Mimarlık Bilimleri ve Uygulamaları Dergisi
Araştırma makalesi
MBUD 2022, 7 (1), 169-188
e-ISSN: 2548-0170

Journal of Architectural Sciences and Applications
Research article
JASA 2022, 7 (1), 169-188
e-ISSN: 2548-0170

Post-Pandemic Urbanism from the Perspective of Healthy Cities: Evaluation of Urban Green Space Sufficiency in Denizli

Aysun AYGÜN OĞUR [1], Sinem ÖZDEDE [2*], Dalya HAZAR KALONYA [1]
ORCID 1: 0000-0002-9403-7124
ORCID 2: 0000-0002-6887-085X
ORCID 3: 0000-0003-0075-0234
[1] *Pamukkale University, Department of Urban and Regional Planning, 20160, Denizli, Turkiye.*
[2] *Pamukkale University, Department of Landscape Architecture, 20160, Denizli, Turkiye.*
* ***e-mail:*** *sinemozdede@gmail.com*

Abstract

The COVID-19 pandemic has re-bought forward the importance of urban open spaces. The scarcities of public spaces and open green spaces have been effective in keeping the city dwellers in their homes due to the need for isolation during the pandemic era. Despite this, cities with sufficient open green spaces have increased the mobility of city dwellers since people interact less with each other. In the process of re-planning urban areas, developing an integrated approach with green infrastructure strategies in parallel with designing resilient cities has the potential to create healthier cities. In this context, the PP-GS (Post-Pandemic Green Spaces) model of the study reveals the minimum amount of green spaces required per capita in the cities, based on the social distance and healthy living principles that emerged during the pandemic. The study examines the required amount of green space in the Denizli urban center based on the PP-GS model from the perspective of healthy cities and proposes spatial suggestions for post-pandemic urban green space planning.

Keywords: *Kent planlama, sağlıklı kent, kentsel yeşil alan, pandemi, COVID-19, Denizli*

Sağlıklı Kentler Perspektifinden Pandemi Sonrası Şehircilik: Denizli'de Kentsel Yeşil Alan Yeterliliğinin Değerlendirilmesi

Öz

COVID-19 pandemisi kentsel açık ve yeşil alanların önemini yeniden tartışmaya açmıştır. Kamusal alanlar ve açık yeşil alanların kentlerdeki yetersizliği, pandemi döneminde izolasyon ihtiyacı sebebiyle, kent sakinlerini evlerinde hapsolmaya itmiştir. Buna karşın yeterli açık yeşil alana sahip kentler, insanların birbiriyle daha az etkileştiği alanlar yaratmış ve kullanıcılara hareket imkânı sağlamıştır. Kentsel alanların yeniden planlanması sürecinde, dirençli kentler tasarlayabilmeye koşut, yeşil altyapı stratejileriyle bütünleşik bir yaklaşım geliştirilmesi daha sağlıklı kentler yaratmak için bir potansiyeldir. Bu bağlamda çalışmada kullanılan PS-YA (Pandemi Sonrası Yeşil Alanlar) modeli, pandemi ile ortaya çıkan sosyal mesafe ve sağlıklı yaşam ilkelerini temel alarak kentlerde kişi başına düşmesi gereken minimum yeşil alan miktarını ortaya koymaktadır. Yapılan çalışma, Denizli kent merkezinin PS-YA modeline göre ihtiyaç duyduğu yeşil alan miktarını sağlıklı kentler perspektifinden incelemekte ve pandemi sonrası kentsel yeşil alan planlaması için mekânsal öneriler sunmaktadır.

Anahtar Kelimeler: *Urban planning, healthy city, urban green space, pandemic, COVID-19, Denizli*

Citation: Aygün Oğur, A., Özdede, S. & Hazar Kalonya, D. (2022). Post-pandemic urbanism from the perspective of healthy cities: Evaluation of urban green space sufficiency in Denizli. *Journal of Architectural Sciences and Applications*, 7 (1), 169-188.
DOI: https://doi.org/10.30785/mbud.1035878

Received: *13/12/2021* – ***Accepted:*** *25/03/2022*

1. Introduction

Parallel to the COVID-19 pandemic and the socio-spatial crisis experienced in the cities, the importance of urban open and green spaces, the diversity, adequacy, and quality of daily activities have started to be re-discussed in the current literature on planning and urban design. It is seen that researchers mainly focus on the post-pandemic urbanism and urban green spaces in conjunction with the concepts of resilience and commons (Herman & Drozda, 2021; Andres et al., 2021; IASC, 2021; Özdede, Hazar Kalonya & Aygün, 2021).

Quarantine, social distance, and isolation have been among the most effective struggle strategies against the pandemic recommended by the World Health Organization (WHO) (Lunn et al., 2020; WHO, 2020). While these measures and restrictions have created an obstacle to the need for socialization, city dwellers trapped in the "new public spaces" (e.g., shopping malls) have had difficulty accessing urban green spaces during the pandemic, which probably will trigger mass reverse migrations towards the urban periphery and rural areas (Maxwell, 2020). On the contrary, the cities that have offered adequate meeting and socializing spaces to the city dwellers by giving importance to the strategies and alternative methods such as pedestrian access and bicycle transportation have triggered the transformation of healthy and sustainable cities (Eltarabily & Elghezanwy, 2020).

In this process, citizens have tended to use individual transportation alternatives such as private cars, taxis, bicycles, scooters, and/or walking, rather than public transportation which had a greater risk of contamination. The pandemic has required more accessible open spaces, green and blue corridors, and bicycle routes in the cities, which promoted relevant professions such as urban planning, landscape architecture, and urban design for further research on how to design healthy, resilient, and sustainable cities. In this context, it is thought that accessible public open and green spaces, and bicycle and pedestrian routes at the neighborhood scale should be standardized shortly (Barbarossa, 2020).

Urban green spaces, especially urban parks, and neighborhood parks are at the forefront of creating livable and healthy environments. In the pandemic, population density creates a risk and streets need to be re-designed for being safe and active living spaces to restore a healthy social life. It has become one of the most important requirements for the urban space to meet the socialization needs of society while providing a healthy environment (Eltarabili & Elghezanwy, 2020). Although the risk of transmission would decrease through vaccination, the risk of virus mutations or the emergence of similar pandemics shortly reveals the necessity of adopting proactive planning and design principles for creating healthy, resilient, and sustainable cities.

The study aims to examine the required amount of green space in Denizli to achieve a healthy, resilient and sustainable city target by increasing the urban mobility, accessibility, and individual "green transportation" types such as bicycles and walking for minimizing the risks of the COVID-19 pandemic. Accordingly, the study applied the hypothetical PP-GS model developed by Özdede et al. (2021) to calculate the green space adequacy of central districts of Denizli and developed spatial suggestions for improving the planning and design processes in the post-pandemic era.

1.1. Urban Spaces in the Post-Pandemic Era

Population growth and relational human activities create suitable conditions for biological hazards and global epidemics, which are called "pandemics" (Tuğaç, 2020). These epidemic processes emerged many times in history such as the "black plague" in Europe in the 14th century and three "influenza" epidemics in the last century (1918 Spanish flu, 1957, and 1968) (Hobday & Cason, 2009).

In the historical process, pandemics have played an important role in reshaping the cities and public spaces. For example, after the "black plague", designing large public spaces has become a priority in Europe, to reduce the sense of isolation of the citizens and strengthen their relationship with natural areas. Decentralization policies have emerged parallelly to reduce the density of new urban settlements (Mahoney & Nardo, 2016; Hays, 2005).

Allam & Jones (2020) stated that the countries that had serious population loss due to the outcomes of industrialization, civil war, city fires, earthquakes, and diseases have adopted important planning and design strategies to renew the cities and increase livability. Howard's "garden city concept" emerged at the beginning of the 20th century, Olmsted's "green lungs theory", Birmingham's "green belt", Copenhagen's "five finger plan" and Boston's "emerald necklace" are some of the examples that contributed to these strategies. Another example is the "Art Deco" revitalization of old swampy areas in Mumbai after the First World War, which was infested by mosquitoes during the Spanish flu (WHC, 2018; Allam & Jones, 2020).

As the most recent pandemic, COVID-19 emerged in China at the end of 2019, spread to the world, and had been acknowledged as a "pandemic" by WHO in March 2020. The UN Development Program (UNDP) states that "COVID-19 is much more than a global health crisis" because it has triggered many transformation processes in every field (Tuğaç, 2020).

