

The changing context of walking behavior: coping with the COVID-19 Pandemic in urban neighborhoods

The changing context of walking behavior

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Abstract

Purpose – It is observed that the COVID-19 Pandemic mostly restricts people's movement and walking habits. In this direction, this study aims to highlight how the walking behaviors of individuals affected in different geographies' neighborhoods before and during the Pandemic.

Design/methodology/approach – This paper focuses on the relationship between neighborhood characteristics and the changing walking behavior of 24 sample regions (514 participants) with the highest incidents of COVID-19 infection from American, European, Asian, Western Pacific, African and Middle Eastern cities. The paper's methodology is supported by an /online questionnaire survey conducted in these 24 disparate neighborhoods in December 2020.

Findings – Findings show that “walkable access” varies over geographies during the Pandemic. Urban amenities within 15–20 min of access become more important than ever. The results unravel that either walkable or non-walkable neighborhoods showcased similarities despite that urban amenities were not within 15–20 min of access. Three prominent aspects should be emphasized to plan walkable neighborhoods: providing walkable access, forming spatial proximity and sustaining social cohesion.

Social implications – The availability of daily amenities, such as shopping stores, health care, education services and pharmacies within a 15–20-min walking distance maintain everyday life and increase social interactions. In addition, places with walkable access encourage an active lifestyle and contribute the public health. The impact of the COVID-19 Pandemic movement restrictions on the walking behavior of individuals highlights how the qualities of distance-based urban planning need to be supported with time-based practical attributes that can shape neighborhood planning frameworks.

Originality/value – This paper highlights the coexistence of “walkability” and “accessibility” measures in urban practice and research to create resilient and sustainable neighborhoods. The “walkable access” term used in the paper addresses joint measures of walkability and accessibility.

Keywords Walkability, Walkable access, 15–20-minutes neighbourhoods, The COVID-19 Pandemic

Paper type Research paper

Introduction

The partial and total lockdowns are imposed to control the spread of COVID-19 infection. A sizeable percentage of individuals from different socio-economic geographies have been forced to spend most of their time at home. Changing travel behavior during the COVID-19 Pandemic made planners refer to the connection of travel behavior and spatial context that facilitates a travel pattern based on a short distance called “spatial proximity” (Weng *et al.*, 2019; Boussauw, 2011).

The public health upheaval caused by the Covid-19 Pandemic has generated significant impacts on societies, cities and settlements around the world (Maturana *et al.*, 2021). Cities like Paris, Melbourne and Shanghai are proposing innovative policies that focus on spatial



proximity-based planning that prioritizes amenity-rich neighborhoods where services fulfilling daily needs are located within (a mile or 1.61 kilometers or 5,280 feet) 15 to 20-min walking distances (Moreno *et al.*, 2021; Weng *et al.*, 2019; Talen and Koschinsky, 2014). Around the world, several conceptual approaches such as the 15-min community life circle and the 20-min neighborhood planning practice, which were accelerated during the COVID-19 Pandemic, have now captured the attention of planners, politicians and human geographers (Guida and Carpentieri, 2021; Salama, 2020; Whittle, 2020).

The need for rethinking urban neighborhoods emerges where distance-based urban planning approaches of the New Urbanism are reconciled with time-based Chrono-urbanism concepts that underline access to necessary urban amenities during the crises. This necessity to understand how COVID-19 disrupted our social and economic systems is crucial for the future of communities, societies and countries around the world (Alraouf, 2021). As one the recent concept of urban studies, Chrono-urbanism is an outgrowth of the concept of “neighborhood units” developed by the American planner Clarence Perry in the early 1900s; the management of cities defines Chrono-urbanism according to time (CNU, 2020; Perry, 2020). And in an op-ed published in 2016, smart city scientist Carlos Moreno brought the concept to the forefront again with “the 15-min city”. Organizing urban areas in this way would allow all residents to access basic needs within a 15-min walk or bike ride. The global COVID-19 Pandemic accelerated the consideration and implementation of the 15-min city in response to the climate crisis and the urban effects of the COVID-19 Pandemic crisis (Moreno *et al.*, 2021).

Through an online questionnaire survey study, this research evaluates people’s 15–20-min walking habits before and during the COVID-19 Pandemic. The survey questionnaires used to describe how walking behaviors are affected by the movement limitations of the COVID-19 Pandemic in 15–20 min walkable (walkable neighborhoods) and non-15–20-min walkable (non-walkable neighborhoods) of 24 neighborhoods located in Africa, Europe, Western Pacific, Southeast Asia, Middle East and North and South Americas from different socio-economic backgrounds. The specific purposes of the research are to:

- (1) Ascertain factors behind the individual’s purpose of walking and place preferences which are forming their walking behaviors before and during the COVID-19 Pandemic,
- (2) Provide insightful suggestions for planning walkable neighborhoods that can be both resilient and socially coherent during any crisis similar to the COVID-19 Pandemic.

The paper’s originality lies in its emphasis on three aspects of neighborhood planning for coping with a crisis such as the COVID-19 Pandemic: walkable access, spatial proximity and social cohesion. These aspects can provide an alternative vision for neighborhood planning approaches and may shed an alternative light on understanding the relationship between the spatial context of the walking behavior of individuals and the planning practice of 15–20-min walkable neighborhoods.

Movement restrictions of the COVID-19 Pandemic

Cities and neighborhoods worldwide have been severely impacted by the COVID-19 Pandemic, causing them to face new challenges. Local and national government administrations announced mandatory lockdowns or strongly worded protocols to mitigate the spread of the COVID-19 infection. These movement restrictions were time-based and age-based mandatory lockdowns and included mandates to wear masks and maintain a social distance of six feet or two meters (CDC, 2021). Adoption of these measures became a “new normal” for almost all individuals living in different cities and neighborhoods

(Sandford, 2020; WHO, 2020). Duration and coverage of lockdowns differed depending on the population and number of cases in the communities. In Russia and Turkey, age-based lockdowns defined scheduled access to daily need services for the vulnerable age groups, such as seniors 65 and over and children under age 16. Time-based lockdowns limited all mobility options for a specific time or day(s) long (CDC, 2021; Fuller *et al.*, 2021; Our World in Data, 2021; WHO, 2020).

