ITU A|Z • Vol 23 No 1 • March 2026 • 235-252

Walkability and stress: Insights from Generation Z during global disruption

Ilgın BAYRAK SAĞTAŞ[1]*, Ece ALTINBAŞAK HAKLIDIR[2]
[1] 20192101084@dogus.edu.tr • Architect, Independent Researcher, Istanbul, Türkiye
ORCID: 0000-0002-8381-2842
[2] ealtinbasak@dogus.edu.tr • Department of Architecture, Faculty of Arts and Design, Dogus University, Istanbul, Türkiye
ORCID: 0000-0002-6267-7784

**Corresponding author*
Received: September 2024 • Final Acceptance: October 2025

Abstract
This study examines the intersection of urban design and urban living conditions by exploring the relationship between perceived walkability and stress management among Generation Z college students in Istanbul during the COVID-19 pandemic. Walkability, essential for comfortable and safe pedestrian navigation, fosters resilient communities, while stress adversely affects individual well-being and social interactions. The research aims to understand how the built environment's physical components impacting walking habits influence mental well-being, particularly stress levels. This research delves into various interconnected variables to enhance the design and policy of urban living conditions. By examining the relationships between perceived walkability, stress levels, and physical environmental factors, the study aims to provide valuable insights that can inform the development of healthier, more supportive urban neighborhoods. Focusing on Generation Z—typically more active and significantly impacted by pandemic isolation—the study involved university students across Istanbul. The Neighborhood Environment Walkability Scale and the Perceived Stress Scale were used to measure perceived walkability and stress management. The findings demonstrated statistically significant associations between perceived walkability and stress levels, alongside notable gender-based differences. These results highlight the critical role of urban design in enhancing urban living conditions outcomes. The study proposes design and planning recommendations to improve neighborhood walkability, contributing to better psychological outcomes and overall urban living conditions as well as the creation of public policies that prioritize physical activity and psychological outcomes, ultimately fostering more livable and resilient communities.

Keywords
Design and physical features, Generation Z, Public health, Stress management, Walkability.

doi: 10.58278/0.2026.123

1. Introduction

Stress, stemming from physical and psychological reactions to life's stimuli, profoundly impacts individuals' well-being by hindering goal attainment and inducing negative emotions (Pettinger, 2002). Managing stress involves identifying and mitigating stressors, essential for maintaining physical and mental well-being (Gümüştekin & Öztemiz, 2004). Conversely, walking offers a plethora of benefits, including stress reduction and enhanced social interaction (Cervero & Kockelman, 1997; Fonseca et al., 2022). Walkability, ensuring safe and comfortable pedestrian access, contributes to vibrant communities (Southworth, 2005).

Stress does not occur spontaneously but is influenced by various environmental factors. Individuals do not respond to stress in the same way; some are more affected while others are less affected. It is possible to group factors that create stress related to oneself, the surrounding environment, and work (Saldamli, 2000). On the other hand, walking has numerous positive effects on human life, such as socialization, health, connectivity, and increased human activity (Cervero & Kockelman, 1997). Walkability, on the other hand, refers to ensuring that pedestrians can reach specific points comfortably and safely in the built environment (Southworth, 2005). Cities with walkable criteria are more social and vibrant. The act of walking not only has transportation significance but also shapes the character of the urban dweller (Wang et al., 2019). Walking reduces stress, protects against many diseases, enriches human activities, and plays a unifying role in fostering social interactions, aiding individuals in perceiving space differently (Fonseca et al., 2022). There are certain components that affect walkability. One of them is the distinction made by Boarnet and Crane (2001) between social and physical factors. Social factors influence individuals' preference for walking, while physical factors enhance the desire to walk. Variables that influence the act of walking include mixed land use, human-scale design, connectivity of roads, physical structure of streets, physical structure of sidewalks, and compatibility with older settlements (Sendich & American Planning Association, 2006).

Walkable areas are safe spaces where residential and commercial activities coexist, public transportation is convenient, social ties are strong, and people can interact (Massengale et al., 2014). Physically walkable neighborhoods are well-perceived and have a positive impact on neighborhood users, encouraging them to walk based on the perception created (Wood et al., 2010).

Walkability is greatly influenced by intergenerational differences. Particularly, Generation Z (individuals born between 1997 and 2012) is believed to have different views and be influenced by various factors when it comes to walkability, as they do in many other aspects. According to a study conducted by Larkin et al. (2018), there are three significant factors that affect Generation Z: advancing technology, growing up in uncertainty, and realism. All these factors have directly influenced the development of Generation Z individuals. With distinct desires and behaviors compared to the previous generation, Generation Z has brought about various changes. Many sectors, such as the economy, education, technology, and fashion, are working to adapt and develop services that cater to this generation (Dovey & Pafka, 2020).

The aim of this study is to examine the relationship between perceived walkability and stress levels among Generation Z university students and to contribute to wellness-oriented urban design strategies by integrating environmental psychology perspectives.

To achieve this aim, the study sets out to: (i) Evaluate perceived walkability in different neighborhood environments using the NEWS (Neighborhood Environment Walkability Scale) scale; (ii) Measure participants' perceived stress levels using the PSS (The Perceived Stress Scale); (iii) Identify correlations between walkability features and stress responses; (iv) Analyze gender-based differences in perception and stress and; (v) Offer design-based insights for enhancing urban well-being based on empirical findings.

1.1. Background

Modern society is increasingly recognizing that humans and culture are integral parts of the natural environment, and that there is a strong connection between human well-being and environmental conditions (Jackson, 2003). It is important to acknowledge that individuals are constantly interacting with their surroundings in their daily lives and are greatly influenced by the characteristics of the physical environment. The interaction between human well-being, human activities, and the physical environment is fundamental. In this interaction process, it is crucial to avoid harming the natural systems upon which the biological and physical environment depend (Çelik, 2006). The physical environment inherently represents the features that enhance or diminish opportunities for behavior and outcomes (Wattchow et al., 2014). Being healthy is closely linked to maintaining a lifestyle that includes healthy eating, physical exercise, and reduced stress, encompassing the physical environment (Bratman et al., 2012).

Individual behaviors are influenced by both the social and physical environment. Unlike a causal relationship between physical activity and health, the role of the physical environment is relatively more significant in determining levels of physical activity. In order to stay healthy, individuals should engage in regular physical activity, and the physical environment should be structured to facilitate this. Levels of physical activity show a significant decline with increased sedentary behavior, leading to adverse well-being outcomes (Transportation Research Board & Institute of Medicine, 2005). Therefore, it is essential to create an environment that encourages physical activity and supports individuals in maintaining an active lifestyle for their urban life quality.

The concept of stress, on the other hand, widely used and experienced by many individuals, has been present since the creation of humankind, despite the increasing number of studies conducted on it. Stress is a psychological state that is commonly used and experienced by everyone. The term "stress" was initially used in the field of physics (Okutan & Tengilimoğlu, 2002). Physicist Robert Hooke first defined stress as the relationship between an object and the external force applied to that object. Physicist Thomas Young explained stress as the response of matter to an external force applied against its resistance. After its use in the field of physics, the concept of stress began to be used in the fields of psychology and medicine. For stress to occur, individuals need to be influenced by their environment or surroundings (İnal, 2019). Stress arises from the physical and psychological responses to stimuli encountered or experienced throughout life. It leads to psychological, emotional, and physical tension, resulting in adverse effects on the human body (Pettinger, 2002).

The industrialization that began in the 19th century in cities laid the foundation for modern planning, characterized by adverse health conditions, inhumane circumstances, and overcrowding. As a result, urban planning was scientifically addressed. In the 21st century, efforts in the economic, social, and physical environments have become crucial for improving urban well-being. While the health discipline addresses issues such as obesity, chronic illnesses, and sedentary lifestyles to provide a healthy environment for urban users, urban planning discipline addresses environmental problems caused by car usage, high-density settlements, and accessibility (Dinçer, 2011). In the literature, environmental stressors, such as crowding and noise in urban contexts, have been found to significantly contribute to stress in individuals (Evans & Cohen, 1987).