It is predicted that the changes that occurred as a result of the pandemic will create crucial global problems regarding urban planning, urban policies, and urban activities (UN Habitat, 2020; Tuğaç, 2020). Thus, it is necessary to analyze the needs and limitations of the pandemic and to transmit the reflections on the urban space. In this context, Kıygı (2020) stated that the pandemic is a challenging experience for the current spatial production practices of Turkey, which cannot even establish accurate coordination between 1/10 and 1/1000 scale plans in terms of spatial justice.

The pandemic has shown that accessible urban services for daily needs at the neighborhood scale are crucial. In this context, the WHO promoted active modes of transportation such as pedestrians and bicycles to maintain social distance and support physical activity concurrently during the pandemic (Erturan, 2020). In addition, Lai, Leone & Zoppi, (2020) suggest that newly designed and/or existing public spaces should be re-planned to avoid overcrowding, and small or medium-sized open space systems should be replaced with large-scale stadiums, arenas, and entertainment venues for outdoor activities such as sports, recreation, cycling, performance, exhibition, public meetings, and forums.

Flexible use of public spaces has become an urgent requirement in the post-pandemic era and created a different mobility morphology due to changing travel behaviors. In this respect, it can be said that the pandemic has created opportunities to re-design more resilient and sustainable cities (Deponte, Fossa & Gorrini, 2020; Barbarossa, 2020). During the COVID-19 pandemic, urban open and green spaces have had the opportunity to ease the burden on the health sector. For example, the "Park Prescription Movement" carried out by the National Recreation and Park Organization (NRPA) in the USA, recommended the use of parks as a part of "preventive medicine" (Küçükali, Küçükali & Taşdemir, 2016).

In the pandemic era, population density has created a threat and some of the most important problem areas have become the re-establishing a healthy social life, prioritizing urban open spaces, and functionalizing the streets and urban parks for daily activities (Maxwell, 2020).

1.2. Urban Green Spaces from the Perspective of Healthy Cities

According to Turkish Constitution article num. 56, "Everyone has the right to live in a healthy and balanced environment". Healthy Cities Project by the WHO Healthy Cities Network also set out with the slogan of "health for all" that aims to create healthy, clean, and high-quality living environments based on equality (Anonymous, 2020a).

In their study examining the effects of the physical environment on human health, Chae & Kim (2020) state that urban parks have both direct effects such as physical and cultural activities and indirect effects such as clean air and environment on public health. They suggest that green space services and conditions should be improved, considering the increasing demands for parks in the need for isolation after the COVID-19 pandemic.

Accessing green spaces has confirmed serious benefits for stress management and physical and mental health in many previous studies (Velarde et al., 2007). Although the idea of designing urban and public spaces from a healthy city perspective is not recent, the COVID-19 pandemic can be seen as an opportunity to remind us once again that the social life and pandemic phenomenon should be

addressed from the perspective of healthy cities (Eltarabily & Elghezanwy, 2020). Similarly, Tuğaç (2020) emphasizes that the pandemic is an important opportunity to change the way of anthropocentric interaction with the environment and/or nature, which causes serious problems in the context of sustainability and resilience.

The solution seeking to the most recent public health issue of the 21st century has led to the re-emergence of the planning methods that change the lifestyles and reduce the risk of contamination, such as safe and continuous walking and bicycle paths and increased public spaces (Litman, 2020). This approach will also be a step toward reducing vehicle traffic, increasing alternative green transportation systems, and greener settlements with reduced carbon footprint (Rueda, 2019).

During the pandemic, the importance of green spaces in terms of environmental justice was explicitly observed. Urban parks, gardens, natural protection areas, and any area where nature can be reached have become indispensable for the citizens in this period (Herman & Drozda, 2021). Issues such as the role of public open and green spaces in the process of designing healthy cities and accessibility injustice to green infrastructure systems among the low-income and/or minority groups have revealed the need to approach urban parks more carefully in the pandemic era (Joassart-Marcelli et al., 2011). Pehlivan (2021) proposes the "self-sufficient 20-minute neighborhoods model", which aims to prevent agglomeration in certain parts of the city during the pandemic to eliminate this injustice.

Ciddi & Yazgan (2020) emphasize the importance of local and central governments' encouragement of physical activity to protect health and maintain the quality of life. Encouraging citizens to engage in physical activity during the quarantine processes of the pandemic plays a crucial role to maintain health. Considering the relationship between health and green spaces, improving existing urban open and green spaces in line with the needs of the public, increasing the amount and continuity of urban green spaces, and ensuring the accessibility of diverse social groups to green spaces have become the primary issues in the post-pandemic era.

1.3. Urban Green Space Planning

The primary criterion in planning urban green space is accessibility. As stated in the European Commission's Report (2000), accessing green spaces should be possible within an average of 15 minutes walking distance from settlement areas. Accessing time and distance vary according to the use, function, and type of the green spaces; considering a primary school neighborhood unit, a child would expect to reach a playground within 10 min. walking distance (approx. 400 meters), a neighborhood park within 20 min. walking distance (approx. 800 meters), and an urban park within 30 min. walking distance (Manlun, 2003; Altunkasa, 2004; Önder & Polat, 2012).

While planning and design of urban green spaces, the largest benefit and efficiency should be provided. In this respect, hierarchical distribution, size, quality, and accessibility of diversely functioned green spaces (e.g., children's playground, neighborhood park, district park, sports area) should be considered (Önder & Polat, 2012). Another criterion is the green space standards per capita regarding the number and size. Although the amount of green space per capita varies among countries and cities, the minimum size recommended by WHO is 9 m^2 (Küçükali et al., 2016).

Ersoy (2009) compares the green space standards developed by various countries for different functions. According to Table 1, Turkey is insufficient in terms of green space standards among the European countries. The urban park standard, which is 10 m^2/pp (per person) in Turkey, increases to 20 m^2/pp in the USA and England; while the environment/natural park standard is 17 m^2/pp in Turkey, it increases to 40 m^2/pp in England, 48 m^2/pp in Germany and 60 m^2/pp in the USA. It is seen that the regional park standard is 260 m^2/pp in the USA.

While the green space per capita standard was 7 m^2 in the Regulation on the Principles of Producing and Amending the Development Plan, which was published in the Official Journal in 1985, it was increased to 10 m^2 with the amendment made in 1999. Spatial Plans Production Regulation listed all "social open and green spaces" as a playground, park, botanical park, zoo, and recreation area. However, instead of setting a standard for each of them, it has standardized 10 m^2 per person for the

total urban open and green spaces. In the 1999 regulation, the distribution of the green space standard per person according to the function as shown in Table 2 was abolished in the amendment made in 2014, and only the total green space per capita was considered.

Table 1. Green space standards per capita in some countries, m²/pp (Adapted from Ersoy, 2009).

Green Spaces (m²/pp)	USA	Germany	UK	France	Holland	Turkey
Neighborhood Park	10	5,8	-	5	3,5	4
District Park	10	8	-	-	-	7
Urban Park	20	15	20	13	7-9	10
Environment/Natural Park	60	48	40	12	20	17
Regional Park	260	78	-	75	25-30	-
Children Playground Area	1	0.5-2.5	-	-	-	2
Kindergarten	5-6	-	10	5	4	1
Sports Area	-	4.5-5	-	8	6.5	-

Table 2. Green space standards in the regulation dated 02.09.1999 (m²/pp)

Children Playground	Neighborhood Park	Urban Park	Sports Area	Total
1.5	2	3.5	3	10

Urban open and green spaces should meet the needs qualitatively as well as quantitatively, and socio-cultural, economic factors and the tendency of citizens to use parks should relatively be considered. Otherwise, these areas may fail to fulfill their function. The open and green space system is an organic part of urban life. Considering the passive green spaces such as "refugees" in the calculation of "parks" to meet the legal standards is an inefficient way of green space planning. The contribution of green space planning to the life quality can be possible if only land-use decisions, urban morphology, and pedestrian and bicycle mobility networks are integrated into urban green spaces (Öztürk, 2004; Emür & Onsekiz, 2007; Eminağaoğlu & Yavuz, 2010).

Adaptation to the "new normal" standards in terms of lifestyle and urban space functioning has become the prior agenda of post-pandemic urbanization. With the changing transportation preferences, the demand for individual transportation rather than public transportation has increased and been strengthened by bicycle paths and the extension of pedestrianized streets in many cities (Roe & Whiteley, 2021). It is emphasized that by designing walkable neighborhoods for urban services and working areas, urban density can be diminished, mass gatherings in public transportation can be prevented and the risk of contamination can be reduced (Honey-Rosés et al., 2020).