In Brazil, South Africa, Indonesia and India, partial and distance-based lockdowns, limited access to all parks, schools, workplaces and places of worship in public places, except emergency health units, cut all physical access to essential urban functions such as work (offices, plazas, ateliers, factories, etc.); commerce (retail, whole sell stores, banks, shopping malls, markets, etc.); education (schools, libraries, museums, etc.); entertainment centers (theaters, cinema, music halls, public centers, etc.) for days, weekends, or months (Haaretz, 2021; Mehtar *et al.*, 2020; Schonfeld, 2020). In the USA, movement restrictions such as personal isolation and stay-home orders are preferred (CDC, 2021; Our World in Data, 2021). Currently, while individuals in communities worldwide are struggling with the current regional economic crisis, terror and administrative challenges, the COVID-19 Pandemic has already worsened poor living conditions and affected walking behavior (Askitas *et al.*, 2021; Kupferschmidt and Cohen, 2020; Sibley *et al.*, 2020). The movement restrictions of the Pandemic show the unpreparedness of many urban neighborhoods in their current planning layouts (Allam and Jones, 2020; Badland *et al.*, 2014; Ritchie, 2020). Urban planning studies should focus on the walking mode of transport and neighborhood walkability, an easy, available, inexpensive and healthful form of physical activity (Dovey and Pafka, 2020; Weng *et al.*, 2019; Yep *et al.*, 2019).

The spatial context of walking behavior of individuals and walkability

The interrelated walkability and walking behavior are two challenging concepts to measure and define separately (Ewing and Cervero, 2010; Forsyth, 2020). Developments in urban neighborhood planning practices of new urbanism have emphasized the principle of walkability and motivating walking behavior as crucial for environmental and social sustainability (Barton, 2020; Leinberger, 2007). Neighborhoods' walkability has been measured using checklists, social surveys, indices and multi-layered spatial analysis. Measures define urban design qualities associated with individuals' perception of walkability and spatial and physical dimensions (Forsyth, 2020; Szerszynski and Urry, 2006; Clemente *et al.*, 2005).

The basic qualities of walking behavior are known as the "five Ds": diversity, density, design, destination and distance (Julie Campoli, 2012; Ewing and Handy, 2009).

Diversity: relates to the mixed land use and texture of destinations which also indicate the preferred walking place of individuals (Ewing and Handy, 2009). Urban amenities already located in the neighborhood and how close they are to each other, such as having housing next to retail stores alongside commercial ones, also define the context of spatial diversity. Mixed land use neighborhoods with residential areas, comingled with commercial zones and entertainment centers, help sustain an economically vibrant social structure. Having a broad mix of daily needs services near housing units can also provide individuals with the opportunities to work close to where they reside.

Density: usually refers to population (in persons per acre or hectare, square mile, or square kilometer) and housing (dwelling units per acre or hectare) (Julie Campoli, 2012; Ewing and Handy, 2009). Population density is sometimes combined with a count of the number of jobs in a given area to calculate an activity density (Ewing and Cervero, 2010). Campoli argues that the quality of walkability is not a physical density itself but the richness of a place that influences peoples' walking behavior (Julie Campoli, 2012; Hutabarat Lo, 2009). Living close

to urban amenities influences the walking behavior of individuals. The availability of these services for meeting daily needs while lessening the reliance on automobiles also increases the motivation for individuals to walk in their neighborhood (Ewing and Cervero, 2010; Shuaib and Rana, 2021). Therefore, urban neighborhood planning can arrange for daily need services whether walking is the best choice for individuals.

Design: includes street network attributes within a neighborhood where vehicular-dependent mobility needs to be incorporated (Julie Campoli, 2012; Ewing and Handy, 2009). Design measures on a neighborhood include physical features such as block size, intersections, sidewalk quality, street width, size or number of trees and availability of pedestrian-friendly services. Campoli's discussion of walkable street design argues the importance of lowering vehicular dependency; connecting streets through a grid system give pedestrians more choice, encourages walking and helps improve design approaches focusing on re-planning neighborhoods has become desert of urban amenities (Julie Campoli, 2012).

Destination accessibility: measures the distance between essential urban services in neighborhoods. In some studies, regional accessibility is simply the distance to the central business district (Leinberger, 2007; Weng et al., 2019). In others, regional accessibility is the number of jobs or other attractions that are reachable within a given travel time, which tends to be highest at central locations and lowest at peripheral ones (Campoli et al., 2001; Handy et al., 2005). One confounding factor, which has been the subject of many studies, is residential self-selection: people who prefer to move towards low-density suburbs, whereas people who prefer to walk, cycle or use transit tend to move towards higher-density urban areas, better served by public transport.

Distance: is usually measured as an average of the shortest walking distance between the essential urban functions and the nearest commuter stops (train, bus, subway, etc.) (Campoli et al., 2001; Handy et al., 2005). Alternatively, it may be measured as the availability of the space where all the essential urban services are accessible without consuming automotive energy and individual time (Ewing and Cervero, 2010; Salingros, 2003). The five Ds makes the biggest impact when planning urban neighborhoods, as these factors also increase social cohesion in urban communities. In a location where a great diversity of urban amenities exist, individuals are motivated to walk in their neighborhoods with greater frequency (Rivera-Navarro et al., 2021). The availability of urban amenities within walkable distance relies on urban design qualities which engage in the well-developed tradition of neighborhood planning.

Relationship between walking behavior of individuals and lockdowns of the COVID-19 Pandemic

During the COVID-19 Pandemic, the restrictions on human movements established a drastic drop in community walking mobility while demand to access daily needs services within a walkable distance has increased (Apple Data, 2021). The COVID-19 Pandemic significantly impacts mobility trends of neighborhoods located in different geographies. For neighborhoods with vehicular-dependent mobility, it was thought that access to daily urban amenities before the Pandemic was well connected (Johnson, 2002; Perry, 2020). Since movement limitations have restricted access to urban amenities, the availability of these daily needs services within a walkable distance became crucial. During the COVID-19 Pandemic, countries and territories worldwide have enforced lockdowns of varying stringency. Some include total or partial movement control for older people or children under age 16 for long periods of time, while others have enforced restrictions based on specific time use of public spaces. In many cases, only essential businesses are allowed to remain open. Age-based measures restricting the movement of older people have been considered in a number of countries. These include people over a certain age, e.g. 65 or 70 years old, staying at home

(also referred to as “self-isolation,” “curfews,” “confinement,” or “shielding”), not going to work, shopping malls, or restaurants, not using public transport and not participating in religious activities. [Table 1](#) highlights cities in different geographies that have been diversely affected due to movement restrictions on mobility trends during the Pandemic. Accordingly, a summary of most COVID-19 cases reported cities in WHO (World Health Organization) regions as Americas, Europe, South-East Asia, Western Pacific, Africa, Eastern Mediterranean, and movement restrictions according to GCDL (Global Change Data Lab) (between January 1, 2020, and March 15, 2021) and changes in routing requests (since January 13, 2020), the most drastic drop as 27% is in Sao Paulo in Brazil and increase is 26% in Jakarta in Indonesia ([Apple Data, 2021](#); [Our World in Data, 2021](#); [WHO, 2020](#)).