In modern urbanized societies, both acute and chronic stress are increasingly recognized as significant issues. Research indicates that crowding, fear of crime, and traffic noise are associated with violence and aggression. The impact of stress on mental well-being has become a serious urban living conditions concern, particularly for those living in urban environments. Stress management is vital for maintaining health, and preventing stress-related disorders is crucial in urbanized soci-

eties. Both built and natural environments can influence perception and have direct or indirect effects on individuals' mental well-being. Therefore, examining and addressing ways in which the environment may negatively impact mental well-being is essential (Jiang et al., 2023). The arrangements made in urban spaces have always been of great importance for human society. Being a "city dweller" has always come with responsibilities. Individuals are residents of the city, and the development of urban communities depends on individuals. The structures, groups of structures, infrastructure, transportation, social facilities, and the organizations that operate them all contribute to the essence of the city. Considering that the city is a human creation, efforts should be made, both physically and socially, to ensure that design promotes healthier environments (Fırat, 2006).

During the pandemic, there have been studies conducted on individuals' physical environments and stress. The continuation of the outbreak and the discovery of its adverse consequences over time have increased the level of stress in society. Symptoms that may reach the psychiatric diagnosis dimension, such as anxiety disorders and depression, can be observed in stress reactions. In a study conducted with 7,143 university students in China after the outbreak, which was defined as "COVID-19," 21.3% experienced mild, 2.7% moderate, and 0.9% severe anxiety symptoms. In a study by Wang et al. involving 1,210 participants in different cities in China, looking at the psychological effects of the outbreak at the end of January and the beginning of February, it was indicated that 28.8% showed anxiety symptoms, 16.5% showed depression symptoms, and 8.1% showed stress symptoms. A survey conducted by Rossi et al. in Italy with 18,147 participants via the internet examined the impact of the pandemic and quarantine process on people's mental well-being. The study revealed that 37% of the participants experienced post-traumatic stress symptoms, 22.9% had adjustment disorders, 21.8% had a high perceived stress level, 20.8% had anxiety symptoms, 17.3% had depression symptoms, and 7.3% had sleep disorder symptoms above the cut-off point for diagnosis. A study conducted by Odriozola-Gonzalez et al. (2020) with 3,550 adult individuals in Spain via the internet showed that 44.1% of the participants had depression, 37% had stress, and 32.4% had anxiety symptoms above the cut-off point for diagnosis. These few studies suggest that some psychiatric diagnoses may increase. Infectious diseases, by their nature, leave fear and anxiety on individuals and also affect their daily relationships. Like other natural disasters (e.g., tsunami, earthquake, etc.), infectious diseases are also referred to as disasters, and the impact of disaster events on individual psychology is not random. Moreover, the response can vary depending on the conditions the individual is in and the level of exposure to the disaster. Therefore, like all disasters, the ongoing pandemic process also affects individuals psychologically. Especially during this period where efforts are being made to slow down the spread and transmission of the virus, the precautions taken create stress. The effect of these measures is the sense of loss. Undoubtedly, these feelings have a negative impact on an individual's psychological well-being (Işıklı, 2020).

1.2. Importance of walking and walkability of streets

Rapoport (1991) identified two environmental characteristics of streets in his study. The first involves the formal/physical features of streets, while the second emphasizes the need to examine streets in terms of activity (social) and use. Streets cannot become living spaces without a functional definition of the linear area between buildings and streets. Streets become living spaces only when they are designed together with public social spaces and physical features that allow specific activities within their surrounding settlements. As a result, the characteristics of the environment are defined as the interactions between the components that constitute the environment, as well as the interactions between individuals and between individuals. Therefore, the

environment is not just a physical space with boundaries shaped by individual activities. It is an important part of the behavior model with social attributes (Alpak et al., 2018).

Walking is the cheapest and simplest form of transportation used in people's daily lives. Walking increases communication among individuals and allows for economic and social relationships. Walking has many positive effects on human life, such as socialization, health, cohesion, and increased human activities (Cervero & Kockelman, 1997). Walkability, on the other hand, ensures that pedestrians can reach specific destinations comfortably and safely in the built environment (Southworth, 2005).

Walking, in addition to being a recreational activity, is fundamentally a means of transportation. In urban outdoor spaces, the movement of individuals, which is the most basic form of transportation, is essentially a simple act of walking. When it comes to interacting with other people and the physical environment, "pedestrian movement" emerges as a convenient and easy mode of transportation. For a life in the urban space that relies on establishing healthy human relationships, pedestrian movement needs to be strongly and effectively organized. Meaningful and appropriate pedestrian flows and movements are essential requirements. Urban areas that prioritize pedestrian movement in transportation and planning concepts highlight their social functions. These types of spaces enable pedestrian movements in terms of social, physical, and perceptual characteristics. Walking is recommended as a therapeutic activity against various negative emotions and illnesses such as stress and cardiovascular diseases. The benefits of walking can be summarized as follows:

- Enrichment of human activities and human interactions
- Perception of space from a different perspective
- Impact on human well-being
- Facilitating socialization and having a unifying role in social life
- Being an environmentally friendly and cost-effective mode of transportation, among others.

Pikora et al. (2003) as cited in Tekel & Görer (2016) divide the components that influence walkability into two categories. The first category is the physical criteria of the urban built environment, and the second category is individual responses. It is also mentioned that both objective and subjective measurements should be used to determine the effects of these factors on walkability.

Yin (2013) provides the answer to the question "What makes a place walkable?" by stating that it is the characteristics of the route (path/permission) connecting the starting and ending points of walking journeys. According to Yin, walkability is modeled based on two main components: built environment and social environment. It is also divided into four subcategories and two separate groups:

- Activities and uses
- Accessibility
- Safety and image
- Sociability.

These four categories reflect how individuals interact with the environmental, physical, and social characteristics of a neighborhood (Yin, 2013).

Alfonzo (2005), on the other hand, evaluates the hierarchy of walking needs within the context of environmental variables that influence individuals' decision to walk. In Alfonzo's proposed hierarchy of walking needs model, "feasibility" is situated at the bottom level of environmental factors. For the walking activity to occur, circumstances that lead individuals to desire walking need to emerge first. The individual's responsibilities, time, and mobility determine the shaping of walking behavior. Accessibility is placed in the second level of this hierarchy. The quality of pedestrian spaces, connections between uses, and pedestrian infrastructure impact accessibility. Accessibility encompasses the variety of destinations that can be reached within a specific time frame. Access to public transportation areas, recreational spaces, and non-residential uses positively affects walkability, while elements such as rivers, closed residential clusters, and disruptions in the continuity of walking paths have a negative impact on accessibility. Safety refers to the individual's protection against crime.

Comfort is an environmental factor that provides convenience and ease while walking. Satisfaction indicates how attractive and enjoyable an area is for walking. During the intermediate process, individual characteristics such as biological, psychological, and demographic factors; societal characteristics such as sociological and cultural factors; and spatial characteristics such as climatic, topographic, and geographical data all influence walkability. The proximity and diversity of areas within walking distance, such as cafes, shops, recreational activities, play an important role in achieving walkability (Tekel & Görer, 2016).