As a result of the quarantine period, the demand for urban open and green spaces has increased. Studies emphasize that green space use after the lockdown period has increased while people relatively adapted to the new normal (Herman & Drozda, 2021). Eltarabili & Elghezanwy (2020) emphasize that the design of green spaces should be built on three pillars to cope with the pandemic crisis: Smart, Sustainable and Comprehensive Planning. To have the optimum benefit of the green infrastructure to public health, a holistic green system consisting of continuous and connected parks and green spaces with different scales, sizes, and functions is proposed instead of fragmented areas (Eltarabily & Elghezanwy, 2020).

The park restrictions in some cities during the pandemic era have revealed the necessity of providing safer environments that respect social distance rules. Accordingly, new design approaches have been applied in green spaces. İzmir Kordon (Figure 1), San Francisco Dolores Park (Figure 2), and New York Domino Park (Figure 3) are some of the new design examples that are considered in this context, aiming to provide safety in the open areas by providing social distance circles to the users.

A recently emerged approach called “Temporary Urbanism” aims to increase the urban health and welfare defined as all practices, policies, and processes that determine the trajectory of a spatial transformation that meets the needs where spatial adaptation is needed. The literature emphasizes that cities that adapt, transform, and restructure after any stress factor are more resilient. From this

perspective, “Temporary Urbanism” can be defined as an approach to be able to contribute to this transformation and adaptation on a micro-scale (Andres & Kraftl, 2021; Akgün Gültekin & Birer, 2019).

While accessing green infrastructure is an important criterion in terms of public health in the living areas that have been transformed into both living and working areas with working from home and lockdown policies, access to green spaces has been an important problem in dense urban settlements. At this point, temporary urban practices can contribute to creating healthy urban spaces with temporary and/or movable parks (parklets), gardens, and green space designs (Andres et al., 2021).

Moreover, during the pandemic process, wide public open spaces have been used as alternative spaces for people to relax and perform physical activities. For example, the old Berlin Tempelhof Airport in Figure 4 functioned as an effective public park by offering sufficient social distance regulations during the pandemic (Kleinschrothve & Kowarik, 2020).

Figure 1. İzmir-Kordon social distance circles (Anonymous, 2020b)

Figure 2. San Francisco Dolores Park social distance circles (Anonymous, 2020c)

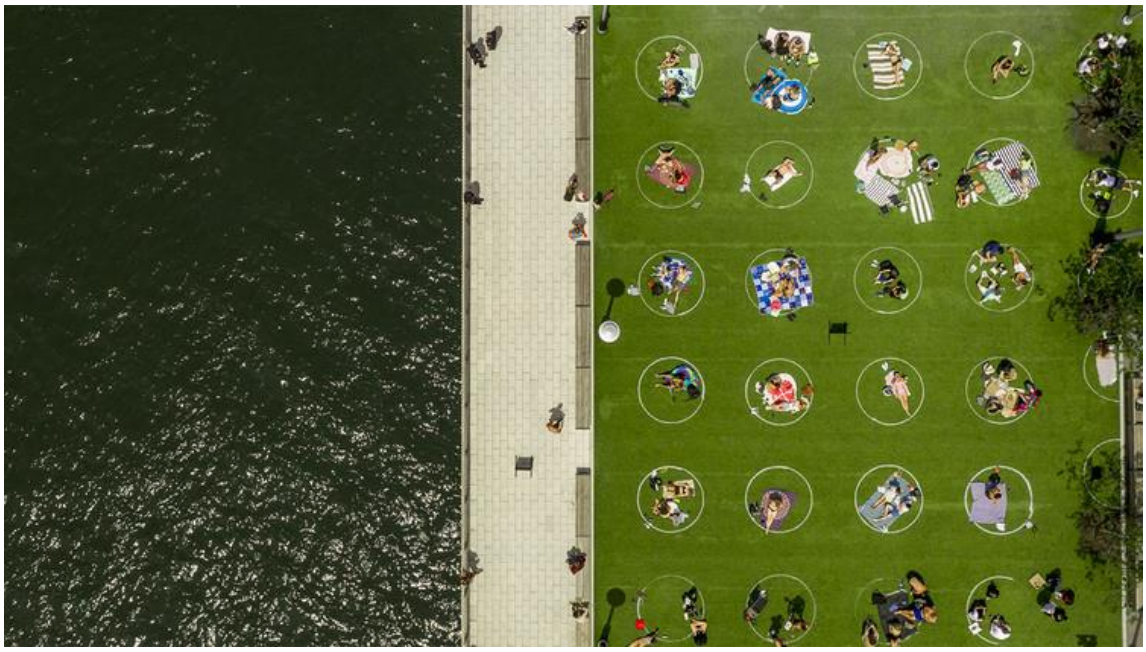

Figure 3. New York Domino Park social distance circles (Anonymous, 2020d)

Figure 4. Berlin Tempelhof Airport as an urban park (Anonymous, 2021)

The results of the study conducted by Herman & Drozda (2021), revealed that parks that have more flexible designs, give freedom to the user in tactical applications such as "Do It Yourself", are more effective in terms of pandemic and social distance. The local government gave priority to planning effective and accessible natural and green spaces in urban centers with an innovative and low-budget approach. “Tactical Urbanism” practices such as widening pedestrian sidewalks, creating temporary bicycle paths, closing some streets, and turning them into temporary parks and gardens have served this purpose (Herman & Drozda, 2021; Atay Kaya & Kut Görgün, 2017).

Post-pandemic urbanism practices for green spaces not only require increased green space per capita, but also a comprehensive approach to the urban green system as a whole. In this context, natural and cultural landscapes such as rural areas, forests, pastures, and lakes should also be considered along with urban parks and gardens, playgrounds and sports fields, squares, and roads within the green infrastructure strategies (Yücesu et al., 2017).

As the studies have revealed, demand for urban open and green spaces has increased in the post-pandemic period. It is obvious that to preserve the quality of urban life, create healthy cities and actively use green spaces, existing standards, functional-spatial distributions, and continuity of the urban green spaces should be the main focuses of planning practices.

2. Methodology and Findings

In the study, the hypothetical PP-GS model proposed by Özdede et al. (2021) regarding the optimum amount of urban green space per capita was used in the direction of the new necessities emerging in the post-pandemic era. Accordingly, the adequacy, area size, and continuity of the existing green spaces in the central districts of Denizli Province were examined.

Urban open and green spaces were spatialized by evaluating the green spaces of Merkezefendi and Pamukkale districts in Denizli. In this context, the optimum green space standards in the post-pandemic era are determined by focusing on public and semi-public open and green spaces (e.g. schools, hospitals, military areas) that can be used as meeting areas in case of disaster. The study aims to create a scientific basis for further research and to improve urban green space standards in the post-pandemic era.

The current green space (m^2) of the central districts of Denizli, which was chosen as the study area, was firstly searched through the TURKSTAT database. However, it has been understood that there is

no aggregated data on the quantity and quality of the green spaces according to provinces and districts in the database. Furthermore, it is determined that the municipalities do not have any collective database on the green spaces. Thus, to calculate the quantity and the quality of the green space standards, the digital map layers are examined using NetCAD and AutoCAD software acquired from Denizli Metropolitan Municipality. The m^2 of the green space layers are calculated by using the "Area-Add-Object" command on the AutoCAD software and applied to the PP-GS model of the study.

2.1. PP-GS Model

Post-Pandemic Green Spaces (PP-GS) Model (Özdede et al., 2021) is created based on the mathematical models used to quantitatively determine the green space standards previously used by Gedikli (2002) and Aytatlı (2013), considering the social distance and restrictions required by the post-pandemic era. The variables in the model are; “social area size per capita”, “group size”, “distance between two groups” and “intensity and frequency of use of the park”. While creating the model, a hypothetical neighborhood of 10,000 people (medium density 150 people/ha) with a walking distance of 400 meters from the primary school unit and a neighborhood park in the center was constructed.

The minimum distance between two people was determined as 2 m, considering the “social distance” phenomenon of the pandemic era (Figure 5). Moreover, the group size was determined as two people and the distance between two groups was determined as 4 m for situations where more than two people are prohibited from being together in public spaces (Figure 6). While determining the intensity and frequency of park use, the frequency of physical activity (at least three times a week, half an hour) recommended by health authorities was taken as the basis.