The concept of 15–20min walkable neighborhood. The “neighborhood unit” concept backs to the 1940s and 1950s with compact and pedestrian-friendly communities design approach for American cities. At that time, Clarence Perry (1872–1944), an American urban planner, suggested that urban planning should be based on systematically improvable design layouts focused on creating pedestrian-friendly neighborhoods. According to his approach, each neighborhood unit should contain physical layouts of building blocks and streets that bring all urban facilities within a pedestrian-friendly environment, including an elementary school, small parks and playgrounds, small stores such as groceries, hardware stores and bakeries ([Johnson, 2002](#); [Perry, 2020](#)). However, the post-WWI Great depressions and, much later on, the social movements of the 1960s brought the concept of the neighborhood unit under attack for supporting social segregation and creating physical connection without social cohesion ([Alexander, 1965](#); [Buttimer and Seamon, 1980](#); [Lynch, 1981](#)). With respect to these critiques,

Global Situation Coronavirus (COVID-19) Source: World Health Organization (WHO)			Restrictions on internal movement since January 1, 2020-March 15, 2021 Source: Oxford Martin School University of Oxford. Global Change Data Lab		Change in routing requests since January 13, 2020 Source: Apple Inc. (Mobility data)
Regions	Country/State	COVID-19 Case	City	Movement restrictions	Walking (%)
America (South)	Brazil	11.5M	Sao Paulo	Restrict movement: Partial lockdowns	-27%
America (North)	California (USA)	3.62M	Los Angeles County	Recommend movement restrictions: Stay at home order	+1%
Europe	Russia	4.34M	Moscow City	Restrict movement: Age based and time based partial lockdowns	+1%
Africa	S.Africa	1.5M	Western Cape	Restrict movement: Partial lockdowns	+5%
South-East Asia	India	11.4M	Mumbai	Restrict movement: Distance based partial lockdowns	+9%
Europe-Asia	Turkey	2.8M	Istanbul	Restrict movement: Age based and time based partial lockdowns	+22%
Western Pacific	Indonesia	1.4M	Jakarta	Restrict movement: Partial lockdowns	+26%

Note(s): [Apple Data \(2021\)](#), [Our World in Data \(2021\)](#), [WHO \(2020\)](#)

Table 1. The summary of mobility changes in the individuals’ routing requests from most affected COVID-19 cases reported by WHO

Krier proposed a new concept of “urban quarters” structured on the mixed-use of housing and integration of daily life facilities within a walkable area of about 0.35 km² (35 hectares) for 15 thousand people (Krier, 2014). This concept has influenced two new planning practices: the “urban villages” in the UK and the “new urbanist neighborhood” planning approach in the USA at the end of the 1980s (Carmona *et al.*, 2012). Both these concepts require fundamental principles about improving the walkable environment and encouraging individuals to walk in their neighborhoods. Also social integration as a process that involves people from different generations and ethnical backgrounds, which takes place in common spaces and everyday life as different modes of socialization (Arroyo *et al.*, 2021). The structure of the urban village is based on creating self-sufficient or self-contained communities with the help of physically networked neighborhoods without encouraging automobile dependency and increasing the social interactions within a walkable environment (Shuaib and Rana, 2021; Szerszynski and Urry, 2006; Tony Aldous, 1992).

New urbanist neighborhoods such as self-contained neighborhoods support a compact, pedestrian-friendly, mixed-use and encourage individuals to take responsibility for their maintenance. According to The Charter of the New Urbanism, the self-contained neighborhood concept can facilitate the independence of individuals who do not prefer driving and prioritize access to daily urban amenities within walking distance (CNU, 2020; Duany *et al.*, 2017). The pedestrian-friendly and motivating walking features of traditional urban villages and self-contained neighborhoods’ attributes have been adopted in recent walkable neighborhoods’ concepts to mitigate crises. In 2016, the Shanghai Master Plan put forward the idea of a “15-min community life circle” as the basic unit of building community life, providing urban amenities and having public social activity places for individuals within walking distance, aiming to form a safe, friendly and comfortable community living environment (Weng *et al.*, 2019; Whittle, 2020). According to the 15-min community circle principles, two inner circles of 5- and 10-min walking distances facilitate access to urban amenities. For instance, the city of Melbourne introduced a long-term planning strategy, guiding the way the city would grow and change (Plan Melbourne, 2017; Shannon *et al.*, 2019). Under the “Plan Melbourne” project, the city was reshaped by creating more access to public transport hubs and urban daily services within a 20-min walk. The Urban planning concept of the 20-min neighborhood aims to create accessible, safe and attractive local areas where people can access most of their everyday needs within a 20-min walk that represents an 800m (appx 0.5 miles) walk from home to a destination and back again. A 10-min walk to a daily living service and 10-min back home is another alternative to designing a walkable neighborhood.

Emphasis on time-based planning, either the 15-min community circle concept or the 15–20-min neighborhood project, constitutes an essential strategy for reducing automobile reliance. This design not only lowers transportation costs but also reduces the community’s greenhouse gas emissions (Moreno *et al.*, 2021). In addition, walkable neighborhoods improve public health, help residents save money and improve access to daily needs. However, the concept of 15–20min walkable neighborhoods contains practical challenges. The 15–20min concept may increase the scale of existing problems in cities such as Rome and Istanbul with deep historical architectural environments and palimpsest structures in their city layout or cities like Shanghai and New York, which possess a high-speed business rhythm under the complexity of social, and racial differences (Weng *et al.*, 2019; Whittle, 2020). However, the adaptation of neighborhoods offering the availability of urban amenities according to proximity and the 15–20-min walkable strategies not only encourage walking behavior as an essential physical and social activity but also provide alternative access to urban services during crises. Therefore, the importance of the time-based neighborhood concepts has grown during the COVID-19 Pandemic under partial and total lockdown restrictions. This concept highlights the importance of planning walkable and accessible neighborhoods to sustain physical and social cohesion.

Research design and methodology

The paper’s methodology is based on qualitative research and supported by a case study and literature survey, including a questionnaire (e.g. [Moreno et al., 2021](#)) that mainly focuses on researching the impact of the COVID-19 Pandemic on the walking behavior of individuals in different neighborhoods worldwide. The effect of movement restrictions can vary in terms of their durations, limitations and geographical practicalities in different countries. Therefore, we collected data relating to the main research question:

RQ. How do COVID-19 Pandemic movement restrictions affect the walking behavior of individuals?

and three sub-questions

RQ1. What does limit your walk pre-Pandemic and during the Pandemic?

RQ2. Where do you prefer to walk pre-Pandemic and during the Pandemic?

RQ3. Why do you need to walk in your neighborhood pre-Pandemic and during the Pandemic?