2. Method

This study adopts an ecological psychology perspective and utilizes the theory of affordances as its theoretical foundation. The theory of affordances offers a comprehensive framework for understanding and elucidating the essential qualities of environments from a psychological standpoint. In the context of walkability research, affordances refer to the various features and attributes of urban environments that afford opportunities for pedestrian activity and interaction. By examining the concept of affordances within the context of walkable urban environments, this study seeks to explore whether the availability of affordances differs across settings characterized by variations in urban design and infrastructure. Understanding these differences is essential for enhancing the walkability of urban areas and creating environments that support diverse pedestrian needs and activities. Moreover, by investigating the relationship between urban design elements, such as street layout, green spaces, and pedestrian amenities, and the perceived affordances for walking, this research aims to contribute to the development of strategies for designing and planning more pedestrian-friendly cities. Ultimately, by leveraging the theoretical insights provided by ecological psychology and the theory of affordances, this study endeavors to inform urban planners, policymakers, and designers in their efforts to create more inclusive, accessible, and multi-functional urban environments conducive to pedestrian activity and well-being.

2.1. Research design

Given the focus of this study on comprehending attitudes and utilizing them as indicators of behaviors in the context of walkability, the survey approach emerged as the preferred methodology. The survey included four main sections: (1) perceived walkability based on the adapted Neighborhood Environment Walkability Scale (NEWS-A), (2) perceived stress assessed using the 10-item Perceived Stress Scale (PSS), (3) context-specific questions about walking behaviors and built environment features, and (4) demographic data. NEWS-A items were measured using a 4-point Likert scale (1 = Strongly Disagree to 4 = Strongly Agree), while PSS items followed a 5-point frequency scale (0 = Never to 4 = Very Often). Additional contextual questions included categorical and multiple-choice formats, and demographic variables were a mix of open-ended and categorical responses. To ensure consistency in spatial reference, participants were instructed to evaluate their environment based on their immediate neighborhood, defined in the survey as areas located within a 10–15-minute walking distance from their home. This definition provided a shared understanding of "local vicinity" and aligned with the walkability-related questions throughout the survey.

In the first part of the survey, the instrument employed to assess perceived walkability and its association with physical activity was the Neighborhood Environment Walkability Scale (NEWS). Developed as a 54-item self-report measure, NEWS serves to evaluate the perceived design features of neighborhoods in relation to physical activity and transportation. With its comprehensive set of questions, NEWS enables researchers to gauge participants' perceptions regarding various environmental attributes that may influence their walking behaviors, such as the presence of sidewalks, proximity to destinations, safety, and

aesthetics. The survey utilized a 4-point Likert scale without a neutral option (1 = Strongly Disagree to 4 = Strongly Agree) to encourage more decisive responses and reduce central tendency bias. This forced-choice format was intentionally selected to prompt participants to take a clear stance, particularly when assessing subjective perceptions of their urban environment. Previous studies have shown that removing the midpoint can minimize indecisiveness and enhance response reliability when evaluating attitudes (Chyung et al., 2017; Johns, 2005; Kulas et al., 2008). By utilizing NEWS, this study aimed to delve into individuals' subjective experiences and perceptions of their neighborhood environments in the context of walkability, providing valuable insights into the factors shaping their walking behaviors and overall physical activity levels.

In the second part of the survey, the Perceived Stress Scale (PSS) was also employed to measure the stress levels experienced by individuals over the last month during the pandemic. This scale, developed by Cohen, Kamarck, and Mermelstein, is widely used in psychological research to assess the degree to which situations in one's life are appraised as stressful. It provides a framework for understanding the personal perception of stress, allowing researchers to gauge the impact of various life circumstances on an individual's psychological well-being.

The final section of the survey consisted of seven direct questions related to participants' experiences with the pandemic and their physical environments. Participants were instructed to reflect on their experiences over the past six months of the pandemic and select the responses that best matched their personal situations. This approach aimed to capture a comprehensive view of the individual impacts and adaptations during the pandemic, facilitating an in-depth analysis of how these factors influenced their daily lives and well-being.

When analyzing the data, the chi-square test was employed to explore correlation relationships, alongside descriptive statistics for further insight.

2.2. Targeted population and sampling

Generation Z university students were chosen as the focus of this study due to their unique characteristics and experiences during the COVID-19 pandemic. As a cohort known for their high levels of digital literacy, social activism, and adaptability to technological advancements, Generation Z has been significantly impacted by the pandemic-induced isolation measures. Before the pandemic, this demographic was typically active in their neighborhoods, engaging in various social and recreational activities. However, with the onset of the pandemic, they were forced to adapt to remote learning and limited social interactions, leading to potential changes in their perceptions of their neighborhood environments and their levels of physical activity. By studying this specific group, the research aims to provide insights into how pandemic-related disruptions have influenced their perceived walkability and stress management, thereby contributing to a better understanding of urban design and urban living conditions strategies tailored to the needs of Generation Z and similar cohorts.

To gather the necessary data, a broad approach was taken to include a diverse representation of Generation Z university students from Istanbul. Participation requests were sent to all 58 universities in Istanbul (13 state, 45 private). Students from 43 universities (6 state, 37 private) participated voluntarily. Initially, 510 individuals joined the study. However, after removing data that did not meet the study's criteria, the final analysis was conducted with 301 participants (n=301).

3. Findings

This study examines the participation of university students in Istanbul, Türkiye. Istanbul is home to a total of 58 universities, including 13 state universities and 45 foundation universities. For the purposes of this study, students from a total of 43 universities participated. The study sample consisted of 301 participants,

with 28% male and 72% female students. Age distribution ranged from 18 to 26 years old.

3.1. Descriptive findings toward physical environment

The first part of the survey focused on individuals' perceptions of their neighborhoods and surrounding environments. Participants were asked about the types of housing available in their vicinity, the presence of stores, facilities, and other amenities, access to these facilities, the condition of local streets, the availability of walking and cycling areas, the aesthetics of the nearby environment, and neighborhood safety.

To assess the walkability of participants' physical environments, they were asked about their mode of transportation to school before the pandemic and, if walking, the approximate duration of their commute. According to the findings, the majority of participants (241) did not walk to school, while the remaining participants are distributed across various walking durations.

As shown in Figure 1, the data highlights the percentage of participants who reported that various facilities are accessible within a 1–5 minute walk. Essential services such as grocery stores, supermarkets, and public transportation are perceived as highly accessible within this short range, which reflects the strengths of a well-connected urban layout. However, accessibility to non-essential services shows greater variability, indicating potential gaps in service distribution that could be addressed to improve overall neighborhood functionality and convenience.

The distribution of responses regarding the accessibility of recreation centers reveals significant insights. As shown in Figure 1, only 7.6% of participants reported that a recreation center was within a 1-5-minute walking distance from their homes, while 13.0% indicated a 6-10-minute walk. Additionally, 10.0% stated that it took 11-20 minutes to reach a recreation center, 7.0% reported a 20-30-minute walk, and 3.7% mentioned that it took over 30 minutes. Notably, a substantial 58.8% of participants responded with "none or don't