By placing the determined values in the mathematical formulas, the amount of green space per capita was calculated in Table 3.

Table 3. The amount of green space per capita in a neighborhood according to the PP-GS Model (Özdede et al., 2021)

Variables	Values
Radius of social space occupied by a person (r1)	1 m
Distance between two groups (X)	4 m
Group size (n)	2 pp
Size of social space per person (A)	25.13 m^2/pp
Usage coefficient of neighborhood park (α)	0.43
Parking requirement per person (Ap)	**10.8 m^2**

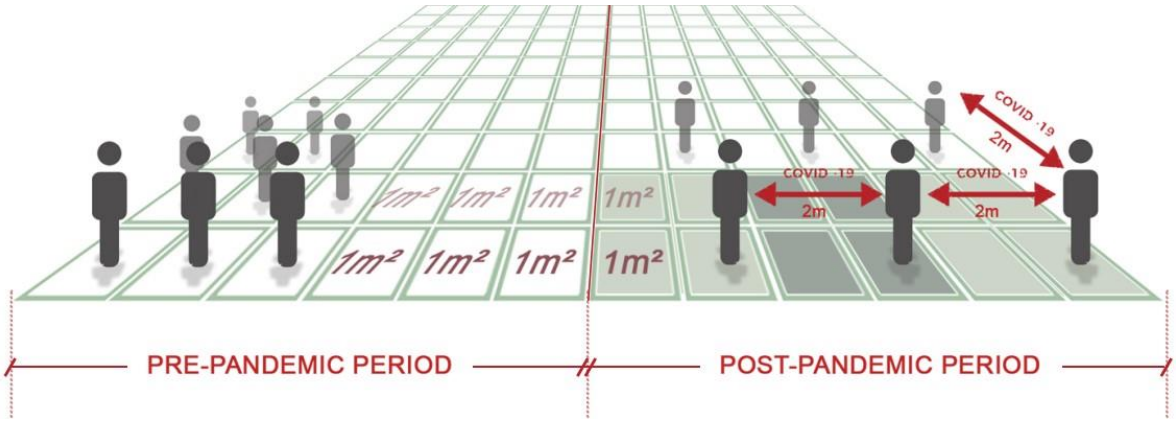

Figure 5. Minimum distance between two people before and after the pandemic (Özdede et al., 2021)

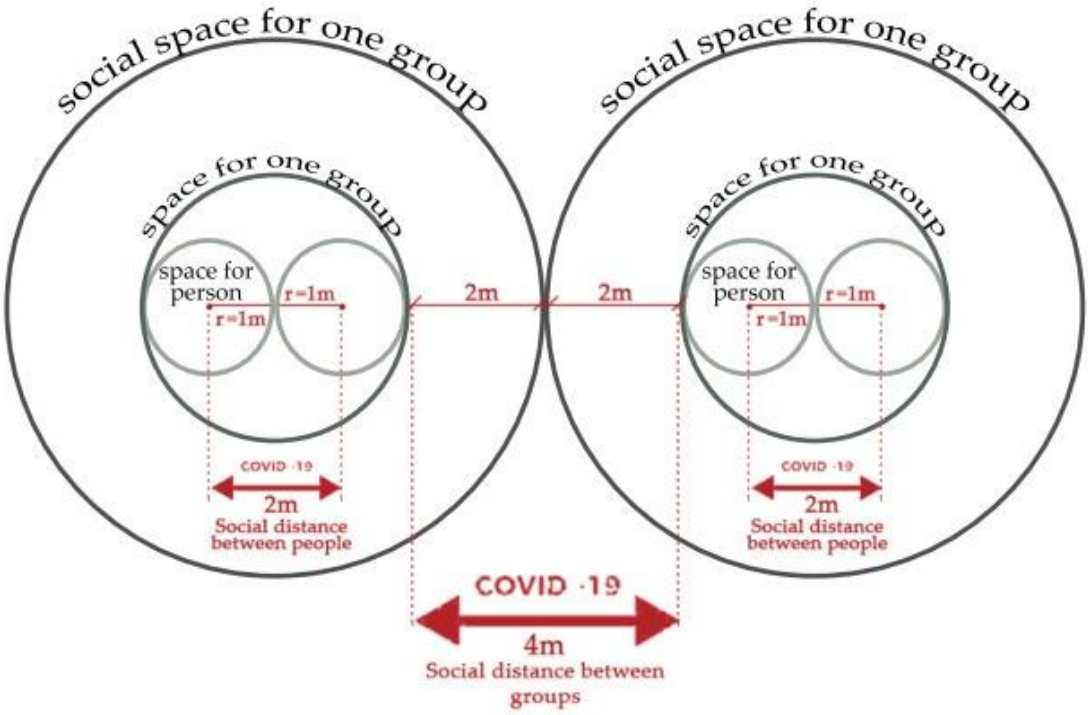

Figure 6. Social distance is determined between individuals and groups (Özdede et al., 2021)

According to the scenario, if each individual uses the neighborhood park 3 days a week, a neighborhood park of 108,000 m² in total, with a unit size of 10.8 m² per person is required in a hypothetical neighborhood with 10,000 inhabitants. When the size ratios among different levels of park determined in regulation are considered and the PP-GS model that is produced for a neighborhood is proportioned based on these ratios, the results seen in Table 4 can be obtained for the whole city.

Table 4. The amount of green space per capita according to the PP-GS Model (m^2/pp) (Özdede et al., 2021)

	Neighborhood Park	Children Playground	Urban Park	Sports Area	Total
Regulation	2	1.5	3.5	3	10
PP-GS	10.8	8.1	18.9	16.2	**54**

According to the model results, when we evaluate the city as a whole in the context of social isolation measures that emerged in the pandemic era, 10.8 m²/pp neighborhood park, 8.1 m²/pp children's playground area, 18.9 m²/pp urban parks, 16.2 m²/pp sports area, and 54 m²/pp total open and green space are required.

In this context, it is revealed that the 10 m²/pp standard specified in the regulation is insufficient in terms of creating healthy cities that offer adequate quantity and quality. The urban open and green space standards need to be reviewed in the post-pandemic era.

2.2. Evaluation of Urban Green Spaces of Denizli

The green spaces of the central districts of Denizli as the study area were examined by comparing the results of the PP-GS model. In 2020, the population of Merkezefendi is 321,546 and the population of Pamukkale is 342,608, and the central districts are 664,154 people in total (TURKSTAT, 2021).

Existing green space sizes (m²/pp) of Merkezefendi and Pamukkale districts are evaluated and compared with the standards produced by the PP-GS Model (Figure 7).

