

Adaptive Design Guidelines for Health-based Promenades in Jeddah City

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Abstract Due to the increasing prevalence of diseases spread worldwide through sedentary lifestyles, open spaces and promenade designs are becoming more popular and receiving attention to increase people's physical activity and improve their health. This research aims to establish and examine new health-based design guidelines for promenades in Jeddah, to help people get rid of Sick Neighbourhood Syndromes and specific diseases such as obesity, diabetes, high cholesterol, bone diseases, and blood pressure. Analytical literature research, precedent analysis, case study analysis, field survey, and simulation are the main methods used to achieve the research goal. The results showed that 10 factors should be considered to ensure and maintain a health-based oriented promenade in Jeddah that can positively affect people's health and performance and avoid the risk of pandemics such as COVID-19. Results also revealed the thriving need for the devised guidelines to be applied, in addition to the other ten recommended factors. The results are limited to Jeddah City as a representative of the Hot Arid Zone. It is recommended to take it for further study to validate the twenty factors.

Keywords COVID-19 Pandemic, Promenade Design, Health-based Space, Visibility and Surveillance, Universal Access, Sustainable Features, Physical Activity Facilities

1. Introduction and Research Background

Recently, COVID-19 caused fundamental changes and a

highly dynamic environment. Uncertainty, complexity, and fast changes confirmed the need for adaptive design solutions [1]. It has generated incredible pressure on public health systems [2]. The World Health Organization (WHO) acknowledged COVID-19 as a pandemic due to the high number of confirmed cases and deaths [3]. This unprecedented health crisis pushed countries worldwide to apply strict policies, including stay-at-home-lockdowns, quarantine and social distancing, restrictions on public events, social gatherings and public transport, and the closure of schools and workplaces [4, 5]. These procedures have influenced human health, social, and economic aspects. On the health scale, due to self-isolation and restrictions to use of open spaces, people experienced adverse physiological and psychological effects such as fatigue, tiredness, insomnia, post-traumatic stress symptoms, anxiety, loneliness, confusion, depression, and anger [4, 6]. At the social scale, due to social interaction restrictions, social cohesion and social wellbeing were harmfully affected by COVID-19 [7]. Chronic illnesses such as cardiovascular diseases, cancer, mental illnesses, and type 2 diabetes have now replaced infectious diseases as the most common cause of death and disability in the urban population, and they are causing great health and financial burden. [8-11]. These diseases share several lifestyle risk factors, including physical inactivity and poor diet [12]. As a result, urban open spaces, parks, promenades, and pedestrian zones have become more critical due to their significant and irreplaceable role. They often represented the only urban space that people could use for physical, social, and cultural activities [4, 6].

Parks are essential elements that contribute to people's health and well-being by providing spaces for relaxation, exercise, interaction, and appreciation. This is very important due to the sharp increase in the sedentary lifestyle. The health impact of urban planning was demonstrated in the 19th century when it was successfully used to reduce the spread of infectious diseases in European cities, by improving sanitation housing and separating polluting industrial areas from residential areas [13-15]. Other studies reported that physical exercise and spending more time in outdoor and green spaces are essential for citizens' emotional well-being and mental health [16-18]. This was reflected through the increase in the visiting and usage of green spaces during the pandemic [11, 19]. Moreover, some activities such as physical exercise, relaxation, and walking have relatively increased, while other activities such as meeting people or observing nature have decreased, while there is a need to adopt new types of urban green infrastructure such as agricultural land and high tree density cover [20, 21].

The application of sustainability is carried out by different stakeholders including academic, government, and other sector initiatives in addition to private-sector ones. Mohamed [22] reviewed tens of Green Rating Systems (GRS) that aim at enhancing the quality of life of residents. These initiatives vary in their nature and way of application, some of them are building standards and codes, frameworks, and programs in addition to rating systems [23]. Green codes could be classified into two types: prescriptive and performance, with outcome-based as a third option. A Prescriptive path is a fast, definitive, and conventional approach to code compliance. It provides tables to quantify certain levels of strictness for materials and equipment. Performance-based codes are designed to achieve certain results, rather than meeting prescribed requirements for individual building elements. Outcome-based codes establish a consumption target for certain areas such as energy, water...etc. One example of the green codes is the International Green Construction Code (IgCC) which provides a comprehensive set of requirements in order to reduce the harmful effects of buildings on the natural environment [23]. One of the most related GRS to the topic of the current research is WELL Building Standard [24] is a performance-based system for measuring, certifying, and monitoring features of the built environment that impact human health and wellbeing, through the air, water, nourishment, light, fitness, comfort, and mind. Programs and frameworks are databases that provide datasets relating to most aspects of sustainability. An example of a framework is the Reference Framework of Sustainable Cities (RFSC), which encourages sustainability and integrated urban development aligned with Europe 2020 guidelines and objectives [25]. City Prosperity Initiative (CPI), measures sustainability at the urban level, to allow local and central governments to use data [26]. Climate Positive Development Program (CPDP), addresses the challenges of rapid urbanization and climate

change [27].

Many studies tackled health issues with the built environment. Some research focused on the open spaces within buildings. Rosa-Jimenez and Jaime-Segura [28] highlighted the ability of housing to accommodate open spaces typical of the city and its public spaces. They emphasized the need to consider the orientation of the housing, the need for a greater number of rooms to facilitate remote working, and the importance of attached open spaces such as terraces overlooking green areas. Nia [29] proposed a comprehensive mitigating strategy to deal with the environmental risk factors of COVID-19 pandemic in the short and long term by designing a healthy urban environment. Kim [30] discussed the relationships between social support and the physical environmental design factors for open space in healing facilities. Xue and Lau [31] investigated the relationships between human health and well-being and the diverse site configuration. The results confirmed that 1) the precise composition of the urban canopy directly impacts the thermal comfort of urban open space, and 2) the comprehensive site configuration significantly influences the personal evaluation of health perception.

Other research focused on a specific type of open spaces and specific design elements. Cranney et al. [32] investigate the importance of physical activity on health and the use of public open spaces. The study concluded that the outdoor gym may not attract new park users, but it does offer existing park users more opportunities for active recreation and social interactions. Veen et al. [33] addressed green open spaces and their role in stimulating physical activity and their potential to promote health. Lau et al. [34] also focused on the green and landscape elements in having a healthy environment in open spaces. Ali et al. [35] discussed the role of green spaces to address respiratory health for elderly people.

Other research focused on a specific dimension of human being health. Koohsari et al [36] addressed the role of accessibility, proximity, and the size of open spaces in encouraging physical activity, and the relation between the surrounding. Douglass et al. [37] investigated the ecological determinants of respiratory health and examined the associations between asthma emergency department visits, diesel particulate matter, and public parks and open spaces in Los Angeles. Gómez et al. [38] studied the ecological design to enhance comfort in open spaces of Valencia City in Spain.