The contextual frame of the research (as is shown in [Figure 1](#)) was designed according to the following three main research steps:

Step 1: Literature review: Focuses on 15–20min walking accessibility to daily necessities in neighborhoods and walkability quality of the neighborhood with respect to the seminal literature of the paper. This step aims to explore the following measures: neighborhood land-use diversity, accessibility and environmental characteristics, including weather, safety and planned urban areas with access to public transits. This step identifies the

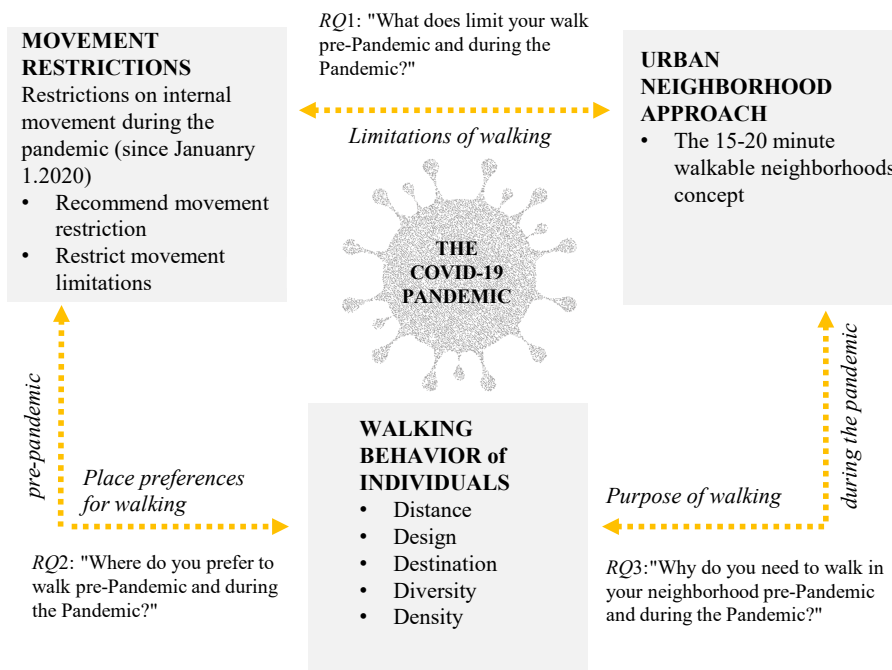


Figure 1. Presents the contextual frame of the research; the relationship between movement restrictions of the Pandemic and the walking behavior of individuals

availability of six basic essential urban spatial functions, including healthcare, living, working, commerce, education and entertainment (Moreno *et al.*, 2021; Weng *et al.*, 2019).

Step 2: Data collection: According to the answers received, regions were classified by neighborhood type-based as 15–20-min walkable or non-walkable neighborhoods. The non-probabilistic online sampling technique was used to define survey participants from the 24 regions with the highest number of COVID-19 cases from American, European, Asian, Western Pacific, African and Middle Eastern cities according to WHO, GCDL reports (between January 1, 2020, and March 15, 2021). The survey questions were prepared via Google forms with ten questions and were sent to recruited online volunteers and a circle of our acquaintances who live in the mentioned regions' (the highest number of COVID-19 cases). The survey questions were spread worldwide within ten days (15–25 Dec 2020). At the end of the tenth day, the number of participants reached 514 people. All participants were self-referred and could complete the survey according to their realities about their neighborhoods. The survey continued to the point that the inclusion of the gender and different age groups ensured. The study called upon middle-aged, older groups and young people in society to point their point of view associated with their living neighborhood during and before the Pandemic. However, the survey was not limited to age, gender, education, occupation, type of residence and settlement duration were also considered (see Table 1).

Step 3: Content analysis: Explores the impact of the COVID-19 movement restrictions on individual walking behavior in walkable and non-walkable neighborhoods according to three main questions of the online questionnaire survey (1) “*Why do you need to walk in your neighborhood pre-Pandemic and during the Pandemic?*” (2) “*Where do you prefer to walk pre-Pandemic and during the Pandemic?*” (3) “*What does limit your walk pre-Pandemic and during the Pandemic?*” Answers were analyzed by SPSS Version 28 (Statistical Package for the Social Sciences), and matrix charts were prepared in the spreadsheet programs. The data collected by questionnaires are disaggregated with the help of matrix tables. Figure 2 examines the respondents' opinion of urban neighborhoods about how individuals cope with the challenges of the movement restrictions of the Pandemic. Open-ended questions of the survey have been disaggregated with the frequency analysis. The percentage of findings was compared with walking behavior trends before the Pandemic and the changing trends during the movement restriction of the COVID-19 Pandemic (see Table 2). Finally, superimposed polar matrix charts were prepared for the general evaluation and a robust understanding of the case studies (see Figure 3). Matrix charts present a change of walking purposes, place preferences and walking limitations by dividing these 24 regions into walkable and non-walkable neighborhoods and showing overlapping data pre- and during the COVID-19 Pandemic.

Results of the survey

The survey includes ethnically, politically and spatially diversified respondents. The residents in these neighborhoods reflect diversity in age, income and educational backgrounds. Findings of the survey are listed following the research steps of the study.

Findings of step 1

The profile of the respondents indicates that 81.5% are young (between 18 and 35 years old) and middle age (between 26 and 50 years old); 93.4% have some level of education (primary school, high schools and college); 70.6% are actively working while 7.4% are not currently

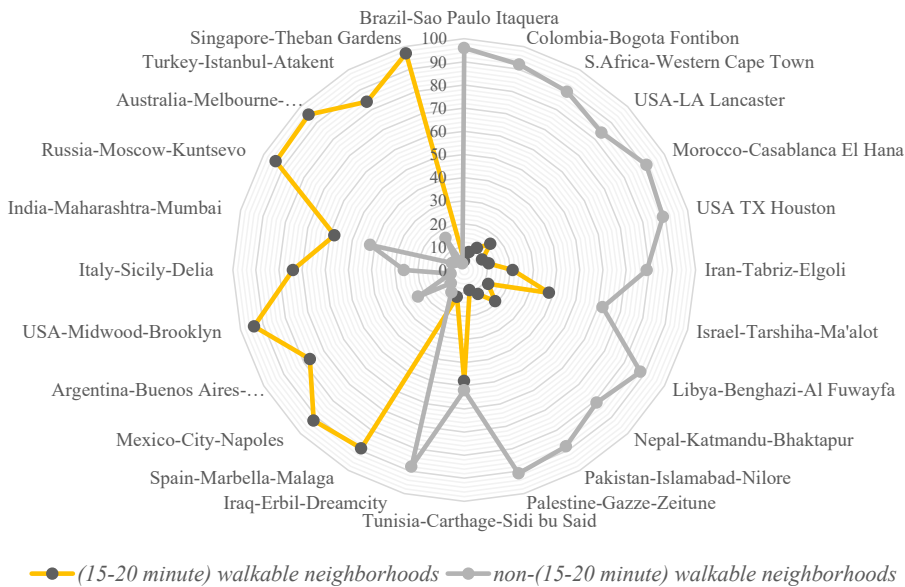


Figure 2. Presents the polar chart of the division of neighborhoods as 15–20-min walkable neighborhoods and non-15–20-min walkable neighborhoods