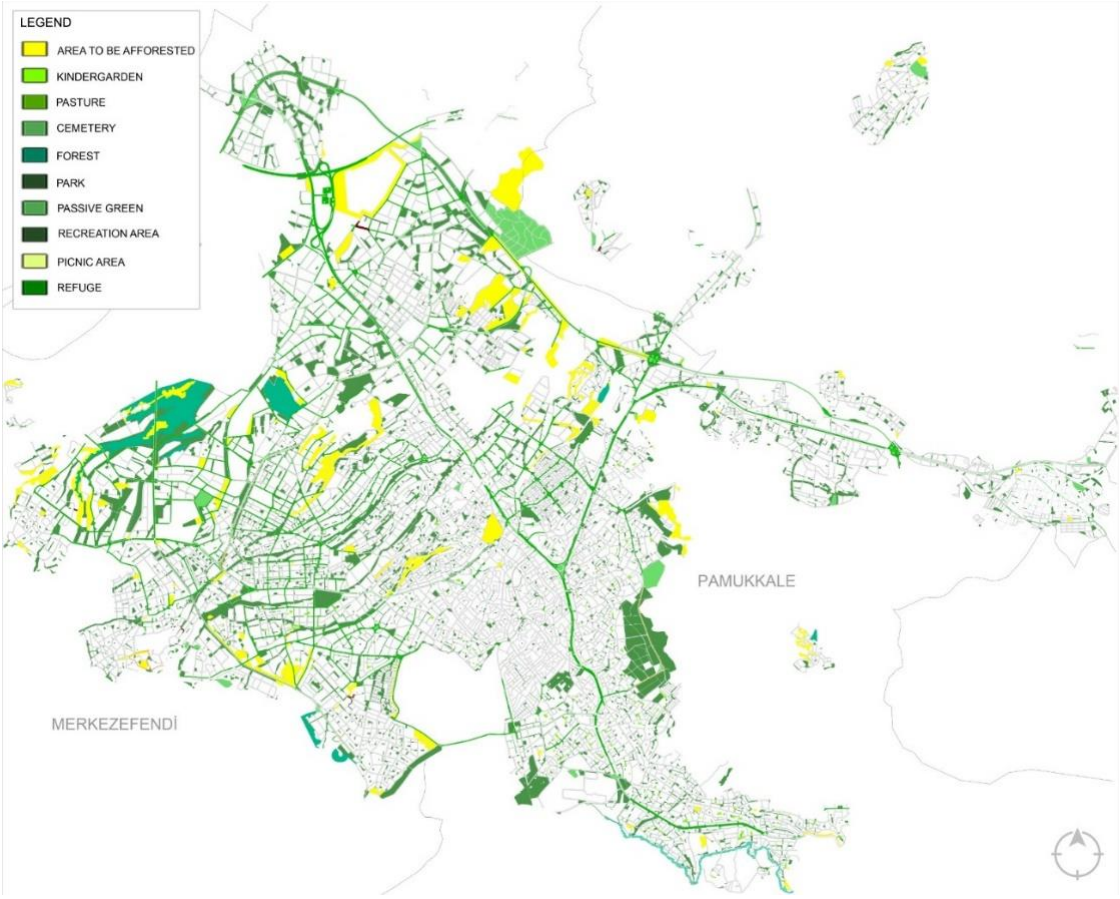

Figure 7. Green spaces of Denizli central districts (Produced by the authors using Denizli Metropolitan Municipality, 2020 data).

Using these values, the total green space sizes were calculated by AutoCAD software, converted to the amount of green space per capita, and used in the model comparison. The green space sizes of Denizli central districts were calculated using the "area" tool in the AutoCAD software on the digital maps obtained from Denizli Metropolitan Municipality and converted into square meters.

Green spaces were calculated in the titles of “neighborhood park”, “children's playground”, “city park” and “sports area”, respectively, leaving the relevant layers open. Considering the often small, fragmented, and discontinuous green space morphology found in the “park” layer it is understood that passive green spaces such as “refugees” are also included in the layers (Figure 8). However, it is foreseen that a clear distinction cannot be made without fieldwork; thus, all areas specified in the layers are included in the calculation.

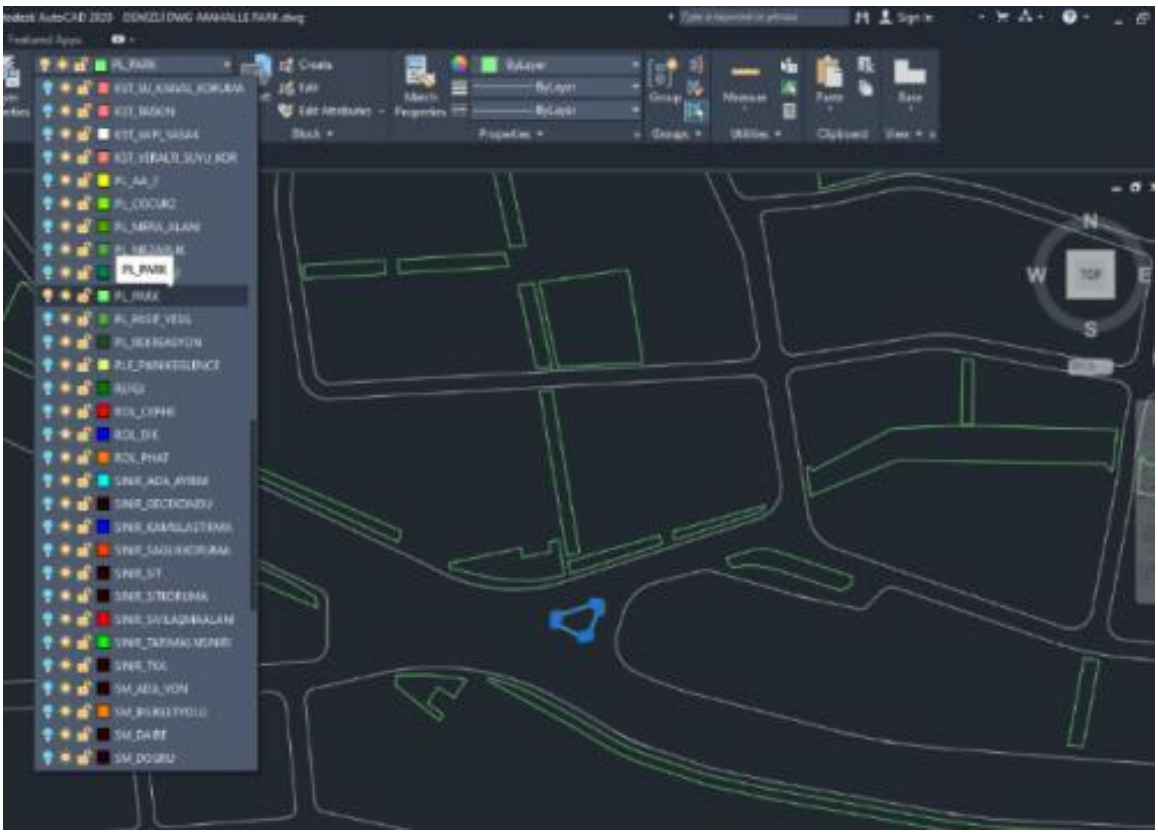

Figure 8. Calculation of the green space amount in Denizli via AutoCAD software.

Accordingly, it has been determined that there are 12.425.182 m^2 of neighborhood parks, 220.282 m^2 of children's playground areas, and 3.173.619 m^2 of urban parks (recreational areas) within the boundaries of Merkezefendi and Pamukkale districts, which have a total population of 664.154 (TURKSTAT, 2021). These numbers are compared with the PP-GS Model numbers recommended for Denizli central districts in Table 5.

Table 5. The amount of green space per capita in Denizli central districts according to the PP-GS Model (m^2/pp).

	Neighborhood Park	Children's playground	Urban Park	Sports Area	Total
Regulation	2	1.5	3.5	3	**10**
PP-GS	10.8	8.1	18.9	16.2	**54**
Denizli Center	18.7	0.33	4.77	-N/A	**23.8**

In the comparison, it is seen that the size of the “neighborhood park” of Denizli Province is above the standard (18.7 m^2/pp) determined in the PP-GS model (10.8 m^2/pp), and it quantitatively provides the size of green space needed within the scope of healthy cities. However, it is seen that the unit sizes of “children's playground area” and “urban park” are not sufficient compared to the model. This situation also reveals the possibility that the relevant areas may have been processed on faulty layers. There is no disaggregated data on “sports areas” on digital maps provided by the municipality so green spaces could not be compared in this category.

When we compare the total green space per capita (23.8 m^2/pp) with the ideal size determined in the PP-GS model (54 m^2/pp), it is seen that Denizli has less than half of the optimum green space per capita and cannot provide social distance in post-pandemic conditions. It is also seen that the green spaces are scattered along with the city in a fragmented and dysfunctional manner. Many areas called “parks” by the municipality do not have the size, quality, and equipment suitable for park usage (Figure 9). Although it seems that there are adequate and accessible open and green spaces within the city, many of these spaces are dysfunctional areas and are not qualified to provide green space adequacy for the city dwellers.

Figure 9. Examples of fragmented and dysfunctional parks in Denizli (Personal Archive, 2021).

Although the continuity of the green spaces seems to be provided in Figure 7, it is seen that the axes that provide continuity are the medians and passive green spaces (refuges) located in the middle of the vehicle roads are not suitable for pedestrian use (Figure 10).

Figure 10. Examples of refuges marked as parks by Denizli Metropolitan Municipality (Personal Archive, 2021).

To have a deeper look into green spaces in Denizli, the central districts are divided into zones considering different characteristics of urban development. Old and dense settlements and newly developing urban areas are included in the zones and those with industry dominancy are excluded. Neighborhoods in the periphery that have a weak connection with the urban centers or that have a rural character are also excluded from the evaluation. As a result, Denizli urban center is divided into seven zones as seen in Figure 11, each having a large urban park within. The distribution of neighborhoods regarding these zones can be seen in Table 6.