Previous studies were carried out in Saudi Arabia to investigate the use of the Public Open Spaces (POS). In his research, Alhajaj [39] demonstrated scenarios for increasing the deployment of POS that will improve the health of Jeddah residents. According to the WHO, the POS amount per person should be 9 m² [40]. In Jeddah, Alhajaj confirmed that the POS per person is 2 m² per person. The first author of the current research in collaboration with other researchers tackled the thermal performance of the POS and the quality of life of

neighborhoods in previous studies [16, 18, 41-44]. One of these studies focused on the impact of the urban fabric and morphology on the UHIs in two districts in Makkah City in Saudi Arabia [43]. The research revealed that the organic/compact urban fabric is better than the deformed iron-grid urban fabric in mitigating the phenomenon of the UHI. Mohamed et al [16] discussed the negative impact of the neighborhood design elements and their interconnection with illness syndromes. Like the Sick Building Syndrome (SBS), the paper introduced a new term to define the relationship between the urban design elements and the sick health syndromes which is "Sick Neighborhood Syndrome" (SNS). Shawesh and Mohamed [18] conducted a detailed assessment of the Outdoor Thermal Comfort (OTC) in Hot Arid Zone (HAZ) using the Physiological Equivalent Temperature (PET) and the Predictive Mean Vote (PMV) thermal indices in Jeddah. The results confirmed the significance of the shading strategy on OTC. The study revealed that there's no percentage of shading permitting people to use the space, otherwise in Hot Arid Zone, the space would be completely unusable under the sun. In another study [41] the oasis effect as a cooling effect phenomenon was discussed in terms of theories and mathematical models. They presented a new vision of this old green phenomenon via the digital simulation of the palm grove behavior.

In conclusion, Physical, mental, and social well-being are essential aspects of human health. To attain a healthy and fulfilling life, six important components must be addressed simultaneously: Physical, environmental, psychological, social, spiritual, and intellectual health [45]. The provision of aesthetic, and environmental attributes in the park attracted more users to the space in addition to other features including accessibility, availability, and quality of facilities, the surrounding land use, and the availability of organized events that attract people to the park [46, 47]. Open spaces in general including promenades play a vital role in addressing health issues. In this sense, specific parameters should be available in open spaces to play their role efficiently. These parameters include the availability of green spaces (agricultural land and high tree density cover), the availability of blue spaces (lakes, rivers, canals, coastal water), facilities encouraging physical exercise (walkway, running path, and outdoor gym equipment), adequate open spaces for social gathering and social distancing (plazas and playgrounds), and accessibility (easy access for all).

It is evident from the above previous studies, that although there are many studies have been carried out on several aspects related to the thermal performance, quality of life occupants' health, there is a lack of a comprehensive framework that addresses several types or elements of open spaces that should be addressed to assess their importance in creating health-based open spaces.

The current research aims to provide a theoretical framework of proposed guidelines for health-oriented promenade design in Jeddah. The research question is: What are the most critical promenade design factors affecting the residents' health.

This could be accomplished by:

1. Explore the design guidelines for promenades through the analytical literature review,
2. Validate the proposed guidelines through field survey and case study analysis,
3. Design a set of health-based design guidelines for Jeddah promenades.

2. Material and Methods

The research methodology adopted the multi-methodological approach, starting with an analytical literature review of research articles, books, governmental codes, standards, and rating systems to map out the guidelines of the promenade design (Figure 1). The different methods are used in different stages as follows:

Stage 1: Using the deductive approach and by reviewing the literature on promenade designs and their impact on users, several factors are suggested for the guidelines,

Stage 2: Some case studies are analyzed accordingly, and the criteria are subsequently revised to consider missing fundamental factors or excluding insignificant aspects.

Stage 3: The criteria are reviewed and validated by promenade's users and experts in the field through online questionnaires (106 professionals) and interviews with residents (36 respondents) to discuss their needs. Then, the final revised criteria, the Jeddah Promenades Design Guidelines, with their relative importance are presented

Stage 4: Among 24 promenades in Jeddah, three criteria are set to filter them and select three cases with the highest score. Consequently, the promenades with the highest three scores are chosen to be further assessed by devised criteria. One promenade is further studied and analyzed using Space Syntax for accessibility analysis.

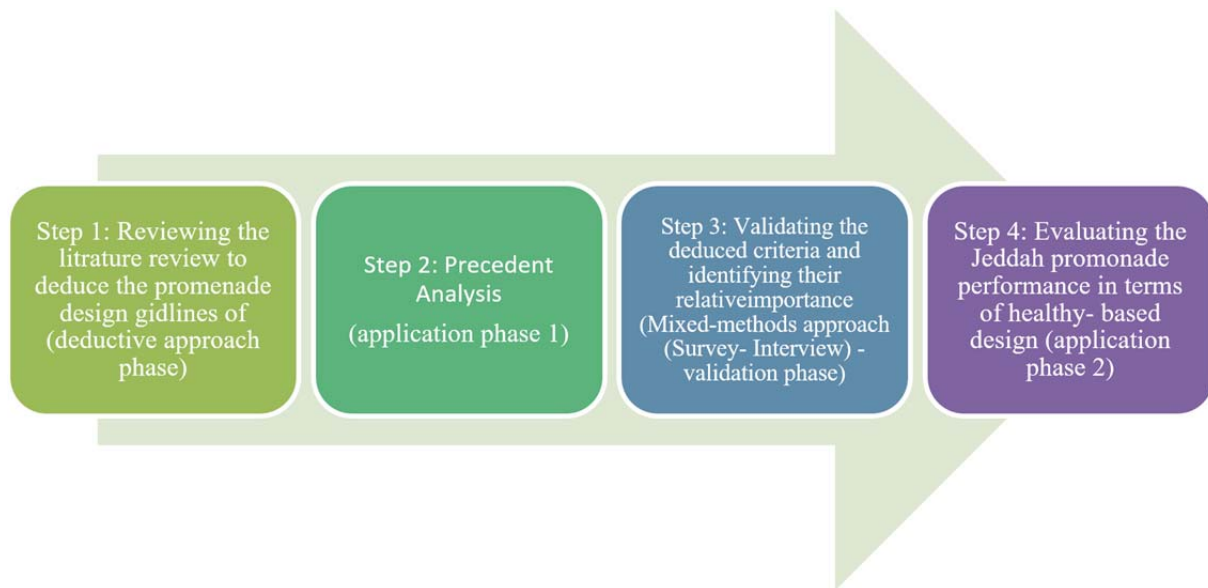


Figure 1. Research methodology structure

3. Design Dimensions for Promenades

Promenades, usually connected by streets at both ends, represent an essential public open space for people's health [48]. A well-designed and well-thought-out promenade contributes to the residents' health in many ways. Several design dimensions should be addressed to achieve well-designed promenades:

- 1) The morphological dimension,
- 2) The social dimension,
- 3) The visual dimension,
- 4) The functional dimension and,
- 5) The temporal dimension.

Like public open spaces, promenades should include facilities that enhance users' experience, such as seating, lighting, public toilets, etc. [49, 50]. It should also have amenities that encourage physical activity, such as outdoor fitness equipment. The consideration of the promenade design is divided into the five dimensions mentioned above, each targeting a specific aspect that contributes to the users' health.