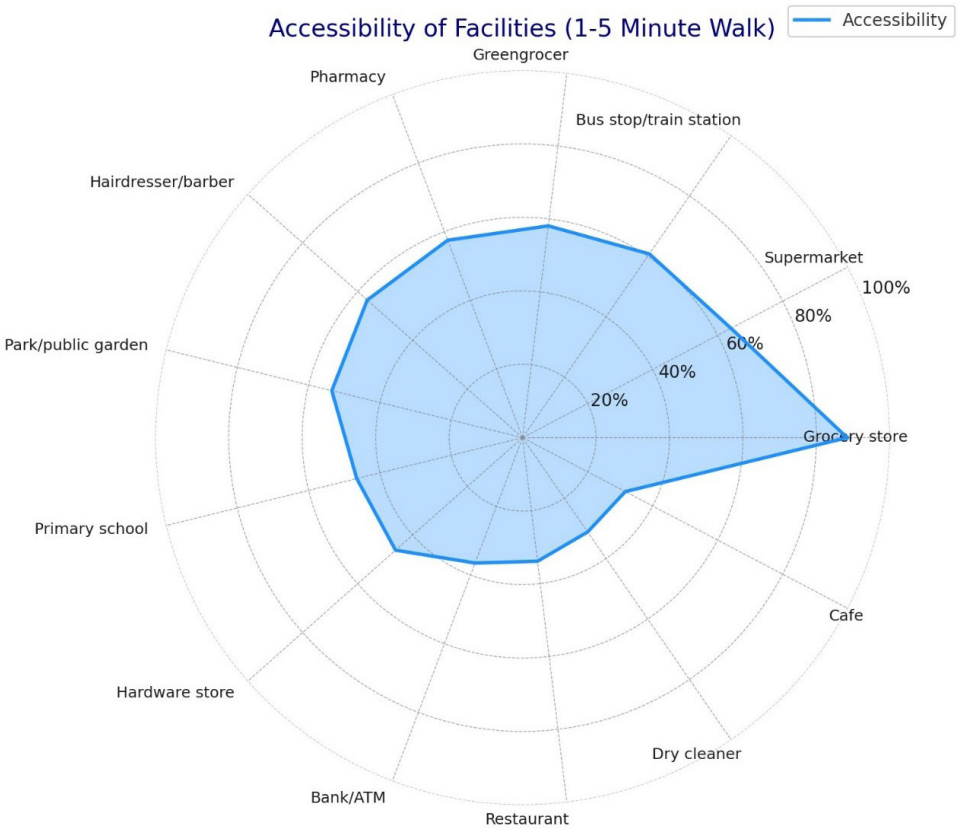

Figure 1. *The distribution of the facilities within a 1-5 minute walking distance from participants' homes.*

know," indicating either a lack of awareness or absence of recreation centers within a convenient distance.

The distribution of responses regarding the accessibility of recreation centers reveals significant insights. Key findings on recreation center accessibility include the following:

- Immediate Accessibility: Only 7.6% of participants reported that a recreation center was within a 1-5-minute walking distance from their homes.
- Moderate Accessibility:
- 13.0% indicated a 6-10-minute walk to reach a recreation center.
- 10.0% reported an 11-20-minute walk.
- 7.0% mentioned a 20-30-minute walk.
- Limited Accessibility: Just 3.7% indicated that reaching a recreation center took over 30 minutes.
- Lack of Awareness/Access: A significant 58.8% of participants selected "none or don't know," suggesting either a lack of knowledge about recreation center locations or their absence within reasonable walking distances.

This distribution highlights that while some participants have moderate access to recreation centers, the majority face significant limitations or are unaware of such facilities within a convenient distance. This finding suggests that recreation centers are significantly less accessible compared to other essential services. The high percentage of participants who responded with "none or don't know" highlights a potential gap in the availability or visibility of recreational facilities in the neighborhood. This disparity underscores the need for improved planning and communication regarding recreational amenities, which are vital for promoting health-related behaviors and social well-being among residents. Ensuring better distribution and awareness of recreation centers could enhance the overall quality of life and community engagement in the area.

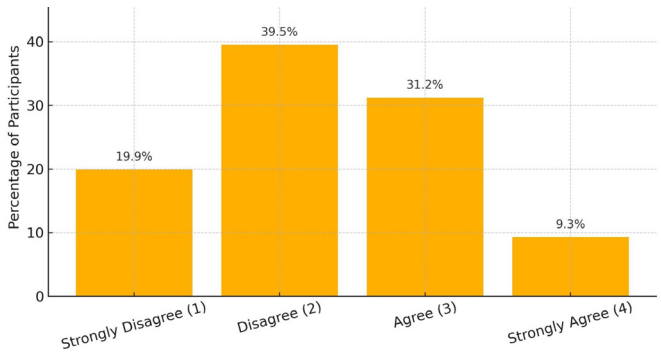

Figure 2. *The distribution of the participant agreement with the statement: "There are pedestrian crossings (marked or unmarked) to help people cross busy streets in my neighborhood".*

The survey also addressed the availability of pedestrian crossings in neighborhood streets to assist pedestrians in safely navigating busy areas. As the results highlight a significant concern regarding pedestrian safety and infrastructure in the surveyed neighborhoods in Figure 2, the high percentage of participants who disagreed or strongly disagreed with the availability of well-marked pedestrian crossings suggests that many areas may lack sufficient infrastructure to ensure safe pedestrian movement. This deficiency can deter walking as a mode of transportation, potentially increasing reliance on vehicles and contributing to traffic congestion. Conversely, the 40.6% of participants who agreed to some extent on the availability of these crossings indicate a partial implementation of pedestrian-friendly initiatives. However, the overall sentiment leans towards a need for significant improvement in pedestrian infrastructure to enhance safety and walkability in urban neighborhoods. To further quantify this response pattern, participant ratings on the 4-point Likert scale yielded the following results: M = 2.30, SD = 0.89, SE = 0.05, indicating moderate levels of agreement with notable variability across the sample.

The survey results reveal contrasting perspectives on neighborhood aesthetics (see Figure 3). A significant portion of residents feel the absence of sufficient trees along the streets, indicating a potential gap in urban greening initiatives that could enhance the visual appeal and environmental quality of the area. Participant responses revealed that a considerable proportion either disagreed (39.5%) or strongly disagreed (25.9%) with the statement on tree-lined streets, while only 34.6% agreed or strongly agreed. To quantify these perceptions, analysis yielded: M

= 2.17, SD = 0.96, SE = 0.06, indicating a below-average agreement level with relatively high variability in responses.

Conversely, responses concerning interesting things to observe while walking reflect a more positive view, with 20.3% expressing agreement and 79.7% expressing disagreement. This suggests that while natural landscaping may be lacking, other aspects of the urban environment may provide visual or cultural stimulation. Supporting this, the computed values were: M = 1.90, SD = 0.87, SE = 0.05, reflecting low agreement and relatively consistent perceptions across participants. These findings underscore the importance of holistic urban design that not only prioritizes green infrastructure but also enriches the pedestrian experience with diverse and appealing elements, thereby fostering a more vibrant and enjoyable community space.

The combined figure (Figure 4) offers a comprehensive view of residents' perceptions of two significant urban issues: traffic congestion's impact on walkability and safety concerns during evening walks. Regarding traffic congestion, 52.2% of participants expressed disagreement with the assertion that traffic makes walking unpleasant or difficult (13.3% strongly disagree and 38.9% disagree). However, 47.9% agreed that traffic issues negatively impact walkability (36.9% agree and 11.0% strongly agree), showcasing a nearly equal division among residents. This bifurcation indicates a substantial variation in pedestrian experiences, possibly influenced by the specific urban layout and traffic management measures in different parts of the neighborhood.

In terms of safety, the majority of participants feel secure in their neighborhoods during evening walks, with a combined 68.4% disagreeing (31.9% strongly disagree and 36.5% disagree) that crime rates deter them from outdoor activities. However, a notable 31.5% of participants agreed to some extent (19.9% agree and 11.6% strongly agree) that safety concerns are a barrier.To further quantify these perceptions, statistical analysis yielded the following results:Traffic congestion – *M = 2.46, SD = 0.86, SE = 0.049*; and Safety concerns at night – *M = 2.11, SD = 0.98, SE = 0.057*.