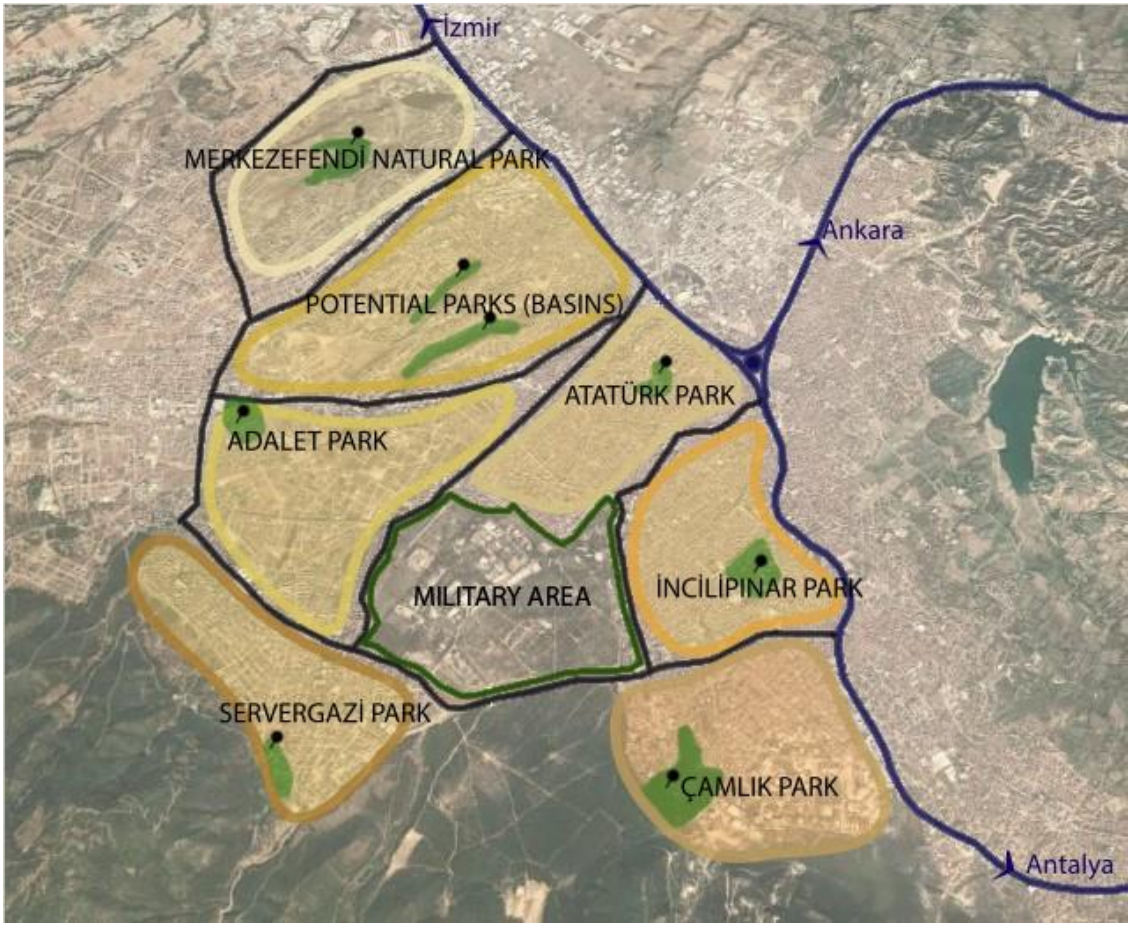

Figure 11. Zones in the city center of Denizli for a detailed evaluation of green spaces.

Table 6. The distribution of neighborhoods to zones

Zone	Neighborhoods
Merkezefendi Natural Park	Kayalar, Yenişafak, Karahasanlı, Hacıeyüplü, Saruhan
Basins	Yenimahalle, Gümüşçay, İlbade, Gültepe, Selçukbey, Şemikler, Çakmak
Adalet Park	Muratdede, Merkezefendi, Bereketler, 1200 Evler, Adalet, Mehmet Akif Ersoy, Alpaslan, Hallaçlar, Barutçular
Atatürk Park	Topraklık, 15 Mayıs, Altıntop, Değirmenönü, Karaman, Akkonak, Sırakapılar, Saraylar
İncilipınar Park	Hacıkaplanlar, Pelitlibağ, Atalar, Fesleğen, Kuşpınar, İstiklal, İncilipınar
Çamlık Park	Kınıklı, Mehmetçik, Yunusemre, Siteler
Servergazi Park	Gerzele, Servergazi, Yenişehir

Based on the neighborhoods in these zones, the total population, urban density, size of total neighborhood parks, and children's playground areas are evaluated for each zone and compared with PP-GS model standards to reveal the specific necessities of different spatial zones (Table 7).

Table 7. The evaluation of green spaces for each zone.

Zone	Population	Urban Density (p/ha)	Neighborhood Park			Children Playground		
			m^2	m^2/pp	PP-GS Model (10.8 m^2/pp)	m^2	m^2/pp	PP-GS Model (8.1m^2/pp)
Merkezefendi Natural Park	23772	8.00	2,131,021	89.64	256,737	0	0	192,553
Basins	67939	55.01	1,353,140	19.91	733,741	1,490	0.02	550,305
Adalet Park	69965	57.17	1,251,882	17.89	755,622	12,058	0.17	566,716
Atatürk Park	95998	218.16	131,015	1.36	1,036,778	8,437	0.08	777,583
İncilipınar Park	77190	228.00	109,752	1.42	833,652	4,159	0.05	625,239
Çamlık Park	47158	16.00	376,635	7.98	509,306	26,203	0.55	381,979
Servergazi Park	37755	11.02	690,100	18.27	407,754	9,816	0.25	305,815

Regarding the neighborhood parks, zones with a relatively low density like Merkezefendi Natural Park, Basins, Adalet Park and Servergazi Park have a larger amount of green space per capita in total than the PP-GS model standard. These areas are located at the new development zones of the city and planned considering bicycle routes and continuous green spaces (Figure 12).

Figure 12. Bike routes in Servergazi Park zone (Personal Archive, 2021).

These zones also benefit from locating at the peripheries of the city that is adjacent to forests and natural areas. Moreover, the natural heritage in these areas is protected since the basins are not suitable for settlements and benefit as a large green continuous axis (Figure 13).

Figure 13. Lavender gardens in Merkezefendi Natural Park zone (Personal Archive, 2021).

Although there are positive aspects of newly developed green spaces, they cannot be seen in the urban center. The most densely populated zones including Atatürk Park, İncilipınar Park, and Çamlık Park suffer from the lack of sufficient green spaces. The sizes of green spaces do not meet the required standards in the regulations. It can be said that the most problematic areas in Denizli regarding urban green spaces are the densely populated central zones. These zones also include the traditional commercial centers that attract a dense population during the day. In terms of the number of children's playground areas, it is seen that none of the zones provide the required amount of space for the city.

Denizli has a promising potential to transform into a healthy and resilient city due to its natural heritage diffused in the city. The proposed conceptual scheme for connected urban green spaces in Denizli can be seen in Figure 14. Further planning recommendations are listed as;

i. The natural areas in the city should remain even though the population increases in peripheral zones.

ii. The continuity of bicycle and pedestrian routes in new development zones should be sustained within new settlements.
iii. The fragmented and unqualified green spaces can be benefited to create green routes in the city. For this purpose, pedestrian routes should be considered as a part of the green system by re-designing.
iv. The comfort level for walking should be increased by planting wide shadow trees to make walking more attractive for dwellers.
v. In the dense city center, open spaces can be used for "tactical urbanism" practices and benefited as a part of the green system.
vi. By "tactical urbanism" bicycle and pedestrian routes should be connected to the city center.
vii. The green connections between zones and urban parks should be enriched by green corridors.