1. Through the morphological dimension, four main elements are examined: land use, building structure, plot pattern, and street pattern. The first two elements are constantly changing, while the last two are more resilient, but can still be subject to change over time. These four elements affect the perceptual experience of the promenade users in terms of ease of access, availability of services and amenities, and the construction of the place [51]. Thus, promenade designs can either attract or discourage people from using them. Hence, it is vitally important to meet the users' needs by offering a mixed-land use environment and accessible street patterns.

2. The social dimension focuses on how people interact

with others and their surroundings. Design can directly influence and promote interaction or limit it. The sense of belonging, security, and comfort in open spaces are essential factors as they can either increase or decrease the interaction of users with their surroundings [12, 51, 52]. In addition, the design of promenades must include elements that allow users to interact with them as an aspect of well-designed spaces.

3. The visual dimension comprises several aspects that directly and indirectly control people's behavior in and around the promenade. Promenades' qualities such as their area, shape, visibility, inclination, order, and landscape influence their visual image. Promenade design, which can include clear paths and defined spaces for various activities that involve users in physical activity and social interaction, can improve their physical and mental health. It may also increase security and convenience by allowing passive surveillance. The integration of the landscape into the design also contributes to the mental health of the residents as it provides attractive and relaxing landscapes in addition to the placement of fountains, sculptures, or other appealing elements.

4. The functional dimension comprises the suitability of the promenade for its users. The amenities selected must ensure the comfort and safety of visitors. To achieve sufficient lighting, a legally required must be installed to facilitate navigation and safety at night. In addition, amenity lighting can give the open space a unique and appealing ambiance [51, 53, 54]. Additionally, security should be addressed both physically and non-physically. By ensuring adequate lighting, signage, directions, and passive surveillance, planners ensure the non-physical safety of users, which is critical to their comfort. In addition, physical security can be achieved by defining and separating pedestrian zones from vehicle ones, including incorporating safe pedestrian access and controlled vehicle

speeds where necessary. The provision of services might attract people, extend their length of stay, and promote social interaction and active engagement. Such services can include but are not limited to, public toilets, soap bubbles, trash bins, various types of seating, shading, and parking lots. The design of the promenades must also include areas that enable physical and social engagement. Through the connection between the different spaces within the promenade, private, semi-private, and public, people may be trying out other people's activities even before they do. These external forces placed by the design lead to the interaction between strangers, known as triangulation [9, 14, 39, 55]. In addition, the comfort and success of the promenade design are achieved by considering the environmental design, dealing with bioclimatic, or concerning the relationships between climate and living matter [41, 43, 56-59], like thermal, visual, and acoustic comfort and air quality. This can be achieved by considering certain design elements that can positively influence the microclimate, the promenade's essentially uniform local climate of a mostly small site or habitat. These considerations include solar development, airflow and quality, the placement of landscape elements, the location of the promenade with the surrounding buildings, and the use of materials [60].

5. The temporal dimension underscores the importance of carefully selecting materials and designs that are subject to change. The planners must consider the effects of time and changes and design the space accordingly to be resistant to future obstacles and challenges. In addition, well-designed promenades are aimed directly at the health and well-being of the residents. Due to the increasingly sedentary lifestyle and decreased physical inactivity worldwide, the World Health Organization "WHO" estimates two million deaths annually because of this matter. The minimum amount of physical activity required for adults is 30 minutes of moderate physical activity per week. Landscape and greenery are some of the factors influencing the increase in this activity. In addition, well-designed open spaces with greenery that create a sense of security have an impact on physical health and have an impact on mental health [61]. In addition to designing the promenade with an attractive natural environment that is relaxing for its users and essential for their mental health while also improving air quality, promenades can be designed as outdoor gyms [62-64]. The combination of the fitness equipment outdoors and a healthy environment directly impacts people from all walks of life. This combination has many benefits for people, including improving well-being, increasing alertness, and reducing anxiety from breathing fresh air. In addition, exposure to the sun increases vitamin D levels,

which enables calcium absorption. In addition, rest can be enhanced by exposure to the sun, which increases the level of serotonin that helps maintain calm. It has also been found that exercising outdoors leads to higher levels of endorphins than exercising indoors [65-67].

From the literature research, it was found that some key features are needed to be assigned to improve the user's experience according to several criteria. These criteria include ten factors that test the level of comfort, safety, physical activity, attractiveness, and durability. The ten factors are composed of visibility and surveillance, seating, lighting, shading, vegetation, parking spaces, accessibility, sustainable equipment, attractive equipment, and facilities that encourage physical activity.

4. Precedent Analysis (Application Phase 1)

In this section, five international case studies (Figure 2) were analyzed to test the applicability of the ten factors that have been deduced from the literature review, and the criteria are subsequently revised to consider missing fundamental factors or excluding insignificant aspects. Two are allocated in Australia while others are from Copenhagen, Spain, and Los Angeles. The first case study is Pirrama Park in Sydney (Figure 2-a), Australia which was completed in 2010 [68-70]. The project received several awards including the medal, 2010AIA National Awards to improve health [68]. The second case study, the Darling Quarter (Figure 2-b), is also located in Sydney, Australia. It has the largest children's playground in Sydney CBD [71, 72]. The Park attracts visitors of all ages because it is divided into areas, each one geared towards a specific group and offering different activities for everyone. The third precedent, Guldbergs Plads Park (Figure 2-c), is a renovated neighborhood park in Copenhagen with an area of 4,500 m², completed in 2015, identity as an activity park [73].

The fourth case study is in Badalona, Spain. The park caters to children of all ages and offers a variety of activity options [74] (Figure 2-d). The fifth is Spring Street Park in Los Angeles (Figure 2-e), which was completed in 2013. The project received 3 awards between 2012 and 2013. The renovated design of the park contributes to the uniqueness and liveliness of the park [75].

The case studies are rated according to the availability of the ten principles, with each principle being rated 10 and the sum of the overall park rating of 100.

Table 1 below shows the results and insights from each case study analyzed.



a) Pirrama Park Source: [69]



b) Darling Quarter Park Source: [71]



c) Guldbergs Plads park [73]



d) Park in Badalona Source: [74]



e) Spring Street Park Source:[75]