Variables	Categories	frequency	(%)
Gender	Female	232	45.1%
	Male	282	54.9%
Age	18–35	214	41.6%
	36–50	205	39.9%
	50+	95	18.5%
Education level	No education	32	6.2%
	Primary school	65	12.6%
	High school	280	54.5%
	Bachelor or PhD	137	26.7%
Occupation	Not working/student	96	18.7%
	Salary worker	229	44.6%
	Employer	114	22.2%
	Retired	75	14.6%
Type of residence	Private condo	125	24.3%
	Apartment flat	319	62.1%
	Nursing home	34	6.6%
	Student hostel	36	7.0%
Duration of settlement	Less than a year	56	10.9%
	1–3 years	68	13.2%
	4–7 years	145	28.2%
	8+ years	245	47.7%

Table 2. Distribution of participants

working; 11.3% are students and 10.6% are retired; 76.1% are living in flats (apartments), nursing homes and student dormitories; a majority of respondents, 66% are living with more than three people (Table 2). Survey results reveal that 75.9% of the respondents have been living in their community longer than four or more years.

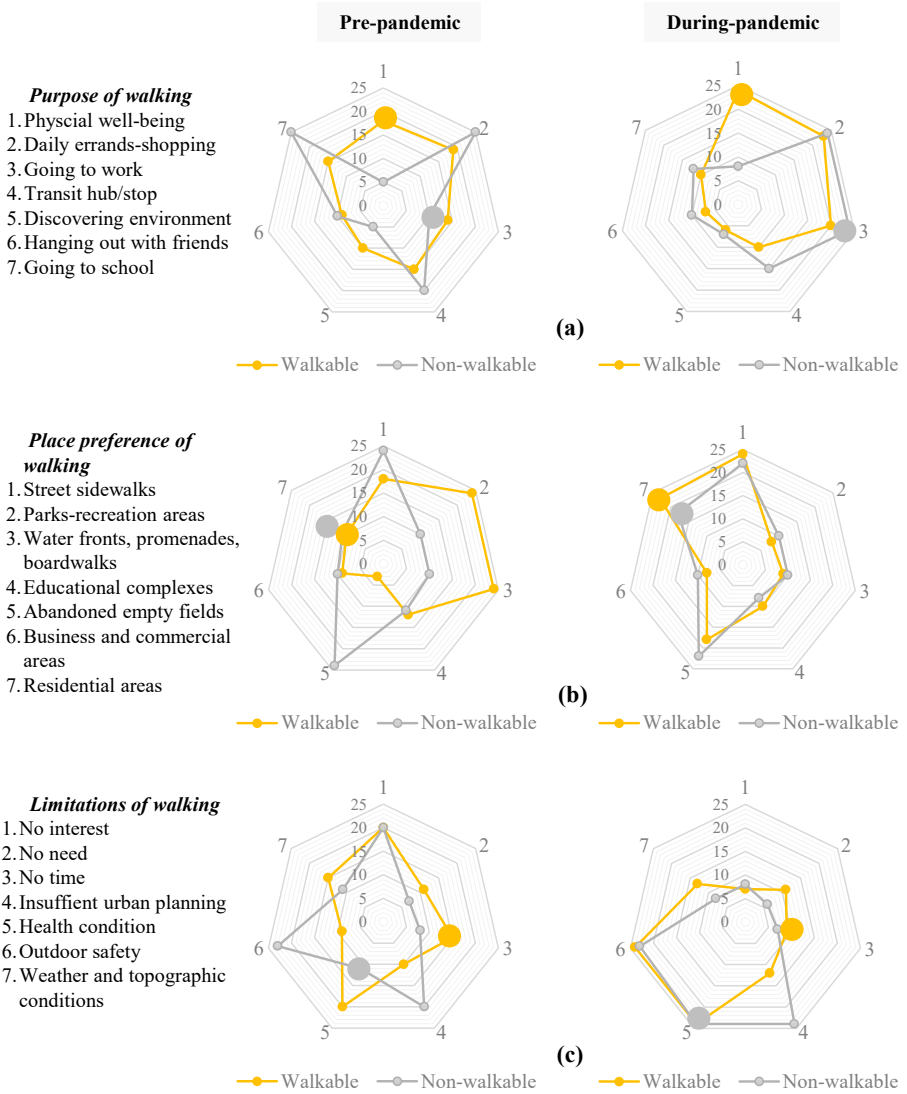


Figure 3. (a) Presents change of walking purposes; (b) Presents change of place preferences; (c) Presents change of walking limitations in the walkable and non-walkable neighborhoods pre-(before) and during the Pandemic

The over-layered polar matrix chart shows that 48.8% of individuals can walk to the following six essential urban amenities: healthcare, commerce, education, entertainment, daily living services and working (Figure 2). On the other hand, 32.6% of respondents can only access daily living services and education centers by walking. Only 10 of 24 neighborhoods is defined as 15–20-min walkable neighborhoods: (1w) Theban Gardens (Singapore), (2w) Atakent (Istanbul), (3w) Geelong (Melbourne), (4w) Kuntsevo (Moscow), (5w) Mumbai (Maharashtra), (6w) Delia (Sicily), (7w) Midwood (NYC), (8w) Rosario (Santa Fe), (9w) Napoles (Mexico City) and (10w) Marbella (Malaga). On the other hand, 14 of the 24 neighborhoods is defined as non 15–20-min walkable neighborhoods; (1n) Fontibon (Bogota),

(2n) Western Cape (Cape Town), (3n) Lancaster (LA), (4n) El Hana (Casablanca), (5n) Pasadena (TX), (6n) Elgoli (Tabriz), (7n) Maalot (Tarshiha), (8n) Al Fuwayfa (Benghazi), (9n) Bhaktapur (Katmandu), (10n) Nilore (Islamabad), (11n) Zeitoune (Gazza), (12n) Sidi Bu Said (Carthage), (13n) Itequera (Sao Paulo) and (14) Dreamcity (Erbil). Hence, the content analysis of data reveals two categories of neighborhoods: individuals living in 15–20-min walkable neighborhoods and people living in non-walkable neighborhoods.

Findings of step 2

Given that 89.1% of lockdowns as time-limited, age-based and distance-limited have allowed for physical access to groceries, pharmacies, bakeries, or health care units, the walking trend increased by 82.1% for respondents who indicated their purpose was to go to the nearest groceries, pharmacies and supermarkets in neighborhoods. In 15–20-min walkable neighborhoods, in pre-Pandemic, 76% was going to the nearest transit hub, and during the Pandemic, 83% of walking purpose was shopping for daily needs. On the other hand, in non-15–20-min walkable neighborhoods, walking purpose has not changed like shopping for daily needs. [Table 3](#) (the percentage of the walking behaviors in walkable neighborhoods) [Table 4](#) (the share of the walking behaviors in non-walkable neighborhoods) shows similarities and differences in the walking behavior of respondents. For instance, Atakent (Istanbul) and Delia (Sicily) show a relative decrease in physical well-being during the Pandemic. In the non-walkable neighborhoods of Western Cape (Cape Town) and Lancaster (LA), shopping has increased.