These values indicate moderate levels of agreement regarding both issues, with greater variability observed in perceptions of safety. Such findings emphasize the need for targeted urban planning interventions that address traffic congestion and enhance pedestrian safety and comfort. Implementing traffic calming measures, improving crosswalk visibility and safety, and promoting alternative transportation modes could mitigate the negative impacts of traffic on the pedestrian environment. Effective management of traffic issues is crucial for fostering a walkable, pleasant, and safe neighborhood, which not only enhances the quality of life for residents but also

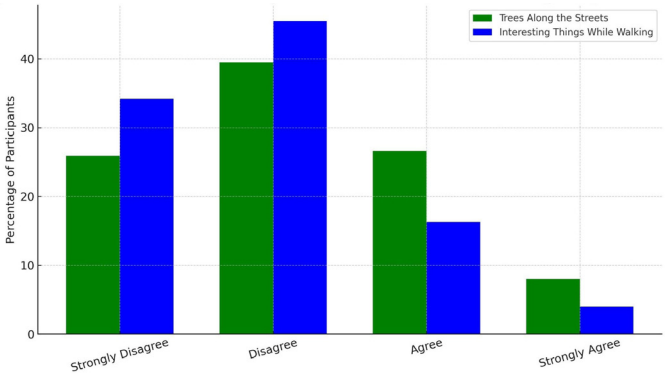

Figure 3. *Combined distribution of responses towards trees (Participant agreement with the statement "There are trees along the streets in my neighborhood.") and interesting things while walking (Participant agreement with the statement: "There are many interesting things to look at while walking in my neighborhood").*

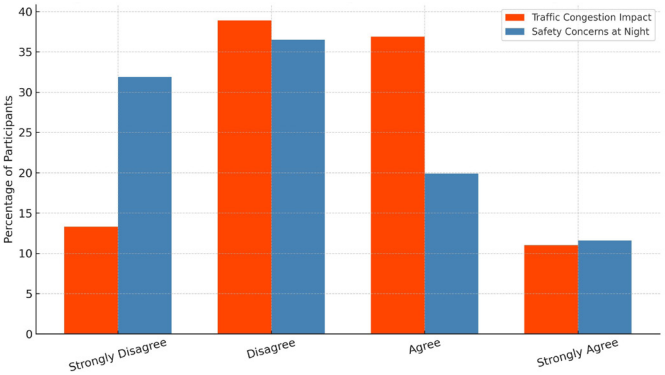

Figure 4. *Combined distribution of responses concerning traffic congestion's impact on walkability (Participant agreement with the statement: "There is too much traffic on nearby streets making it unpleasant or difficult to walk") and safety concerns (Participant agreement with the statement: "Crime rates in my neighborhood make it unsafe to go on walks in the evening." during evening walks.*

contributes to the overall sustainability of urban areas.

These findings underscore the importance of targeted interventions, such as traffic calming measures, improved crosswalk safety, enhanced street lighting, and community engagement initiatives, to create walkable and secure neighborhoods that foster residents' well-being and overall urban sustainability. Such interventions are crucial for improving safety perceptions and encouraging residents to maintain healthy lifestyle choices by feeling secure in their outdoor environments.

3.2. Descriptive findings toward stress level

The second part of the survey focused on measuring the stress levels experienced by individuals during their last month of the pandemic period. A total of 10 questions from the Perceived Stress Scale (PSS) were included, and participants were requested to respond to these questions based on their personal experiences. The analysis of perceived stress levels among participants using the PSS reveals a significant trend towards moderate and high stress levels, with the majority reporting these conditions (see Figure 5). This pattern underscores the profound psychological impact of the pandemic on individuals, highlighting a prevalent sense of stress that may be attributed to the ongoing health crisis and its numerous social and economic repercussions. The prevalence of moderate stress as the most common stress level, peaking at a specific score within this category, suggests that while extreme stress is less common, a substantial portion of the population is experiencing a heightened level of stress that could potentially lead to more severe well-being outcomes if not addressed. To summarize the overall distribution quantitatively, stress levels yielded a mean score of 22.92 (SD = 6.91, SE = 0.40) on the PSS, indicating a moderate average stress level with noticeable variability across participants.

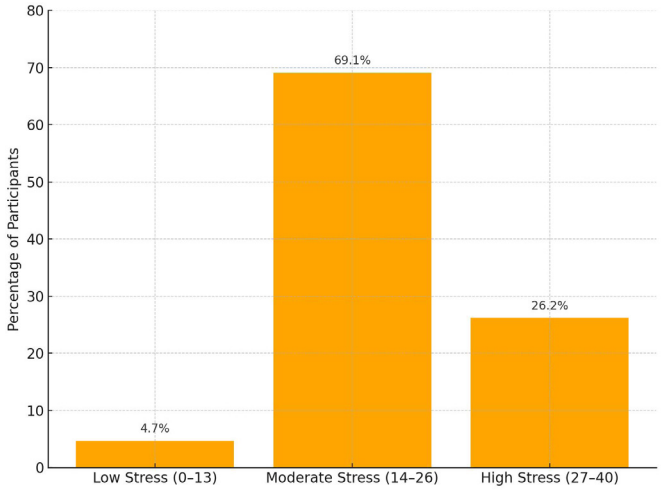

Figure 5. *The distribution of perceived stress levels among participants.*

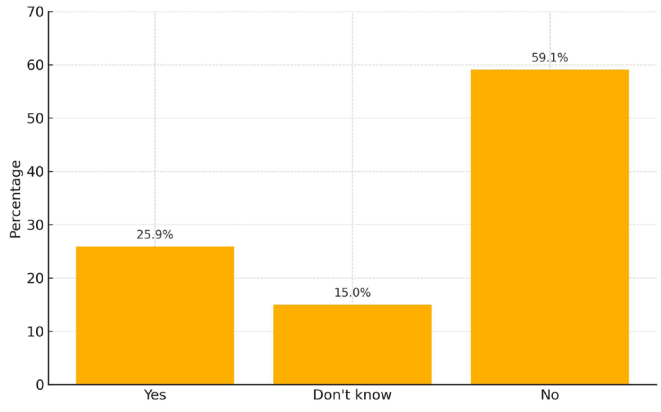

Figure 6. *The distribution of perceived adequacy of walking areas during the pandemic.*

3.3. Descriptive findings toward participants' walking activities and their physical environments

The survey data indicates a significant perception among participants that walking areas in their neighborhoods were inadequate during the pandemic (see Figure 6). A large majority expressed dissatisfaction with the availability and quality of walking spaces such as bike paths, parks, recreational areas, and waterfronts, which were critical for maintaining physical and psychological well-being during lockdowns. This sentiment highlights a gap in urban planning and the need for more resilient infrastructure to support urban living conditions in crisis situations. Statistical analysis of the responses (M = 1.67, SD = 0.86, SE = 0.05) reveals a clear tendency toward negative evaluations, underscoring the perceived insufficiency of walking areas across the sampled neighborhoods.

The survey reveals a substantial decrease in walking activities among participants during the pandemic

compared to pre-pandemic levels (see Figure 7). A significant 72.1% of participants reported a reduction in their walking activity, while only 16.9% indicated an increase, and 11.0% reported no change. This trend highlights the profound impact of pandemic-related restrictions and altered daily routines. Statistically, responses yielded a mean score of M = 1.45 on a 3-point scale (1 = Decreased, 2 = No Change, 3 = Increased), with a standard deviation (SD) = 0.77 and standard error (SE) = 0.04, indicating a clear skew towards reduced activity. These findings underscore the need for adaptive urban strategies that sustain physical activity even under movement restrictions. Interestingly, the small group that increased their walking suggests that for some, walking became a compensatory form of physical activity amidst the closure of gyms and recreational facilities.

The survey explored how physical and environmental features within neighborhoods influenced walking activities during the pandemic, focusing on sidewalk continuity and width. As shown in Figure 8, the majority of participants reported that these features had no significant impact on their walking activities, suggesting a degree of adaptability or indifference to these factors under pandemic conditions. However, a notable proportion of responses indicated a positive impact, reflecting that well-maintained and continuous sidewalks can enhance the walking experience, possibly encouraging more physical activity during restrictive times. Conversely, the negative responses highlight areas where improvements in urban infrastructure could potentially increase outdoor activity levels. The mixed impact underscores the importance of considering urban design in urban living conditions strategies, particularly in fostering environments that support physical activity during crises like a pandemic.