Figure 2. The five selected case studies

Table 1. Case Studies Evaluation

	Case Studies	Pirama Park		Darling Quarter		Guldbergs Park		Badalona Park		Spring Street Park	
#	Type	Description		Description		Description		Description		Description	
1	Visibility and Surveillance	Fairly good surveillance as it is adjacent to the street and it is surrounded by buildings	10	Fairly good surveillance as it is adjacent to the street, and it is surrounded by buildings	10	Fairly good surveillance as it is adjacent to the street and it is surrounded by buildings	10	Fairly good surveillance as it is adjacent to the street and it is surrounded by buildings	10	Fairly good surveillance as it is adjacent to the street and it is surrounded by buildings	10
2	Seating	Available seating but could be increased	7	A fairly good amount of seating available	9	A fairly good amount of seating available	9	Seating provided	10	Unique seating available	10
3	Lighting	Fairly good lighting at night	7	Fairly good lighting at night	9	Not enough lighting	5	Fairly good lighting at night	10	Fairly good lighting at night	10
4	Shading	Available shading near seating areas and playgrounds only	6	Available shading near seating areas and playgrounds but is not enough in respect to the park size	6	Limited shading from natural vegetation only	4	Available shading near seating areas	5	Available shading near seating areas and playgrounds	10
5	Vegetation	The ratio between the size of the park and the vegetation available can be increased	7	A good amount of vegetation is available	9	A fairly good amount of vegetation available	9	The ratio between the size of the park and the vegetation available can be increased	9	Not enough availability of vegetation in respect to the ratio between the size of the park and the vegetation available	3
6	Parking Spaces	Parking provided for cars	8	Provision of underground public parking	10	Parking provided for cars	10	Parking provided for cars	10	Parking provided for cars	10
7	Universal Access	Available ramps	7	Accessible	7	It can be accessed, but no specific facilities are provided	5	It can be accessed, but no specific facilities are provided	5	It can be accessed, but no specific facilities are provided	9
8	Sustainable Features	complex stormwater management system/ used for irrigation and solar energy	10	Solar Power	10	Not available	0	Not available	0	Not available	0

Table 1 continued.

9	Attractive Features	Open direct view to water	9	Unique, attractive design	10	Unique design and features	10	Open direct view to children's play area for additional safety	5	The park design is unique, bold, and attractive in addition to the provided special seating changing design pattern	8
10	Facilities encouraging physical activity	small watercraft, wading and swimming, fishing, and yarning, playground/ place for public activities, festivals, meetings, events	10	It offers a range of different features that encourage physical activity	19	A range of facilities available that encourage physical activity to residents of different ages, also allows for parties and events to take place	9	Playground activities mainly targeting children	5	Open spaces for walking, cycling and children's playground area but no available facilities that encourage physical activity	7
Total			81		90		71		69		77

From the previous analysis, the park with the highest score was Darling Quarter Park in Australia, with an overall score of 90. It included activities for people of all ages distributed in different zones and consisted of sustainable features, a water management system, and solar energy. Next, it was Pirama Park with a difference of 9 points. The Park had activities that allowed user interaction and physical engagement for all ages. The third score was Spring Street Park, with a total score of 77. This Park was lively, innovative, and inviting in design but had only one children's play area and lacked various facilities to encourage physical activity. The latter was Guldbergs Park, with a score of 71. It offered various unique and encouraging activities for people of all ages. The last park with a score of 69 was the park in Badalona, which is aimed only at children. Overall, all parks were assigned to locations with a high level of passive surveillance. Each one had unique activities that were different from the others. The best parks were the ones that appealed to all ages with various activities. In addition, comfort is essential in extending people's stay in the park, so the provision of parking, seating, shading, and lighting is very important. In addition, the importance of universal access had been reported in several studies as an essential feature [76-78]. Therefore, the parks must consider disabled people and offer them appropriate access and activities.

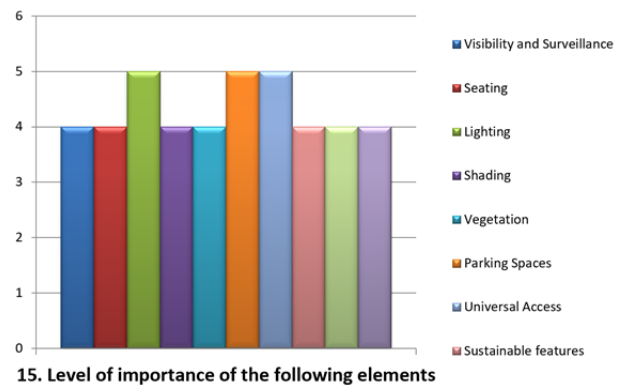
5. Validation and Identification of the Relative Importance

The guidelines are further evaluated through a subjective assessment. An online semi-structured questionnaire was distributed to residents of Jeddah and professionals in the field. This survey included 15 questions to be answered by both residents and professionals and three questions directed to professionals. The total number of respondents was 142, 106 of which were professionals, and the rest were residents. On the other hand, the semi-structured interviews were conducted with promenade users and doctors. The interview included ten closed-ended questions for further statistical analysis and one open-ended question to explore the interviewees' opinions. All participants were asked to scale the importance of the availability of the abovementioned criteria, reported in Table 1, from 1 to 5, where five is very important, and one is least important. The interviewed doctors include several specialties such as internal medicine doctors, nutritionists, psychologists, physical medicine rehabilitation rheumatology, and cardiologist.

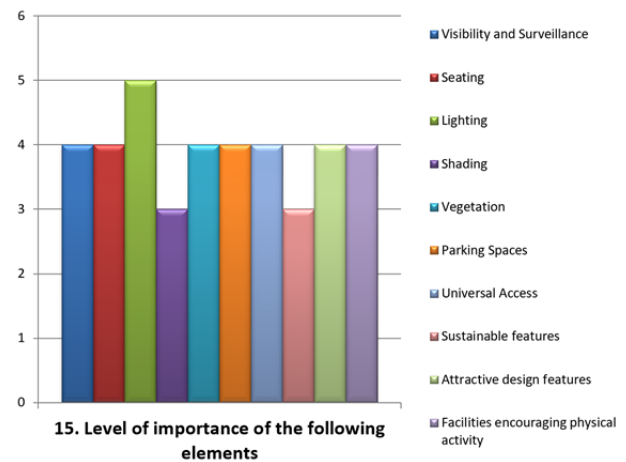
5.1. Survey Results

The promenade users confirmed the high importance of three factors: lighting, parking spaces, and universal access, while all other ones came in the second level of importance

(Figure 3-a). Their selection confirms the fact that promenades in Jeddah are fragmented across the city fabric that depends mainly on vehicular movement. It also reflects the community's need to provide people with special needs and different ages and categories with easy access to promenades. The semi-structured interview with promenade users confirmed the need for physical activities, natural ventilation, shaded areas, vegetation, refreshments, and proper seating. Regarding the professionals' category, the lighting factor got the highest importance, while shading and sustainable features got neutral importance, and all other factors got moderate importance (Figure 3-b).



a) Promenades' users' view



b) Professionals of urban design view

Figure 3. Degree of the importance of park evaluation criteria

The survey results of both promenade users and professionals highlighted the extreme importance of lighting in designing the promenades. Space parking and universal access came in the second level of importance. All other criteria came at the third rank of importance, except shading and sustainable features, which came at the fourth level of importance. In this sense, the revised criteria according to their importance are listed below in Table 2.

The semi-structured interview with residents and doctors confirmed the importance of public open spaces to enhance the health conditions of the residents. They also confirmed that outdoor exercise is preferred over indoor ones as it provides users with a natural environment with natural air and direct sunlight. These two components are of great value to one's health [19, 79]. They emphasized the need for vegetation as it is one of the natural features that improve an individual's mental health and provide shading for users. The majority of people believe that exercising under direct sunlight may speed up the burning process as they sweat more. This is a wrong interpretation as they might be losing only water from their body and may put their lives at risk since excessive sunlight may lead to dehydration or heat stroke, especially since users are performing a physical activity that decreases their body's hydration levels. Therefore, the balance between the exposed and shaded areas is recommended. Educational signage must be available for health awareness to users as well as refreshments since users lose water while exercising and must restore the required hydration levels. Moreover, the provision of seating on the promenade was also recommended. While exercising, some people may need to rest a little since the promenade targets people of different ages who may suffer from various health problems.