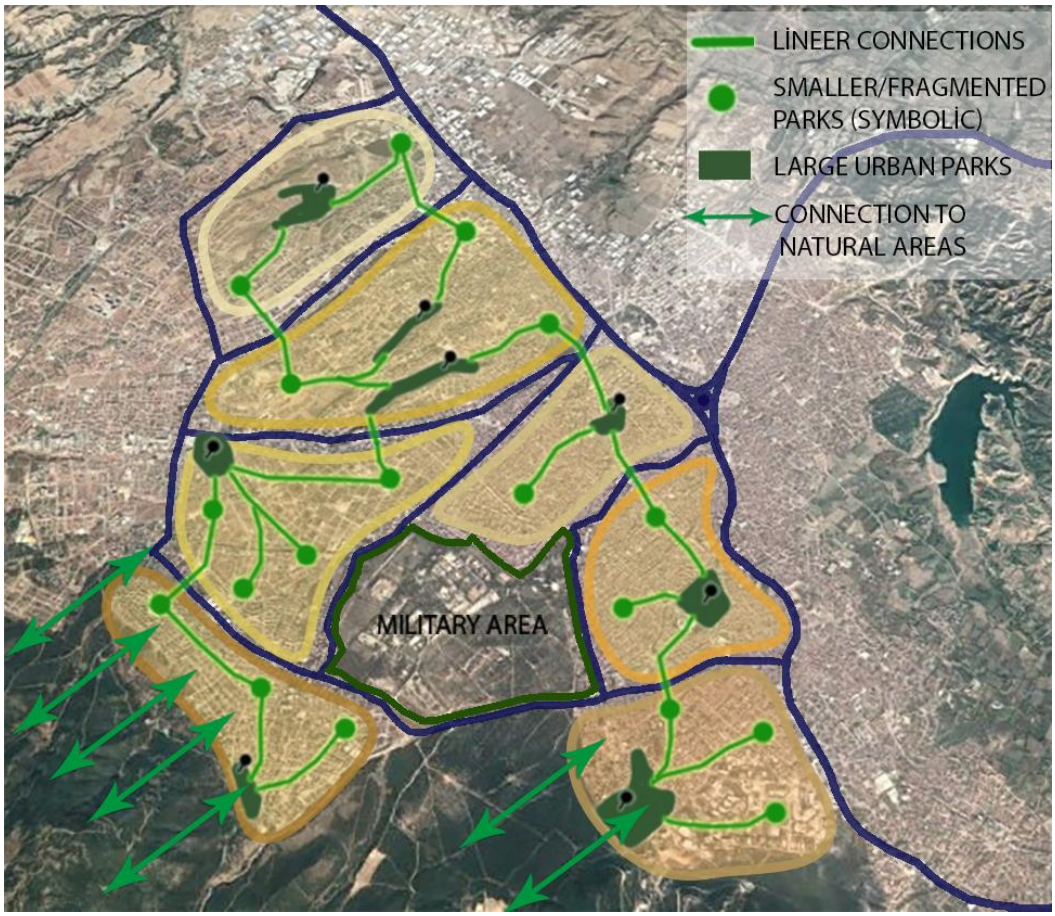

Figure 14: Conceptual scheme for connected urban green spaces

3. Conclusion and Evaluation

The COVID-19 pandemic has had significant consequences, especially in metropolitan cities, affecting the lifestyles of present and future generations. During the pandemic, playgrounds were closed in some areas, parks were locked and access to open spaces for recreation was interrupted. The pandemic era has revealed the lack of green spaces in cities due to the increased risk of contamination in densely populated settlements. In addition, accessibility inequalities to parks in terms of size and quality have become more visible.

Green spaces can be effective in the development of the city if only there is a systematic formation. The organization of cities and their attainment of a healthy environment depend on the distribution of open and green spaces in the city, their size, function, and aesthetic qualities. Open and green space systems should be designed in a holistic system, considering the characteristics of cities (Eminağaoğlu & Yavuz, 2010). Spatial arrangements should be made in existing cities to offer a

healthy urban life according to the “new normal” standards. Considering the needs that emerged with the COVID-19 pandemic, the creation of urban spaces that protect physical and mental health and the quality of life, and the evaluation of green spaces from the perspective of healthy cities can guide planning approaches during the post-pandemic era. In this study, it is evaluated whether Denizli is a healthy city in terms of urban open and green spaces within the framework of pandemic conditions.

According to the PP-GS model, 54 m²/pp of open and green space is needed throughout the city in the post-pandemic era. As a result of the model, the 10 m²/pp standard specified in the current regulation is insufficient in terms of creating healthy cities that offer high quality of life and the necessity of revising urban open green space standards emerges as a result of the model.

According to the findings, it was revealed that Denizli could not provide sufficient and functional use of open and green spaces to the city dwellers in terms of size, continuity, and accessibility. The deficiencies of the city in terms of open and green space systems can be summarized as i) The size of the urban green spaces is not sufficient to meet the social distance rules, ii) The green spaces are too fragmented, small, scattered, and dysfunctional, iii) The passive green spaces (e.g. refugees) are not suitable for use by the city dwellers are included in the green space systems, iv) qualified green spaces to have lack of continuity.

All in all, the primary goal of Denizli should be to ensure the continuity between the green spaces. Although there are many fragmented and dysfunctional green spaces, they can be included in the green infrastructure system by giving function to these areas through “tactical urbanization” and “temporary urbanization” approaches and practices. By including design elements such as pocket parks, pedestrian and bicycle paths, accessible and qualified open and green space systems can be designed throughout the city. From this point of view, it can be said that there are important advantages to healthy urban planning in Denizli during the post-pandemic era and the resilience of the city can also be increased by using these advantages.

It is seen that the cities, which cannot provide the green space standards that are valid today, are quite lacking in the formation of healthy urban environments in the post-pandemic era. While setting new normal standards in the cities, it is necessary rethinking open and green spaces in terms of practices, functions, and accessibility of local citizens, which turned out to be insufficient primarily in terms of quantity and accessibility. On the other hand, each city has unique necessities in terms of its location, climate, population, or natural heritage. For example, a city located on a coastal line or riverside has natural open space while an inner city with no watershed suffers from a lack of open spaces and requires more parks and planned green spaces. The model proposed in this study can be modified for other cities or settlements by considering the citizens’ requirements on green spaces usage frequency, population, and habits.

Acknowledgment and Information

This article was presented at the "2nd international City and Ecology Congress within the Framework of Sustainable Urban Development" and was only published in summary. It complies with national and international research and publication ethics. Ethics committee permission was not required for the study.

Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

References

Anonymous. (2020a). Turkish Healthy Cities Association, http://www.skb.gov.tr/wpcontent/uploads/2014/05/Sağlıklı-Kentler-Hareketi-Mayıs-2014.pdf, Access date: 07.12.2020.

Anonymous. (2020b). İzmir Kordon social distancing measures, https://www.izmir.bel.tr/tr/Haberler/izmir-de-yesil-alanda-cemberli-sosyal-mesafe-donemi/43622/156, Access date: 07.11.2021.

Anonymous. (2020c). San Francisco Dolores Park social distancing measures, https://www.sfgate.com/local/slideshow/SF-Dolores-Park-social-distancing-circles-202586.php, Access date: 07.11.2021.

Anonymous, (2020d). Domino Park social distancing measures, https://www.archdaily.com/940244/domino-park-introduces-social-distancing-circles-to-adapt-to-the-covid-19-crisis, Access date: 07.11.2021.

Anonymous, (2021). Berlin Tempelhof Airport as an urban park, https://www.liberationroute.com/pois/247/tempelhof-airport, Access date: 17.11.2021.

Akgün Gültekin, A. & Birer, E. (2019). Kamusal Alanda Özgürleştirici Müdahaleler: Parazit Mekanlar, Kent Akademisi 12 (40), 4, 729-738.

Allam, Z. & Jones, D. S. (2020). Pandemic stricken cities on lockdown. Where are our planning and design professionals [now, then and into the future]?. *Land Use Policy*, 97, 104805.

Altunkasa, M. F. (2004). Adana'nın kentsel gelişim süreci ve yeşil alanlar. Adana Kent Konseyi Çevre Çalışma Grubu Bireysel Raporu, p.17, Adana.

Andres, L., Bryson, J. R. & Moawad, P. (2021). Temporary Urbanisms as Policy Alternatives to Enhance Health and Well-Being in the Post-Pandemic City. Current environmental health reports, 1-10.

Andres, L. & Kraftl, P. (2021). New directions in the theorization of temporary urbanisms: adaptability, activation and trajectory. *Progress in Human Geography*, 45(5), 1237-1253.

Atay Kaya, İ. & Kut Görgün, E. (2017). Kentsel mekân üretiminde 'kendin yap' hareketi, *Planlama* 27 (1), 57-74.

Aytatlı, B. (2013). Erzurum kentinde kişi başına düşmesi gereken aktif açık ve yeşil alan miktarının matematiksel modelle belirlenmesi, Master's Thesis, Atatürk Üniversitesi, Fen Bilimleri Enstitüsü.

Barbarossa, L. (2020). The post pandemic city: challenges and opportunities for a non-motorized urban environment. An Overview of Italian Cases, *Sustainability*,12 (17), 7172.

Chae, J. H. & Kim, W. J. (2020). The Evaluation of physical environmental factors in urban parks for healthy city-focus on Seoul, *Journal of the Korean Institute of Landscape Architecture*, 48(4), 29-40.