Statistical summaries:

- For sidewalk continuity, the responses yielded a mean score of M = 2.17, with a standard deviation of SD = 0.64 and a standard error of SE = 0.037.
- For sidewalk width, the mean score was M = 2.12, with a standard deviation of SD = 0.66 and a standard error of SE = 0.038.
- These scores, centered around the neutral-midpoint of the scale, further support the interpretation of nuanced and mixed effects perceived by participants.

Participants were also asked to evaluate the relationship between their outdoor walking activities and perceived safety in their neighborhood during the pandemic. As shown in Figure 9, nearly half (49.5%) of the participants reported that their sense of safety had no impact on their walking activities, while 20.6% indicated a positive influence and 29.2% reported a negative impact. These results suggest a complex perception of safety during the pandemic, where for many individuals, safety did not pose a barrier to walking. However, the substantial proportion of negative responses underscores the importance of urban safety enhance-

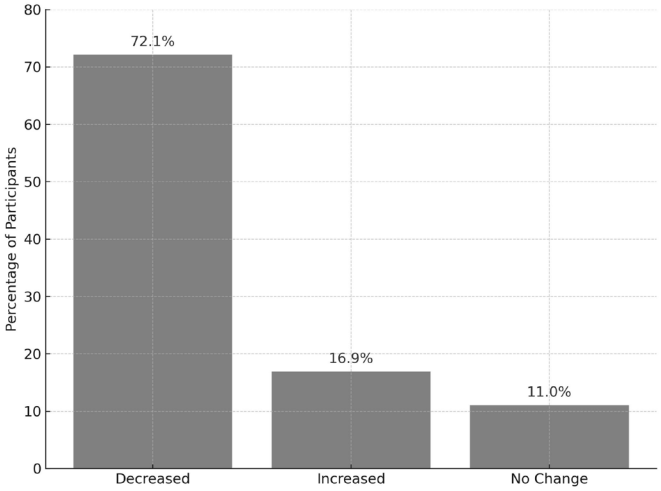

Figure 7. *The distribution of participants' reported change in walking activity before and during the pandemic.*

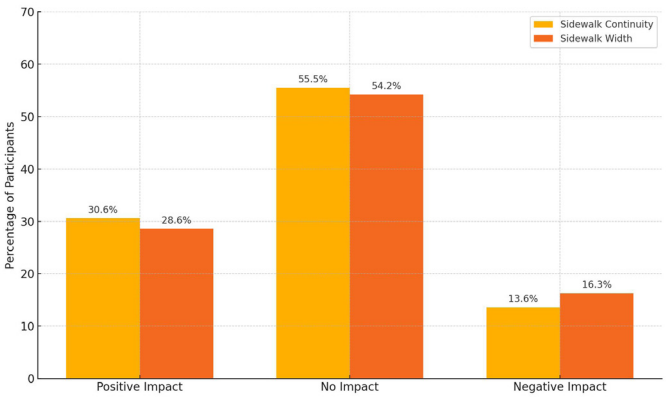

Figure 8. *Perceived impact of sidewalk continuity and width on walking activities during the pandemic.*

ments, particularly during crises that alter public space usage. The computed average score for this item was M = 1.91 (where 1 = positive, 2 = no impact, 3 = negative), indicating a general leaning toward neutrality or slight negativity. The standard deviation was SD = 0.70, and the standard error was SE = 0.05, reflecting a moderate dispersion of responses. These findings reinforce the significance of psychological comfort and perceived safety in encouraging sustained physical activity during disruptive events such as a pandemic. (See Figure 9).

3.4. Correlational findings

In the correlational analysis section of our study, we explore the associations between various neighborhood characteristics and the perceived stress levels among residents. Utilizing statistical methods such as the Pearson Chi-Square test and Fisher's Exact Test, we aim to uncover the nuanced impacts that factors like neighborhood safety, parking availability, street conditions, sidewalk presence, and local crime rates have on individual stress perceptions. Following table summarizes the correlational findings:

The correlational results presented in Table 1 reveal several important patterns highlighting the relationship between environmental stressors and perceived stress levels among residents. Notably, neighborhood safety was significantly associated with stress levels ($\chi^2(4) = 13.673$, $p = .008$, $n = 301$), suggesting that lower perceptions of safety correspond with higher stress. Similarly, crime-related concerns—both during the daytime ($\chi^2(6) = 20.754$, $p = .002$; Fisher's Exact Test = 18.226, $p = .003$) and evening hours ($\chi^2(6) = 23.465$, $p = .001$; Fisher's Exact Test = 20.342, $p = .001$; $n = 301$)—were strongly associated with elevated stress, underscoring the psychological toll of perceived insecurity in both daily activities and after dark. These findings are consistent with prior studies indicating that perceived crime and safety risks significantly influence mental well-being, reduce feelings of comfort in public spaces, and deter outdoor mobility, especially in vulnerable populations.

Additionally, poor physical infrastructure such as uneven streets ($\chi^2(6) = 14.747$, p = .022; Fisher's Exact Test = 16.255, p = .008; n = 301) and insufficient sidewalks ($\chi^2(6) = 13.572$, p = .035; Fisher's Exact Test = 12.361, p = .040; n = 301) was also significantly associated with higher stress levels. These features likely increase discomfort, fear of accidents, and reduced willingness to engage in walking-based activities, thereby compounding psychological strain. Similarly, difficulty in parking in local shopping areas (p = 0.045), while seemingly mundane, appears to be another stress-inducing factor, likely due to its cumulative effect on daily frustrations and time management.

Together, these findings provide a holistic view of how the built environment and perceived security interact to shape psychological experiences. They emphasize the need for integrated urban design and public safety strategies that simultaneously enhance both the physical walkability infrastructure and social safety, in order to promote not just functional but also emotionally supportive neighborhoods.

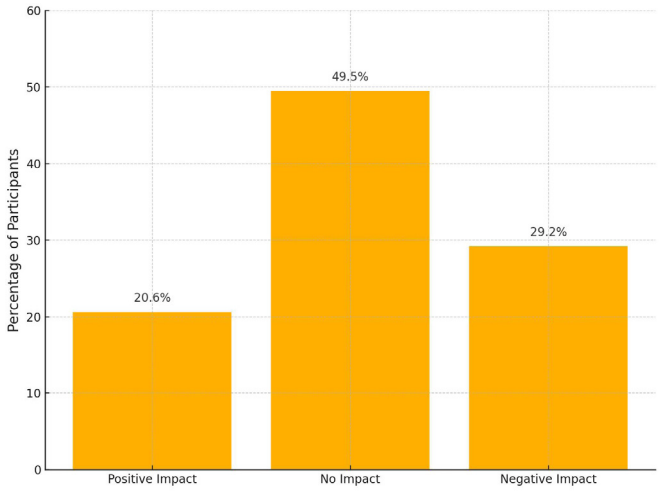

Figure 9. *Impact of perceived safety on walking activities during the pandemic.*

4. Discussion

The findings of this study elucidate the critical relationship between urban design, walkability, and stress management, particularly among Generation Z university students in Istanbul during the COVID-19 pandemic. By employing the Neighborhood Environment Walkability Scale (NEWS) and the

Table 1. *Correlational findings.*

Neighborhood Characteristic	Statistical Test Used (p-value)	Key Findings
Neighborhood Safety	Pearson Chi-Square (p = 0.008)	Higher levels of perceived stress are significantly associated with lower neighborhood safety.
Difficulty Parking in Local Shopping Areas	Fisher's Exact Test (p = 0.045)	Difficulty in finding parking correlates significantly with increased stress among residents.
Uneven Streets	Fisher's Exact Test (p = 0.008)	Uneven street conditions are significantly linked to higher perceived stress levels.
Sidewalk Availability	Fisher's Exact Test (p = 0.040)	Lack of adequate sidewalks is significantly associated with higher stress, emphasizing the need for better pedestrian infrastructure.
High Crime Rates	Fisher's Exact Test (p = 0.022)	High crime rates in neighborhoods are significantly correlated with increased stress among residents.
Daytime Safety Concerns Due to Crime	Fisher's Exact Test (p = 0.003)	Daytime safety concerns due to high crime rates are strongly linked to higher stress levels.
Evening Safety Concerns Due to Crime	Fisher's Exact Test (p = 0.001)	Evening safety concerns significantly exacerbate stress, highlighting the need for enhanced safety measures after dark.