All users' and professional recommendations confirm the suggested 10 design factors. Table 3 summarizes the design guidelines for Health-Based promenades along with their impacts on the dimensions of space (the morphological, the perception, the social, the visual, the functional, and the temporal dimensions) and the six components of health (the environmental, physical, psychological, social, spiritual, and intellectual).

6. Evaluation of Jeddah Promenades

6.1. Local Promenade Case Study Selection- Stage-1

To select a promenade for the study, data on all promenades were collected from Jeddah's Municipality

website, which is shown in (Table 4). Then three criteria were set to filter the promenades and select the 3 with the highest score.

The first criterion was rating the promenades from the newly built to the oldest to ensure that the promenade had been used for some time. Therefore, the oldest received the highest score of 5, and the newly built ones had the lowest score of 0. The second criterion was sorting the promenades according to their area from largest to lowest (from 5 - 0). The study aimed at exploring to explore promenades with areas that could include different opportunities and activities. The third and final criterion was the availability of various services. Promenades with a variety of services received the highest score of 5, and those with no or low availability of different services received the lowest score of 0. This criterion aimed to ensure the functionality of the promenades by providing various services for the users. After sorting each criterion, the overall rating score was calculated from 5 to 0. The score criteria are illustrated in the key legend of Table 4. As a result, the promenades with the highest three values were selected for further evaluation (Table 4).

6.2. Local Promenade Case Study Selection- Stage 2

The three promenades with the highest scores of 4.7, 3.5, and 3.3, Al-Rawda Promenade, Prince Faisal Bin Fahed, and Al-Rehab Promenade, were selected to be further analyzed according to the evaluation criteria developed in Part 1. Each promenade element was rated from 1 to 5 depending on its availability and condition. Table 5 shows the assessment of each factor. Then the total number of points for each promenade was calculated. The promenade with the highest score was the Al-Rawda with a total score of 3, then Prince Faisal bin Fahed with a total score of 2.2, and finally the Al-Rehab with a total score of 2.1. All were equipped with fitness equipment but were very low on the Prince Faisal bin Fahed Promenade, as the fitness equipment was insufficient for Al-Rawda and Al-Rehab with the promenade size. None of the promenades analyzed contained sustainable features. Only the Al-Rawda Promenade had a universal approach in its design and integrated a particular section, especially for the blind.

Table 4. Local Promenade Case Study Selection_ Stage 1






Local Promenade Case Study Selection_ Stage 1									
#	Promenade	Photo	Year	Criterion one	Area (m)	Criterion two	Services	Criterion 3	Total Evaluation Score out of 5
1	Al-Rawda		2013	5	99,000 m	5	<ul style="list-style-type: none"> • Parking • Parking for the disabled • Path for the Blind • Seating • Gym Equipment 	4	4.7
2	Al Nakheel		2013	5	30,000 m	1	<ul style="list-style-type: none"> • Parking • Seating 	1	2.3
3	Al Safa		2013	5	26,000 m	1	<ul style="list-style-type: none"> • Parking 	0	2
4	Northern Corniche		2013	5	38,500 m	2	<ul style="list-style-type: none"> • Parking • Seating • Kids Playground 	2	3
5	Palestine Street		2013	5	35,000 m	2	<ul style="list-style-type: none"> • Parking • Seating 	1	2.7

Table 4 continued.







6	Bohayret AlShabab		2014	4	15,500 m	0	<ul style="list-style-type: none"> • NA 	0	1.3
7	Al Waha		2014	4	36,000 m	2	<ul style="list-style-type: none"> • Parking • Seating 	1	2.3
8	Al Faysaliya		2014	4	30,000 m	1	<ul style="list-style-type: none"> • Parking 	0	1.7
9	Al-Rehab		2015	3	75,600 m	5	<ul style="list-style-type: none"> • Parking • Seating • Gym Equipment • Bike Track 	2	3.3
10	Shatea Al Sayf		2015	3	30,000 m	1	<ul style="list-style-type: none"> • Parking • Seating • Kids Playground 	2	2
11	Montazah Thahbann		2015	3	11,000 m	0	<ul style="list-style-type: none"> • Parking • Seating • Kids Playground 	2	1.7

Table 4 continued.

12	Prince Faisal bin Fahed Promenade		2014	3	82,600 m	5	<ul style="list-style-type: none"> • Parking • Parking for the disabled • Seating • Gym Equipment • Bike Track 	3	3.5
13	Al Jamaa		2016	2	50,000 m	3	<ul style="list-style-type: none"> • Parking • Seating • Kids Playground • Gym Equipment 	3	2.7
KEY LEGEND:									
Criteria 1 Evaluation (Recent to Oldest):									
	Recent	Under construction	2017	2016	2015	2014	2013	Oldest	
Evaluation Mark	Least	0	1	2	3	4	5	Highest	
Criteria 2 Evaluation (Area Smallest to Largest):									
	Smallest	10,000 to 20,000	20,000 to 30,000	30,000 to 40,000	40,000 to 50,000	50,000 to 60,000	60,000 and above	Largest	
Evaluation Mark	Least	0	1	2	3	4	5	Highest	
Criteria 3 Evaluation (Variety of Available Services):									
	Lack Services	0-1	2	3	4	5	6 and above	Various Services	
Evaluation Mark	Least	0	1	2	3	4	5	Highest	

Table 5. Local Promenade Case Study Selection - Stage 2

























Local Promenade Case Study Selection_ Stage 2										
		Al-Rawda Promenade			Prince Faisal Bin Fahed Promenade			Al-Rehab Promenade		
#	Type	Description		E#	Description		E#	Description		E#
1	Visibility and Surveillance	Fairly good surveillance as it is adjacent to the street, and surrounded by buildings.		4	Fairly good surveillance as it is adjacent to the street, and surrounded by buildings.		4	Fairly good surveillance as it is adjacent to the street, and surrounded by buildings.		4
2	Seating	The seating provided is extremely low.		2	Fairly good availability of seating.		3	Fairly good availability of seating.		3
3	Lighting	Available lighting poles.		5	Fairly good lighting availability but could be increased concerning the size of the promenade.		3	Available lighting poles.		5
4	Shading	Only in one section.		2	Not enough and allocated in certain areas only.		2	Low availability of shading above seating and gym equipment only and positioned in a direction that allows sun exposure.		2
5	Vegetation	Bushes are available along the sides of the promenade. No variety.		4	A good amount of various vegetation is available.		5	Artificial spots of grass are available in the middle of the promenade.		1
6	Parking Spaces	Good provision of parking that can contain a large number of vehicles.		5	Availability of parking could be increased concerning the size of the promenade.		3	Parking lots are low concerning the size of the promenade.		3

Table 5 continued.