Ciddi, P. K. & Yazgan, E. (2020). COVID-19 salgınında sosyal izolasyon sırasinda fiziksel aktivite durumunun yaşam kalitesi üzerine etkisi, *İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi,* 19(37), 262-279.

Denizli Büyükşehir Belediyesi. (2020). Denizli merkez ilçeler yeşil alan katmanları (NetCad / AutoCad); Denizli merkez ilçeler ortofoto.

Deponte, D., Fossa, G. & Gorrini, A. (2020). Shaping space for ever-changing mobility. COVID-19 lesson learned from Milan and its region'. TEMA Journal of Land Use, Mobility and Environment. Special Issue | COVID-19 vs City-20, 133-149.

WHO. (2020). Coronavirus disease 2019 (COVID-19) situation report — 44. Access date: 4.5.2020.

Eltarabily, S. & Elghezanwy, D. (2020). Post-pandemic cities-the impact of COVID-19 on cities and urban design. *Architecture Research*, 10(3), 75-84.

Ersoy, M. (2009). Kentsel Planlamada Arazi Kullanım Standartları, TMMOB Şehir Plancıları Odası Yayınları, Ankara.

Erturan, A. (2020). Pandemi ve post-pandemide kentlerimizde nasıl ulaşacağız. Spektrum tasarım rehberleri, Pandemide ve Post-pandemide Toplum ve Mekân: Görüşler, Öngörüler, Öneriler. Issue;02.

Eminağaoğlu, Z. & Yavuz, A. (2010). Kentsel yeşil alanların planlanması ve tasarımını etkileyen faktörler: Artvin ili örneği, III. Ulusal Karadeniz Ormancılık Kongresi, Vol: IV p: 1536-1547.

Emür, S. H. & Onsekiz, D. (2007). Kentsel yaşam kalitesi bileşenleri arasında açık ve yeşil alanların önemi- Kayseri Kocasinan İlçesi park alanları analizi. *Sosyal Bilimler Enstitüsü Dergisi*, 22 (1), 367-396.

Gedikli, R. (2002). Kentlerde, kişi başına düşmesi gereken açık yeşil alan büyüklüğünün değerlendirilmesinde kullanılabilecek matematik model önerisi, *Planlama*, 4(1), 62-76.

Hays, J. N. (2005). Epidemics and pandemics: Their impacts on human history. Abc-clio.

Herman, K. & Drozda, Ł. (2021). Green Infrastructure in the Time of Social Distancing: Urban Policy and the Tactical Pandemic Urbanism. *Sustainability,* 13(4), 1632.

Hobday, R. A. & Cason, J. W. (2009). The open-air treatment of pandemic influenza. *American Journal Of Public Health,* 99(2), 236-242.

Honey-Rosés, J., Anguelovski, I., Chireh, V. K., Daher, C., Konijnendijk van den Bosch, C., Litt, J. S., Mavani, V., McCall, M. K., Orellana, A., Oscilowicz, E., Sanchez, U., Senbel, M., Tan, X., Villagomez, E., Zapata, O. & Nieuwenhuijsen, M. J. (2020). The impact of COVID-19 on public space: an early review of the emerging questions–design, perceptions and inequities. *Cities&Health*, 1-17.

IASC (2021). IASC 2021 Urban Commons Conference, https://www.youtube.com/watch?v=YWn7QlH9VuA, Access date: 10.05.2021.

Joassart-Marcelli, P., Wolch, J. & Salim, Z. (2011). Building the healthy city: The role of nonprofits in creating active urban parks. *Urban Geography* 32(5), 682-711.

Kıygı, G. (2020). Salgının mekânsal hafızası: norm, ölçek, adalet, Spektrum tasarım rehberleri, Pandemide ve Post-pandemide Toplum ve Mekân: Görüşler, Öngörüler, Öneriler, Issue: 02.

Kleinschroth, F. & Kowarik, I. (2020). COVID-19 crisis demonstrates the urgent need for urban green spaces. *Frontiers in Ecology and the Environment*, 18(6), 318.

Küçükali, H., Küçükali, İ. & Taşdemir, M. (2016). Sağlığın yeşil belirleyicileri: Parklar, Sağlık Düşüncesi ve Tıp Kültürü Dergisi, p. 40-45.

Lai, S., Leone, F. & Zoppi, C. (2020). COVID-19 and spatial planning. A few issues concerning public policy, TEMA Journal of Land Use, Mobility and Environment. Special Issue | COVID-19 vs City-20, 231-246.

Litman, T. (2020). Pandemic-resilient community planning. Victoria Transport Policy Institute.

Lunn, P. D., Belton, C. A., Lavin, C., McGowan, F. P., Timmons, S. & Robertson, D. A. (2020). Using Behavioral Science to help fight the Coronavirus. Journal of Behavioral Public Administration, 3(1). https://doi.org/10.30636/jbpa.31.147

Mahoney, E. & Nardo, D. (2016). The Black Death: Bubonic Plague Attacks Europe. Greenhaven Publishing LLC.

Manlun, Y. (2003). Suitability analysis of urban green space system based on GIS. Master of Science, International Institute for Geo-Information Science and Earth Observation Enschede, Netherlands.

Maxwell, P. (2020). Post-pandemic urbanism: why embracing street life is central to the future of the city, Frame, https://frameweb.com/article/post-pandemic-urbanism-why-embracing-street-life-is-central-to-the-future-of-the-city?fbclid=IwAR2qxqFBJ4SEl25sR0k1Hrj7XMko303C5uCo8g58niRkDewYVUdDLl8-ka0, Access date: 02.10.2020.

Önder, S. & Polat, A. T. (2012). Kentsel açık-yeşil alanların kent yaşamındaki yeri ve önemi. Kentsel Peyzaj Alanlarının Oluşumu ve Bakım Esasları Semineri, 19, 73-96.

Özdede, S., Hazar Kalonya, D. & Aygün, A. (2021). Pandemi Sonrası Dönemde Kişi Başına Düşen Kentsel Yeşil Alan İhtiyacını Yeniden Düşünmek, *İdealkent* 12 (Covid-19 Special Issue), 362-288.

Pehlivan, H. (2021). Socio-Spatial Inequalities Deepened by the COVID-19 Pandemic and New Dynamics of Urban Space, *Planning* 31(3): 352-360.

Roe, D. & Whiteley, J. (2021). Post-Pandemic Urbanism. A discussion paper on planning and urban design considerations for cities during the pandemic and after. City of St. Louis Planning and Urban Design Agency. MO, USA.

Rueda, S. (2019). Superblocks for the design of new cities and renovation of existing ones: Barcelona's case. In Integrating human health into urban and transport planning. 135-153. Springer, Cham.

Tuğaç, Ç. (2020). Kentsel Sürdürülebilirlik ve Kentsel Dirençlilik Perspektifinden Tarihteki Pandemiler ve COVID-19 Pandemisi, *Sosyal Bilimler Enstitüsü Dergisi*. Salgın Hastalıklar Özel Sayısı, 259-292.

TURKSTAT. (2021). Denizli ilçe nüfusları, https://tuikweb.tuik.gov.tr/PreTabloArama.do?metod=search&araType=vt, Access date: 10.05.2021.

UN Habitat (2020). UN-Habitat COVID-19 Response Plan. Access date: 03.05.2020, https://unhabitat.org/sites/default/files/2020/04/final_u n-habitat_covid-19_response_plan.pdf

UNDP. (2020). UN Human development deport, https://www.tr.undp.org/, Access date: 19.12.2020.

Velarde, M. D., Fry, G. & Tveit, M. (2007). Health effects of viewing landscapes–Landscape types in environmental psychology. *Urban Forestry& Urban Greening*, 6(4), 199-212.

WHC. (2018). Victorian Gothic and Art Deco Ensembles of Mumbai - Map of the Inscribed Property, World Heritage Council - UNESCO (2018), Access date: 22.04.2020, https://whc.unesco.org/en/list/1480/documents/

Yıldızcı, A. C. (1982). Kentsel yeşil alan planlaması ve İstanbul örneği. İTÜ Fen Bilimleri Enstitüsü. Unpublished PhD Thesis, İstanbul.

Yücesu, Ö., Korkut, A. & Kiper, T. (2017). Kırklareli Kent Merkezinin Açık ve Yeşil Alanlarının Analizi ve Bir Sistem Önerisi, *Artium,* 5 (2), 22-37.