Perceived Stress Scale (PSS), the research provided both descriptive and correlational insights that inform urban planning and urban living conditions policies.

The descriptive analysis indicated that the majority of participants did not walk to school before the pandemic, suggesting that the infrastructure may not adequately support pedestrian transit. Despite the accessibility of essential services like grocery stores and public transportation, the significant lack of recreation centers and the perception of insufficient pedestrian crossings highlight areas needing improvement. These findings suggest that while basic amenities are available, recreational and safety infrastructure lag, which are crucial for promoting regular physical activity and psychological outcomes.

Interestingly, the aesthetic appeal of neighborhoods received mixed reviews. While some participants found their surroundings engaging, the lack of natural elements like trees was a notable shortfall. This points to the need for a holistic approach to urban design that combines green spaces with aesthetically pleasing urban elements to enhance walkability and community engagement.

The pandemic's impact on walking activities was profound, with a notable decrease in walking during the lockdown. This highlights the need for adaptable urban spaces that can support physical activity even during restrictive times. Furthermore, the mixed responses regarding sidewalk quality and perceived safety underscore the importance of continuous investment in pedestrian infrastructure and community safety measures.

The correlational analysis revealed significant associations between neighborhood characteristics and perceived stress levels. Key findings include:

- *Neighborhood Safety*: Higher levels of perceived stress were significantly associated with lower neighborhood safety ($p = 0.008$). This underscores the importance of safe urban environments in mitigating stress and promoting mental well-being.

- *Parking Difficulty:* Difficulty in finding parking in local shopping areas correlated significantly with increased stress ($p = 0.045$). This suggests that even car-dependent aspects of urban design can impact stress levels, highlighting the need for comprehensive transportation planning that includes both vehicular and pedestrian needs.
- *Street and Sidewalk Conditions:* Uneven street conditions ($p = 0.008$) and lack of adequate sidewalks ($p = 0.040$) were significantly associated with higher stress levels. These findings emphasize the importance of maintaining high-quality pedestrian infrastructure to support mental well-being.

Crime Rates and Safety Concerns: High crime rates ($p = 0.022$) and safety concerns during both daytime ($p = 0.003$) and evening ($p = 0.001$) were strongly linked to increased stress. This highlights the critical need for effective policing, community engagement, and urban design strategies that enhance safety.

The findings of this study are broadly consistent with prior research on the relationship between neighborhood environments and perceived stress. Previous studies have similarly highlighted how environmental stressors such as crime rates, lack of pedestrian infrastructure, and traffic-related concerns contribute to increased psychological distress among urban residents (Frumkin, 2002; Giles-Corti et al., 2016). For example, studies have shown that neighborhood safety and fear of crime are significant predictors of reduced outdoor activity and higher stress, especially among women and elderly populations (Lorenc et al., 2013; Foster & Giles-Corti, 2008). Likewise, the importance of walkable environments, including well-maintained sidewalks and access to local amenities, has been emphasized as crucial not only for promoting physical activity but also for supporting mental health and reducing stress (Sarkar et al., 2018; Giles-Corti et al., 2016). Our results align with these findings, reinforcing the argument that urban environments play a key role in shaping both the physical and psychological well-being of residents. The current study contributes to this growing body of literature by offering context-specific evidence from a Turkish urban setting, thereby enhancing the geographic diversity of research in this domain.

The study's findings highlight essential urban planning implications, particularly the need to prioritize walkable neighborhoods, enhance safety, and incorporate both functional and aesthetic elements into city design. Emphasizing the unique needs of Generation Z, urban planners should focus on creating inclusive spaces that reduce perceived stress and support healthy behavior. Additionally, the importance of resilient infrastructure is underscored, advocating for adaptable urban spaces that can support urban living conditions during crises.

The following summarizes key implications for urban planning drawn from this study's findings.

- Enhancing Walkability: Urban planners should prioritize the development of walkable neighborhoods by improving pedestrian infrastructure, ensuring the availability of recreational facilities, and incorporating green spaces. These elements are essential not only for promoting health-related behaviors but also for reducing stress.
- *Safety and Security:* Addressing safety concerns through better lighting, increased police presence, and community watch programs can significantly reduce stress levels and encourage outdoor activities.
- *Holistic Design:* Incorporating both functional and aesthetic elements in urban design can enhance the overall quality of life. Trees, parks, and visually appealing elements should be integral parts of urban planning.
- *Inclusive Planning:* Recognizing the diverse needs of different population groups, particularly younger generations, is crucial. Generation Z, with its unique characteristics and preferences, should be considered in urban planning efforts to create spaces that meet their needs and promote their well-being.
- Resilient Infrastructure: The pandemic has highlighted the need for resilient urban infrastructure that

can support urban living conditions during crises. Flexible use of spaces and the availability of safe, open areas for physical activity should be prioritized.

5. Conclusion

While the COVID-19 pandemic presented certain methodological challenges, it also provided a unique context in which the effects of environmental factors such as walkability could be examined under heightened conditions of stress and mobility restriction. Although some degree of stress may be attributed to general anxieties related to the pandemic, the Perceived Stress Scale (PSS) captured participants' broader psychological responses, which were then correlated with their perceptions of the built environment. This approach enabled the study to explore how environmental design features contributed to stress regulation during a time when individuals were especially sensitive to their immediate surroundings. Moreover, Generation Z—being digitally connected yet spatially constrained—offered a distinctive lens through which the restorative potential of walkable environments could be interpreted. This study contributes to understanding the relationship between walkability and perceived stress, particularly among Generation Z students in Istanbul during the COVID-19 pandemic. It finds that increased walkability correlates with reduced perceived stress, suggesting the potential of walkable environments to support mental resilience in urban populations. The findings align with existing literature highlighting the mental health benefits of physical activity and walkable urban environments (e.g., Southworth, 2005; Cervero & Kockelman, 1997). They also confirm previous studies that link environmental quality—such as sidewalk conditions, safety, and access to amenities—to psychological well-being (e.g., Wood et al., 2010; Jiang et al., 2023). The gender-based differences in stress and walkability perception also echo past research noting the variability of stress experience across demographic lines. However, the study reveals that recreation centers and well-maintained sidewalks remain limited or underrecognized in many neighborhoods. This reflects a gap in the implementation of walkable design principles, which calls for policy attention. Overall, the research supports the notion that urban form can significantly shape public mental health outcomes, especially during periods of disruption. Future studies may consider integrating more direct measures of well-being or longitudinal assessments to further understand causality. Integrating qualitative insights from residents could also enrich findings.

While this study identified important patterns linking perceived walkability to stress levels among Generation Z participants, it is important to acknowledge that participants resided in varied urban environments. These contextual differences may influence how built environment features are experienced. Although the study utilized descriptive statistics to illustrate key trends, correlational analysis was also applied to explore the relationship between walkability and stress perceptions. Future studies could build on these findings by incorporating spatial clustering or typological comparisons to better capture environmental variability and its effects on health-related perceptions.