7	Universal Access	Ramps and parking for people with special needs are available and accessible. In addition, part of the promenade is dedicated to the blind.		5	None		0	None		0
8	Sustainable Features	None		0	None		0	None		0
9	Attractive Features	None		0	Sculptures are available on one side of the promenade.		1	None		0
10	Facilities encouraging physical activity	The promenade is equipped with gym equipment in its beginning and its end. Some signage is provided.		3	It is located in one area only and is not enough concerning the promenade size.		1	Some signage is available for motivation. Floor paint and gym equipment are available, which encourage physical activity.		3
Total				3			2.2			2.1

KEY LEGEND:					
Evaluation Number (E#)	Very Low (1)	Low (2)	Medium (3)	High (4)	Very High (5)

7. The Analysis of Al-Rawda Promenade, Jeddah (Application Phase 2)

The field study of Al-Rawda Promenade utilized two techniques; these are the observational analysis and the accessibility of the promenade was then examined using the space syntax.

Site Analysis

The promenade is located next to a famous street in Jeddah (Al-Tahlia Street) and intersects with another main street (Al Medina Road). It has two streets on its sides that are back roads. The width of the promenade is about 30 meters, and the streets on its sides are 10 meters in width. There is some commercial space on the sides of the promenade. The surrounding buildings are of good quality and mostly two-story (about 6 meters high). The architectural style of the surrounding buildings is

predominantly modern, and the construction system is wall-bearing and Skelton systems. The promenade itself is divided into eight sections with intersections. The promenade runs from East to West, while the good wind direction is northwest. The promenade direction significantly reduces the possibility of wind currents. Due to the lack of high-rise buildings, the promenade is exposed to direct sunlight throughout the day. The width is very large to the building’s height, resulting in a poor sense of confinement. Figure 4 shows the vertical cross-section of Al-Rawda Promenade.

It has been found that the serial vision is constant without changing in scenery or attractive features throughout the promenade, in two directions from point A to point B and then in the opposite direction from point B to point A (Figure 5).

The facilities and services available on the promenade are divided into five sections: 1) Sidewalk quality, 2) Accessibility, 3) Furniture, 4) Landscape and 5) Services (Figure 6).

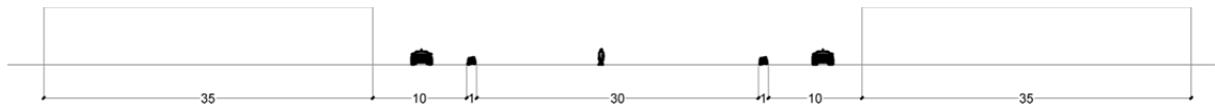


Figure 4. Al-Rawda Promenade Elevation



Figure 5. Al-Rawda Promenade Serial Vision

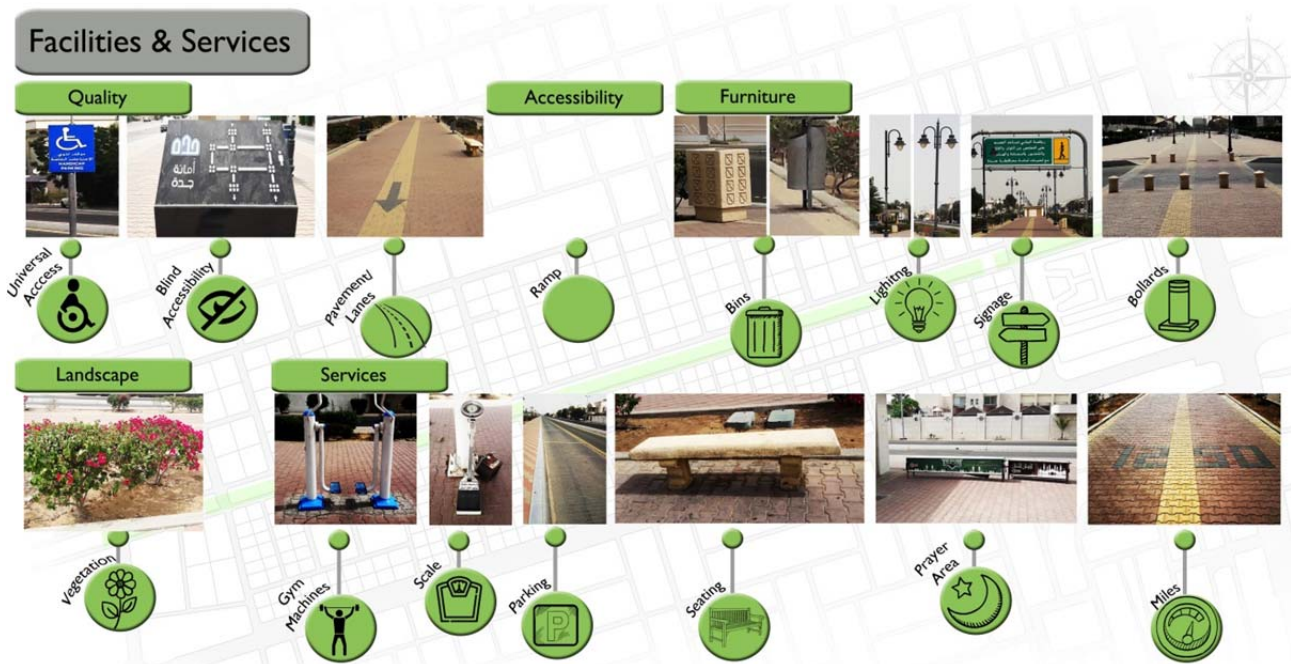


Figure 6. Al Rawda Promenade Facilities and Services

The promenade consists of a well-developed sidewalk accompanied by universal access for people with special needs. In addition, a section of the promenade was dedicated to blind people. It includes lanes for pedestrians and ramps for universal access. It has various furniture types such as seating, lighting, shading, bollards, signage, and trash cans. On the other hand, some of the available features were very minimal in terms of promenade size, such as shading. At the end of the promenade, some shading devices were used on the outdoor fitness equipment. This is considered a weak point of the promenade since it is exposed to sunlight all day, which increases its temperature. Some of the available seating is not in good condition. The existing signage on the promenade was also very minimal. The landscape consists of low bushes on either side of the promenade. The landscape lacks variety and does not include tall landscape elements such as trees that can be used to improve visual appeal and reduce the overall temperature of the promenade. In addition, the promenade does not have any water features, which can also lower the temperature and act as a visual attraction for the promenade users. There are some services such as parking on either side of the promenade, fitness equipment, and prayer rooms but very minimal. In addition, there is a lack of public toilets and refreshments.

