park utilization. This paper also concurs with the literature [42]-[47] which emphasizes the importance of parks being easily accessible and offering a variety of activities and amenities for people of all ages who use linear parks as another component of urban infrastructure, based on sound sustainable urban design and development principles and resulting in more active and by extension healthy lifestyles.

Well-designed parks not only provide physical health benefits but also contribute to mental and social well-being. They can serve as spaces for relaxation, leisure, and social interaction, enhancing community cohesion and pride. Furthermore, parks have become particularly important during the COVID-19 pandemic [48], providing flexible outdoor settings for various cultural, leisure, and commercial activities.

Future research can explore the specific environmental characteristics that promote physical activity in parks located in countries with hot climates. Understanding the association between physical activity levels and park characteristics in these regions can provide valuable insights for park design and development initiatives.

Overall, well-designed open parks are valuable community resources that offer numerous physical, mental, and social benefits. By considering the recommendations and implementing appropriate measures, cities can create parks that promote active and healthy lifestyles for their residents.

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