Finding of step 3

The duration and limitations of mandatory restrictions influence changing trends of respondents. [Figure 3](#) shows the overlapping global data obtained from three main questions of the paper: walking purposes, place preferences and walking limitations of the COVID-19 Pandemic between walkable and non-walkable neighborhoods before and during the Pandemic. The 21% of respondents have no interest in walking, 22% have no time for walking in the pre-Pandemic in 15–20-min walkable neighborhoods. According to [Figure 3a](#) (purpose of walking): findings show an increase in walking for physical well-being from 19% to 25% during the Pandemic. However, “going to work” behavior increased from 10% to 25% in non-walkable neighborhoods. [Figure 3b](#) (place preference of walking): the results have shown that people’s walking preference increased in residential sites and open areas from 11% to 24% despite walkable accessibility to parks.

Similarly, respondents have shown interest in exploring residential sites and nearby open spaces in non-walkable neighborhoods. [Figure 3c](#) (limitations of walking): Findings show that “no time” to walk increased to 16% during the Pandemic in the walkable neighborhood. In the non-walkable neighborhoods, concerns on health conditions of Pandemic results in a decrease in walking behavior from 24% to 12%. In addition, in non-walkable neighborhoods, 16% of respondents mention insufficient urban planning, and 17% lack outdoor safety as the most limiting factor of walking in the pre-Pandemic.

Discussion

Our data are based on the online questionnaire survey demonstrating that lockdown restrictions during the Pandemic affected the walking behavior of individuals by changing the purpose of walking and the place preferences for walking. In this study, we have focused on three essential aspects of the relationship between walking behaviors and the walkability of neighborhoods under the movement restriction of the COVID-19 Pandemic. These aspects

Table 3.
Presents
disaggregated data
with frequency
analysis method and
the percentage of the
walking behaviors in
walkable
neighborhoods

	Theban Gardens (Singapore)	Atakent (Istanbul)	Geelong (Melbourne)	Kuntsevo (Moscow)	Mumbai (Maharashtra)	Delia (Sicily)	Midwood (NYC)	Rosario (Santa Fe)	Napoles (Mexico City)	Marbella (Malaga)
Purpose of walking	Physical well-being	21%	19%	23%	21%	21%	19%	21%	21%	21%
	During	20%	17%	11%	17%	15%	17%	17%	17%	17%
	Pre	12%	21%	11%	12%	16%	21%	12%	12%	12%
	Daily errands-shopping	11%	13%	7%	7%	13%	5%	9%	11%	5%
	Going to work	10%	3%	22%	13%	3%	22%	13%	13%	13%
	During	13%	14%	17%	17%	15%	12%	17%	13%	17%
	Pre	9%	13%	6%	5%	13%	5%	5%	5%	5%
	Transit hub/stop	13%	7%	13%	14%	9%	16%	13%	13%	15%
	During	21%	19%	18%	19%	19%	10%	19%	19%	19%
	Pre	18%	24%	21%	20%	21%	21%	19%	21%	21%
Place preference of walking	Discovering environment	16%	4%	17%	13%	17%	4%	19%	19%	19%
	Hanging out with friends	15%	17%	15%	15%	17%	15%	15%	15%	15%
	Going to school	11%	7%	12%	11%	7%	19%	11%	11%	11%
	Street	10%	10%	9%	10%	10%	14%	10%	10%	10%
	Sidewalks	11%	7%	12%	11%	7%	19%	11%	11%	11%
	Parks-	10%	10%	9%	10%	10%	14%	10%	10%	10%
	recreation areas	21%	19%	18%	19%	19%	10%	19%	19%	19%
	Water fronts, promenades	21%	24%	21%	20%	21%	21%	21%	21%	21%
	Educational complexes	20%	15%	19%	23%	21%	19%	17%	17%	17%
	Abandoned empty fields	16%	21%	17%	11%	15%	4%	19%	19%	19%
Business and commercial areas	15%	17%	15%	13%	17%	15%	15%	15%	15%	
During	12%	21%	11%	12%	16%	21%	12%	12%	12%	
Pre	11%	7%	11%	7%	13%	5%	9%	11%	5%	
During	9%	13%	6%	6%	13%	5%	5%	5%	5%	
Pre	13%	7%	14%	14%	9%	16%	13%	13%	13%	
Residential areas	10%	3%	22%	13%	3%	22%	13%	13%	13%	
During	13%	14%	17%	22%	15%	12%	17%	17%	17%	

(continued)

		Theban Gardens (Singapore)	Atakent (Istanbul)	Geelong (Melbourne)	Kuntsevo (Moscow)	Mumbai (Maharashtra)	Delia (Sicily)	Midwood (NYC)	Rosario (Santa Fe)	Naples (Mexico City)	Marbella (Malaga)
Limitations of walking	No interest	19%	21%	21%	21%	19%	19%	10%	19%	23%	19%
		21%	18%	17%	15%	21%	21%	21%	17%	11%	10%
	No need	21%	16%	12%	16%	19%	19%	4%	21%	11%	10%
		17%	15%	3%	14%	15%	15%	15%	7%	11%	21%
	No time	7%	11%	13%	3%	11%	11%	19%	22%	13%	19%
		9%	10%	19%	17%	10%	10%	10%	17%	22%	17%
	Insufficient urban planning	21%	21%	5%	13%	21%	21%	19%	5%	6%	4%
		15%	20%	13%	7%	17%	17%	17%	13%	14%	15%
	Health condition	16%	12%	19%	19%	12%	12%	21%	10%	18%	21%
		14%	11%	23%	21%	11%	5%	8%	21%	20%	7%
	Outdoor safety	3%	10%	19%	21%	13%	13%	22%	4%	17%	5%
		17%	13%	15%	17%	13%	17%	16%	15%	13%	13%
	Weather conditions	13%	9%	11%	7%	5%	5%	5%	19%	12%	22%
		7%	13%	10%	9%	13%	15%	13%	10%	9%	17%

Table 3.