Space Syntax Analysis

The second technique of field study analysis involved examining the accessibility of the promenade using the Space Syntax software. This software is used in urban design to study and analyze space and its effects on social

performance and economic activity [80]. The study analysis was carried out in the Al-Rawda district. The CAD file of the Al-Rawda District was obtained from Jeddah Municipality. On utilizing the Space Syntax software in analyzing the urban characteristics of Al-Rawda Promenade (Figure 7- Figure 10), the axial lines have different levels (red, orange, yellow, green, blue, and indigo) (Figure 7): red lines have the highest value, while orange lines have a middle value, and the indigo lines have the lowest value. The dark red and orange lines are highly accessible, integrated, and connected areas. The green and blue axes are the less accessible, integrated, and connected areas. A high value of integration means that those streets attract dominant land uses and experience a high volume of movement, while low values of integration indicate segregated streets that experience a low or rare volume of movement.



Figure 7. Space Syntax Analysis, All Line Map,

The accessibility map reveals the flow of movement in urban spaces [80]. As shown in Figure 8, Al-Rawda Promenade acquired high values. This means that it is one of the best accessible streets in the neighborhood. Connectivity illustrates the number of directly connected neighbors in space [80]. The promenade has the second-highest in the Al-Rawda District. This makes it easier for users to access the promenade (Figure 9).



Figure 8. Space Syntax Analysis, Accessibility Map



Figure 9. Space Syntax Analysis, Connectivity Map



Figure 10. Space Syntax Analysis, Integration Map

Integration measures the places most and least desirable to people [80]. The integration map of Al-Rawda District, (Figure 10), shows that the promenade has the second-highest integration value after Al Madina street. Thus, the promenade represents a trendy excursion destination and is easy to reach. This consequently helps to attract more users to the promenade, as it is the preferred destination in the neighborhood and thus contributes to its success.

According to the spatial analysis of Al-Rawda District, the selected promenade shows a high degree of accessibility, connectivity, and integration with its surroundings. These positive features of the promenade make it a very accessible destination for the district's residents. This can lead to more users coming to the promenade. Thus, the promenade can help improve the health of users.

8. Conclusions

The research led to the most important 10 preliminary design guidelines for health-based promenade design from literature research and precedent analysis. These are 1) Visibility and surveillance, 2) Seating, 3) Lighting, 4) Shading, 5) Vegetation, 6) Parking Spaces, 7) Universal access, 8) Sustainable features, 9) Attractive features, and 10) Facilities encouraging physical activity. The survey's validation process for the suggested ten factors revealed an agreement regarding the high importance of lighting, providing adequate parking spaces and offering universal access represent critical criteria for healthy promenades. From the field study, the promenades in Jeddah have been shown to need specific improvements to ensure the health of their users. This could be summarized as follow:

- Raising people's awareness by placing educational signs on promenades to educate them about health-related issues,
- Participatory design is seen as critical to realizing users' needs and achieving a well-designed promenade to serve them,
- The promenade must be designed with clearly identified paths that ensure users' safety from vehicles,
- It is important to allocate the promenade away from vehicle zones, when possible, to lower the chances of air pollution,
- Attractive features and motivational signage could be added to increase users' visual interest and inspire them as well as promote healthy living,
- The average recommended time for walking is 30-34 minutes 3 to 5 times a week,
- Vegetation is essential to improve individuals' mental health and provide shading for users,
- The balance between the exposed and shaded areas is crucial,

- Refreshments must be available since users are losing water while exercising and must restore the required hydration levels,

Future work

The current study contributed to establish validate health-based design guidelines with their relative importance (ten factors). However, there is a need to include the new factors (ten factors) that come to the fore while conducting the present study in future research in different contexts to map out an inclusive health-based design framework.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

The first author supervised the entire work of the research, wrote and developed the final submitted draft, and responded to the reviewers' comments. The second author supported the first author in updating the literature review of the final draft. The third author conducted the survey and the field study under the supervision of the first and second authors.

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Appendices

Appendix 1: Online Questionnaire

Jeddah Promenades

Dear Participant,

I am working on a research as part of my thesis to acquire my masters degree in urban design at Effat University. As part of the research, this survey collects information related to personal experience in Jeddah promenades. Your voluntary participation is highly appreciated.

The survey should take approximately 5 minutes and all information provided will be confidential and anonymous; besides the information is solely used for this research only.

1 Gender/ الجنس

Female/ انثى Male/ ذكر

2 Nationality

Saudi Non Saudi

3 Age

less than 20 20-29 30-39

40-49 50-59 60-69

70 and above

4 Education

Elemntary High school Graduate Bachelor's degree

Master's degree Professional degree Doctorate degree

5 Design- Related Profession

Architect Engineer Interior Designer

Urban Designer Landscape Architect Marketing

6 If you suffer from certain diseases please check them below (may choose more than one)

- | | | |
|---|-----------------------------------|---|
| <input type="checkbox"/> Blood Pressure | <input type="checkbox"/> Diabetes | <input type="checkbox"/> Heart Problems |
| <input type="checkbox"/> Obesity | <input type="checkbox"/> Asthma | <input type="checkbox"/> High Cholesterol |
| <input type="checkbox"/> Bone Diseases | <input type="checkbox"/> None | |

7 Do you exercise outdoors?

- Yes No

8 What is your preferred place for outdoor exercise?

- Corniche Promenades
 Other (Please Specify)

9 Reasons for your preferred choice (may choose more than one answer)

- | | | |
|---|--|---|
| <input type="checkbox"/> Has everything I need | <input type="checkbox"/> Proximity | <input type="checkbox"/> Shaded |
| <input type="checkbox"/> Includes seating | <input type="checkbox"/> Includes services | <input type="checkbox"/> Availability of public toilets |
| <input type="checkbox"/> Clean environment | <input type="checkbox"/> Well-maintained | <input type="checkbox"/> Attractive design |
| <input type="checkbox"/> Other (Please Specify) | | |

10 Negative or unavailable features/ services at your preferred location

- | | | |
|---|---|---|
| <input type="checkbox"/> Doesn't have everything I need | <input type="checkbox"/> Distant | <input type="checkbox"/> Not shaded |
| <input type="checkbox"/> No seating | <input type="checkbox"/> No services | <input type="checkbox"/> Unavailability of public toilets |
| <input type="checkbox"/> Unclean environment | <input type="checkbox"/> Not maintained | <input type="checkbox"/> No attractive design |
| <input type="checkbox"/> Other (Please Specify) | | |

11 How many times do you exercise at your preferred location?

Everyday

Twice a week

Once a week

Once a month

Never

12 Preferred time to visit

Morning (8:00 am-11:00 am)

Afternoon (12:00 pm-4:00 pm)

Evening (5:00 pm-8:00 pm)

At Night (9:00 pm-12:00 am)

Never

13 Preferred day to visit

Weekday

Weekend

Never

14 Preferred months to visit

Spring (March to May)

Summer (June to August)

Fall (September to November)

Winter (December to February)

Never

15 On scale 1 to 5, please mark the importance of the following availability in promenades in Jeddah.

Very unimportant	Unimportant	Neutral	Important	Very Important
Visibility and Surveillance				
1	2	3	4	5
Seating				
1	2	3	4	5
Lighting				
1	2	3	4	5
Shading				
1	2	3	4	5
Vegetation				
1	2	3	4	5
Parking Spaces				
1	2	3	4	5
Universal Access (serves everyone including people with special needs)				
1	2	3	4	5
Sustainable features (i.e. solar panels, water recycling, recycle bins..)				
1	2	3	4	5
Attractive design features				
1	2	3	4	5
Facilities encouraging physical activity/ outdoor gym				
1	2	3	4	5

16 Are there any specific design requirements needed for the promenade design?

- Specific required width
- Natural Air
- Materials/Paving
- Other (Please Specify)
- Specific required length
- Vegetation
- Shading
- Direct Sunlight
- Fences

17 Are there any specific design functions needed for the promenade design?

- Specific required width
- Public toilets
- Fences
- Parking
- Other (Please Specify)
- Specific required length
- Outdoor gym equipment
- Kids Playground
- Services
- Parking Spaces
- Mini shops

18 Are there any factors that need to be avoided/eliminated promenade designs?

- Vehicle streets
- Mini shops
- Other (Please Specify)
- Parking
- Kids Playground
- Vegetation/Trees

Appendix 2: Self-Directed Questionnaire

Jeddah Promenades

Dear Participant,

I am working on a master research in urban design at Effat University.