References

Alfonzo, M. A. (2005). To walk or not to walk? The hierarchy of walking needs. *Environment and Behavior, 37*(6), 808–836. https://doi.org/10.1177/0013916504274016

Alpak, E., Mumcu, S., & Yılmaz, S. (2018). Açık mekanların çevresel özellikleri: Algısal, fiziksel ve sosyal faktörler. *Uluslararası Çevre ve Planlama Dergisi, 1*(1), 541–551.

Boarnet, M., & Crane, R. C. (2001). *Travel by design: The influence of urban form on travel*. Oxford University Press. https://doi.org/10.1093/oso/9780195123951.001.0001

Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health. *An-*

nals of the New York Academy of Sciences, 1249(1), 118–136. https://doi.org/10.1111/j.1749-6632.2011.06400.x

Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D: Transport and Environment, 2*(3), 199–219. https://doi.org/10.1016/S1361-9209(97)00009-6

Chyung, S. Y., Hutchinson, D., Shamsy, J. A., & Nihan, N. (2017). Evidence-based survey design: The use of a midpoint on the Likert scale. *Performance Improvement, 56*(10), 15–23. https://doi.org/10.1002/pfi.21727

Çelik, Y. (2006). Sürdürülebilir kalkınma kavramı ve sağlık. *Hacettepe Sağlık İdaresi Dergisi, 9*(1), 19-37.

Dinçer, E., (2011*). Kentli Hakkı Olarak Kent Sağlığı ve Şehir Planlama*. Sağlıklı Kentler Birliği 7. Yıl Konferansı, 22-24 Eylül, Tepebaşı-Eskişehir, Konferans Kitabı, 46-56.

Dovey, K., & Pafka, E. (2020). What is walkability? The Urban DMA. *Urban Studies, 57*(1), 93–108.

Evans, G., & Cohen, S. (1987). Environmental stress. In D. Stokols & I. Altman (Eds.), *Handbook of environmental psychology* (pp. 571–610). Wiley.

Fonseca, C., Ahern, J., & Pereira, P. (2022). Perceived walkability and respective urban determinants. *Sustainability, 14*(15), 9089.

Foster, S., & Giles-Corti, B. (2008). The built environment, neighborhood crime and constrained physical activity: An exploration of inconsistent findings. *Preventive Medicine, 47*(3), 241–251. https://doi.org/10.1016/j.ypmed.2008.03.017

Fırat, A. (2006). Sağlıklı kentler ve kentsel sağlık. *Sağlık Araştırmaları Dergisi, 8*(2), 319–340.

Frumkin, H. (2002). Urban sprawl and public health. *Public Health Reports, 117*(3), 201–217. https://doi.org/10.1016/S0033-3549(04)50155-3

Giles-Corti, B., Vernez-Moudon, A., Reis, R., Turrell, G., Dannenberg, A. L., Badland, H., Foster, S., Lowe, M., Sallis, J. F., Stevenson, M., & Owen, N. (2016). City planning and population health: A global challenge. *The Lancet, 388*(10062), 2912–2924. https://doi.org/10.1016/S0140-6736(16)30066-6

Gümüştekin, G., & Öztemiz, A. (2004). Örgütsel stres yönetimi ve uçucu personel üzerinde bir uygulama. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 23*(2), 61–85.

Işıklı, S. (2020). **Covid-19 salgınının psikolojik sonuçları ve etkili başa çıkma yöntemleri*. Nobel Akademik Yayıncılık.

Jackson, L. E. (2003). The relationship of urban design to human health and condition. *Landscape and Urban Planning, 64*(4), 191–200. https://doi.org/10.1016/S0169-2046(02)00230-X

Jiang, B., Chang, C.-Y., & Sullivan, W. C. (2023). A dose of nature: Tree cover, stress reduction, and mental health in urban parks. *Landscape and Urban Planning, 234*, 104651.

Johns, R. (2005). One size doesn't fit all: Selecting response scales for attitude items. *Journal of Elections, Public Opinion and Parties, 15*(2), 237–264. https://doi.org/10.1080/13689880500178849

Kulas, J. T., Stachowski, A. A., & Haynes, B. A. (2008). Middle response functioning in Likert-responses to personality items. *Journal of Business and Psychology, 22*(3), 251–259. https://doi.org/10.1007/s10869-008-9064-2

Larkin, C. M., Jancourt, M., & Hendrix, W. H. (2018). The Generation Z world: Shifts in urban design, architecture, and the corporate workplace. *Corporate Real Estate Journal*, *7*(3), 230–242.

Lorenc, T., Petticrew, M., Whitehead, M., Neary, D., Clayton, S., Wright, K., Thomson, H., Cummins, S., Sowden, A., & Renton, A. (2013). Fear of crime and the environment: Systematic review of UK qualitative evidence. *BMC Public Health, 13*(1), 496. https://doi.org/10.1186/1471-2458-13-496

Massengale, J. M., Dover, V., Charles, & Kunstler, J. H. (2014). *Street design: The secret to great cities and towns*. Wiley.

Odriozola-González, P., Planchuelo-Gómez, Á., Irurtia, M. J., & de Luis-García, R. (2020). Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. *Psychiatry Research, 290*, 113108. https://doi.org/10.1016/j.psychres.2020.113108

Okutan, M., & Tengilimoğlu, D. (2002). İş ortamında stres ve stresle başa çıkma yöntemleri: Bir alan uygulaması. *İşletme Araştırmaları Dergisi*,

15(1), 42–56.

Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science & Medicine, 56*, 1693–1703.

Pettinger, R. (2002). *Stress management*. Capstone Publishing.

Saldamli, Ö. (2000). Otel işletmelerinde stres kaynakları ve çalışanlar üzerindeki etkileri: Beş yıldızlı otellerde bir uygulama. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 6*(6), 1–15.

Sarkar, C., Webster, C., & Gallacher, J. (2018). Residential greenness and prevalence of major depressive disorders: A cross-sectional, observational, associational study of 94 879 adult UK Biobank participants. *The Lancet Planetary Health, 2*(4), e162–e173. https://doi.org/10.1016/S2542-5196(18)30051-2

Sendich, E. & American Planning Association (Eds.). (2006). *Planning and urban design standards* (1st ed). Wiley.

Southworth, M. (2005). Designing the walkable city. *Journal of Urban Planning and Development, 131*(4), 246–257. https://doi.org/10.1061/(ASCE)0733-9488(2005)131:4(246)

Tekel, A., & Görer, N. (2016). Yürünebilirlik kavramı ve yürünebilirliği etkileyen temel faktörler. *Gazi Üniversitesi Mimarlık Fakültesi, Şehir ve Bölge Planlama Dergisi, 23*(3), 207–215.

Transportation Research Board and Institute of Medicine. (2005). *Does the built environment influence physical activity?: Examining the evidence—Special Report 282*. The National Academies Press. https://doi.org/10.17226/11203

Wang, R., Helbich, M., Yao, Y., Zhang, J., Liu, P., Yuana, Y., & Liu, Y. (2019). *Urban greenery and mental wellbeing in adults: Cross-sectional mediation analyses on multiple pathways across different greenery measures* (Version 1). arXiv. https://doi.org/10.48550/ARXIV.1905.04488

Wattchow, B., Jeanes, R., Alfrey, L., Brown, T., Cutter-Mackenzie, A., & O'Connor, J. (Eds.). (2014). *The Socio-ecological Educator: A 21st Century Renewal of Physical, Health, Environment and Outdoor Education*. Springer Netherlands. https://doi.org/10.1007/978-94-007-7167-3

Wood, L., Frank, L. D., & Giles-Corti, B. (2010). Sense of community and its relationship with walking and neighborhood design. *Social Science & Medicine, 70*(9), 1381–1390. https://doi.org/10.1016/j.socscimed.2010.01.021

Yin, L. (2013). Assessing walkability in the city of Buffalo: Application of agent-based simulation. *Journal of Urban Planning and Development, 139*(3), 166–175. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000147