Table 4.
Presents
disaggregated data
with frequency
analysis method and
the percentage of the
walking behaviors in
non-walkable
neighborhoods

Purpose of walking	Pre	Western										Dreamcity (Erbil)				
		Fortibon (Bogota)	Cape Town	Lancaster (LA)	El Hana (Cassablanca)	Pasadena (TX)	Eigoli (Tabriz)	Maalot (Tashiba)	Al-Fuwayfa (Benghazi)	Bhaktapur (Katmandu)	Nilore (Islamabad)		Zeitoune (Gazza)	Sidi Bu Said (Carthage)	Itequera (Sao Paulo)	
Physical well-being	During	11%	7%	19%	12%	11%	7%	19%	11%	11%	11%	19%	11%	11%	11%	7%
	During	10%	10%	10%	9%	10%	10%	14%	10%	10%	10%	10%	10%	10%	10%	9%
	Pre	21%	19%	10%	18%	19%	19%	10%	19%	19%	19%	19%	19%	19%	19%	19%
	During	21%	24%	20%	20%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%
Going to work	Pre	21%	21%	19%	23%	21%	21%	19%	21%	21%	21%	19%	21%	21%	21%	21%
	During	20%	15%	17%	11%	17%	15%	17%	17%	17%	17%	17%	13%	17%	15%	
	Pre	16%	21%	4%	17%	19%	21%	4%	19%	19%	4%	19%	19%	19%	21%	
	During	15%	17%	15%	13%	15%	17%	15%	15%	15%	15%	15%	13%	15%	17%	
Discovering environment	Pre	12%	16%	21%	11%	12%	16%	21%	12%	12%	12%	12%	12%	12%	16%	
	During	11%	13%	7%	11%	7%	13%	5%	9%	11%	12%	5%	17%	12%	14%	
	Pre	9%	7%	5%	6%	5%	13%	5%	5%	5%	5%	8%	3%	5%	13%	
	During	13%	7%	13%	14%	13%	9%	16%	13%	13%	13%	13%	13%	13%	7%	
Going to school	Pre	10%	3%	22%	13%	13%	3%	22%	13%	13%	13%	22%	13%	13%	3%	
	During	13%	14%	17%	22%	17%	15%	12%	17%	13%	17%	16%	17%	19%	17%	
	Pre	21%	19%	10%	18%	19%	19%	10%	19%	19%	10%	10%	19%	19%	19%	
	During	18%	24%	21%	20%	21%	21%	21%	19%	21%	21%	21%	20%	23%	21%	
Place preference of walking	Pre	16%	21%	4%	17%	19%	21%	4%	19%	19%	4%	19%	19%	19%	21%	
	During	15%	17%	15%	13%	15%	17%	15%	15%	15%	15%	15%	13%	15%	17%	
	Pre	11%	7%	19%	12%	11%	7%	19%	11%	11%	11%	19%	11%	11%	7%	
	During	10%	10%	10%	9%	10%	10%	14%	10%	10%	10%	10%	10%	10%	9%	
Educational complexes	Pre	21%	21%	19%	23%	21%	21%	19%	21%	21%	21%	19%	21%	21%	21%	
	During	20%	15%	17%	11%	17%	15%	17%	17%	17%	17%	17%	13%	17%	15%	
	Pre	12%	16%	21%	11%	12%	16%	21%	12%	12%	12%	21%	12%	12%	16%	
	During	11%	13%	7%	11%	7%	13%	5%	9%	11%	5%	8%	17%	3%	14%	
Business and commercial areas	Pre	10%	3%	22%	13%	13%	3%	22%	13%	13%	13%	22%	13%	13%	3%	
	During	13%	14%	17%	22%	17%	15%	12%	17%	13%	16%	16%	17%	19%	17%	
	Pre	9%	13%	5%	6%	5%	13%	5%	5%	5%	5%	5%	5%	5%	13%	
	During	13%	7%	13%	14%	13%	9%	16%	13%	13%	13%	13%	13%	13%	7%	

(continued)

Limitations of walking	Western										Itaquera (Sao Paulo)	Dreanicity (Erßhl)	
	Fontibon (Bogota)	Cape Town	Lancaster (LA)	El Hana (Cassablanca)	Pasadena (TX)	Elgoli (Tabriz)	Maalot (Tarsishta)	Al-Fuwayfa (Benghazi)	Bhaktapur (Katmandu)	Nilore (Islamabad)			Zeitoune (Gazza)
No interest	21%	21%	19%	23%	21%	21%	19%	21%	21%	21%	19%	21%	21%
During	20%	15%	17%	11%	17%	15%	17%	17%	17%	17%	17%	13%	17%
Pre	12%	16%	21%	11%	12%	16%	21%	12%	12%	12%	21%	12%	12%
During	11%	13%	7%	11%	7%	13%	5%	9%	5%	8%	17%	3%	14%
No time	10%	3%	22%	13%	13%	3%	22%	13%	13%	13%	13%	13%	3%
During	13%	14%	17%	22%	17%	15%	12%	17%	17%	22%	17%	19%	17%
Pre	9%	13%	5%	6%	5%	13%	5%	5%	5%	5%	5%	5%	13%
During	13%	7%	13%	14%	13%	9%	16%	13%	15%	13%	13%	13%	7%
Insufficient urban planning													
Health condition	21%	19%	10%	18%	19%	19%	10%	19%	19%	10%	19%	19%	19%
During	18%	24%	21%	20%	21%	21%	21%	19%	21%	21%	20%	23%	21%
Outdoor safety	16%	21%	4%	17%	19%	21%	4%	19%	19%	19%	19%	19%	21%
During	15%	17%	15%	13%	15%	17%	15%	15%	15%	15%	13%	15%	17%
Pre	11%	7%	19%	12%	11%	7%	19%	11%	11%	11%	11%	11%	7%
During	10%	10%	10%	9%	10%	10%	14%	10%	10%	10%	7%	10%	9%

Table 4.

include the purpose of walking, the preference for places, walking accessibility and the aspects of movement limitations of the COVID-19 Pandemic lockdowns on walking behavior.

In walkable neighborhoods, the primary purpose of walking of respondents is for physical exercise, basic shopping needs, going to school, or health services before the Pandemic. However, during the Pandemic, that purpose focuses mainly on accessing daily services such as supermarkets, pharmacies and health services. Further, the walking purpose under movement restrictions such as time-based and age-based lockdowns have created many psychological pressures on individuals that they never experienced previously. This encouraged people to break the lockdown rules, such as the increased number of people jogging and exercising in the streets, as in Delia (Sicily-Italy). The mayor's reaction, "*how come everyone has turned into a running enthusiast!*" briefly depicts the changing psychology as well as the well-being of individuals who are under the state of the imposed mandatory curfews and lockdowns (Euronews, 2020). As another example, Atakent (Istanbul) and Rosario (Argentina) neighborhoods' respondents have similar walking purposes. The pre-Pandemic walking purpose changed from going to the nearest transit hub to going shopping during the Pandemic. Findings also indicate the influence on changing routing during Pandemic, while walking under total lockdown in Rosario has dropped 27%, in Atakent this increases 5% under age-based and time-based limitations (Our World in Data, 2021).

On the other hand, in non-walkable neighborhoods coping with the limitations of the Pandemic has become more challenging. Pandemic restrictions have brought multifaceted problems to these neighborhoods. As an example, in neighborhoods such as Itaquera (Brazil), Fontibon (Colombia), Elgoli (Iran), Maalot (Israel) and Nilore (Pakistan), non-15–20-min walkable neighborhoods showcased that their purpose for walking was not affected by the COVID-19 Pandemic. Their main objective for walking continues to be ongoing daily shopping.

The place preferences for walking: individuals in non-walkable neighborhoods responded that their most preferred walking places before the Pandemic were empty abandoned fields and sidewalks. On the other hand, the individuals in walkable neighborhoods responded that their most preferred places for walking were parks, recreational and residential areas between buildings. This difference indicates two different attributes of urban neighborhood planning: proximity and land-use diversity. Moreno argues that spatial proximity allows for the transition between urban amenities such as residential, commercial, educational centers, health care units and other primary institutions in a reduced time (Moreno et al., 2021; Whittle, 2020). Distance-based urban planning provides optional neighborhood amenities for socializing and physical activities (Gehl and Svarre, 2013; Urry, 2002).

Regarding individual responses from the neighborhoods, creating socially attractive places like waterfronts, seaside promenades and board walks-including various cafés and restaurants helps increase the individuals' sociability but also helps provide a diversity of a healthy mix of residential, commercial and entertainment components. In the non-walkable neighborhoods of Benghazi (Libya), Dream city (Erbil-Iraq) and El Hana (Casablanca), preference in walking between buildings, parks and recreational places has not changed as it was in Lancaster (LA) and Sidi Bu Said (Carthage) in the pre-Pandemic era. In the walkable neighborhoods like Kuntsevo (Moscow) under aged-based and time-based lockdown limitations and Geelong (Melbourne) under stay home order, preferences of individuals have remained similar with non-walkable neighborhoods as a walking preference to parks and recreational parks during the Pandemic.

Movement limitations of walking: respondents indicated that movement restrictions of the Pandemic have various impacts on neighborhoods regardless of whether they have walkable access to urban amenities within 15–20 min or not. During the Pandemic, the time-based and aged-based lockdowns limited walkable access to many social outdoor gatherings, events and projects. This new normal has brought alternative ways to deal with the increased physical isolations during the Pandemic. For instance, the digitalization of urban amenities

that provide remote working, education and shopping creates physical distance, whether in walkable or non-walkable neighborhoods. In Kuntsevo (Moscow), Mumbai (India), Nilore (Pakistan) and Bhaktapur (Nepal), volunteer help to those who had to stay home due to partial lockdowns and age-based restrictions contributed to the continuity of social life (Bavel *et al.*, 2020; Our World in Data, 2021).

Walkable and non-walkable neighborhoods as two stratified groups of respondents, 23.4% of individuals living in walkable neighborhoods expressed the desire to end lockdowns to walk in the streets and hang out with friends in outdoor cafés and restaurants are comfortable without considering lockdown time limitations and or social distancing. The 24.7% of the individuals living in non-walkable neighborhoods indicated that their neighborhood needs urgent re-planning to provide amenities within walking distance and a safe neighborhood environment. A share of people living in the crowded housing unit expressed their needs for a walkable neighborhood. The walkable neighborhoods fulfill daily life needs and are a metric of adaptation to the urban uncertainties.

Conclusion

This study highlights the walking behaviors of individuals in the neighborhoods before and during the Pandemic. The availability of urban amenities within walking distance has a dominant influence on walking behavior. Before the Pandemic, individuals living in walkable neighborhoods used to walk by going to parks, promenades, supermarkets, pharmacies, healthcare units and entertainment centers located within a 15–20-min walking distance. However, due to time and age-based lockdowns during the Pandemic, individuals could only be outdoors to meet their dietary and healthcare needs. Further, limitations forced individuals to change their habitual walking locations to street sidewalks, nearest residential areas, and even some underdeveloped lots. On the other hand, in non-walkable neighborhoods, walking habits did not significantly alter; it is a consequence of the urban planning challenges, such as a low residential density, poorly connected street networks and fragmented land use.

Quick access to basic amenities within a 15–20-min walkable distance is critical, especially under the limited time restrictions of partial lockdowns allowing individuals to be outside only 2–3 h. This study suggests that three main aspects should be emphasized to plan walkable neighborhoods: providing walkable access, forming spatial proximity, sustaining social cohesion. The spatial, social and economic implications of a 15–20-min walkable distance are listed as three aspects.

Providing walkable access for the primary six essential urban social functions of living, working, commerce, healthcare, education and entertainment can help support an amenity-rich community circle. Access to urban amenities is highly beneficial to promote the quality of walking behaviors of individuals. The more individuals walk in a well-built environment, the more they reduce their dependence on vehicular mobility. They were encouraging walking initiatives to be included in the post-Pandemic urban neighborhood planning instructions.

Forming spatial proximity; in planning layouts helps increase the interconnectedness of urban amenities. At this point, planning an urban neighborhood in a compact layout can bring daily services within walking distance, improving remote access of locals, such as remote shopping and working, and bringing contextual importance to hyper-local living.

Sustaining social cohesion and developing viable projects; such as community gardens and outdoor sporting events where communities can spend more outdoor time together generally helps individuals form closer bonds. During an urban crisis, it became clear that social cohesion and inclusivity were crucial for everyone, whether they lived in a walkable or non-walkable neighborhood.

Walking and walkability provide various benefits, including basic mobility, consumer cost savings, cost savings (reduced external costs), efficient land use, community livability,

improved fitness and public health, economic development and support for equity. Economically and socially disadvantaged people often rely on walking and cycling, so improving non-motorized transport can help achieve social equity and economic opportunity.

Limitations and future studies

This study has four main limitations: (1) Participants' spatial distribution is limited to online volunteers and a circle of acquaintances who live in the mentioned regions (2) Participants' socio-economic profiles (e.g. gender and age) did not include in the walking behavior analysis. (3) Walking may have happened outside the areas within which walkability was determined. Location-specific walking measures are essential to estimate the relationships between walkability measures and local walking accurately. (4) The study was limited to the qualitative questionnaire survey without counting COVID-19 cases per study area. Future studies should focus on four directions:

- (1) Online interactive maps should be used to survey and map participants' environmental perceptions.
- (2) The fuzzy cognitive analysis can be taken as a holistic approach to investigating neighborhood walkability.
- (3) Walking access should be investigated in the New Urban Agenda (NUA) and the United Nations Sustainable Development Goals (SDGs) – especially concerning two goals: good health and well-being, sustainable cities and communities.
- (4) The walkable neighborhood capacity that fulfills the needs of everyday life is not emphasized as a metric of adaptation in risk mitigation discourse.

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