As part of the research, this survey collects information related to personal experience in using and exercising in Jeddah promenades. Your voluntary participation is highly appreciated.

The survey should take approximately 5 minutes and all information provided will be confidential and anonymous; besides the information is solely used for this research only.

عزيزي المشارك ،

أنا أعمل على بحث الماجستير في التصميم الحضري في جامعة عفت.

كجزء من البحث ، يجمع هذا الاستبيان المعلومات المتعلقة بتجربتك الشخصية في استخدام و التمرين في ممرات المشاة الرياضية في جدة.

مشاركته التطوعية في الاستبيان مشكورة مقدماً. يجب أن يستغرق الاستبيان حوالي 5 دقائق.

لأن المعلومات المقدمة هي سرية و لن يتم استخدامها في غير غلة الاستبيان

Basic Info:

1. Gender/ الجنس

- Female/ انثى
 Male/ ذكر

2. Nationality/ الجنسية

- Saudi/ سعودي
 Non Saudi/ غير سعودي

3. Age/ العمر

- Less than 20
 20-29
 30-39
 40-49
 50-59
 60-69
 70 and above

4. Education/ التعليم

- Elementary/ ابتدائي
 High school Graduate/ خريج الثانوية
 Bachelor's degree/ درجة البكالوريوس
 Master's degree/ ماجستير
 Professional degree/ درجة إحتراافية
 Doctorate degree/ درجة الدكتوراه

5. Design- Related Profession/ مهنة ذات صلة بالتصميم

- Architect/ مهندس معماري
 Engineer/ مهندس
 Interior Designer/ مصمم داخلي
 Urban Designer/ مصمم المناطق الحضرية
 Landscape Architect/ مهندس المناظر الطبيعية
 Marketing/ تسويق
 Other (Please specify)

6. If you suffer from certain diseases please check them below (may choose more than one)/ إذا كنت تعاني من أمراض معينة ، يرجى التحقق / (منها أوداه (قد تختار أكثر من واحد

- Blood Pressure/ ضغط الدم

- Diabetes/داء السكري
- Heart Problems/مشاكل قلبية
- Obesity/بدانة
- Asthma/الربو
- High Cholesterol/عالي الدهون
- Bone Diseases/أمراض العظام
- None/لا شيء

Exercise Related Questions:

7. Do you exercise outdoors? هل تمارس الرياضة

- Yes/نعم
- No/لا

8. What is your outdoor preferred place for exercise?

- Cornice/الكورنيش
- Promenades/الزهره
- Other (Please specify)

9. Reasons for your preferred choice (may choose more than one answer)/ أسباب اختيارك (المفضل قد تختار أكثر من إجابة واحدة)

- Has everything I need/لديه كل ما أحتاجه
- Proximity/قرب
- Shaded/مظللة
- Includes seating/يشمل مقاعد
- Includes services/يشمل الخدمات
- Availability of public toilets/توافر المراحيض العامة
- Clean environment/بيئة نظيفة
- Well-maintained/محافظة عليه جيدا
- Attractive design/تصميم ملفت
- Other (Please Specify)

10. Negative or unavailable features/ services at your preferred location/ ميزات / خدمات سلبية أو غير متوفرة في موقعك المفضل

- Doesn't have everything I need/ ليس لديه كل ما أحتاجه
- Distant/بعيد
- Not shaded/غير مظللة
- No seating/لا مقاعد
- No services/لا خدمات
- Unavailability of public toilets/عدم توافر المراحيض العامة
- Unclean environment/بيئة غير نظيفة
- Not maintained/لم يتم الحفاظ عليها

- No attractive design/لا يوجد تصميم جذاب
- Other (Please Specify)

11. How many times do you exercise at your preferred location? كم عدد المرات التي تمارس فيها في موقعك المفضل؟

- Every day/كل يوم
- Twice a week/مرتين في الأسبوع
- Once a week/مرة في الأسبوع
- Once a month/مرة في الشهر
- Never/أبدا

12. Preferred time to visit/الوقت المفضل للزيارة

- Morning (8:00 am-11:00 am)/ صباح (8:00 صباحا - 11:00 صباحا)
- Afternoon (12:00 pm-4:00 pm)/ بعد الظهر (12:00 م - 4:00 م)
- Evening (5:00 pm-8:00 pm)/ مساء (5:00 مساء - 8:00 مساء)
- At Night (9:00 pm-12:00 am)/ في الليل (9:00 مساءً - 12:00 صباحًا)
- Never/أبدا

13. Preferred day to visit/اليوم المفضل للزيارة

- W Weekday/يوم من أيام الأسبوع
- Weekend/عطلة نهاية الأسبوع
- Never/أبدا

14. Preferred months to visit/الأشهر المفضلة للزيارة

- Spring (March to May)/ الربيع (مارس إلى مايو)
- Summer (June to August)/ الصيف (من يونيو إلى أغسطس)
- Fall (September to November) / الخريف (من سبتمبر إلى نوفمبر)
- Winter (December to February)/ الشتاء (من ديسمبر إلى فبراير)
- Never/أبدا

15 On scale 1 to 5, please mark the importance of the following availability in promenades in Jeddah.

Type		Very Unimportant 1	Unimportant 2	Neutral 3	Important 4	Very Important 5
Visibility and Surveillance		1	2	3	4	5
Seating		1	2	3	4	5
Lighting		1	2	3	4	5
Shading		1	2	3	4	5
Vegetation		1	2	3	4	5
Parking Spaces		1	2	3	4	5
Universal Access		1	2	3	4	5
Sustainable Features		1	2	3	4	5
Attractive Features		1	2	3	4	5
Facilities encouraging physical activity		1	2	3	4	5

For Professionals:

****ONLY IF YOU ARE A PROFESSIONAL IN THE FIELD, KINDLY ANSWER THE FOLLOWING/ فقط إذا كنت مهنيًا في المجال، يرجى الإجابة على ما يلي**

16. Are there any specific design requirements needed for the promenade design?/ هل هناك أي متطلبات تصميم محددة مطلوبة لتصميم التند؟
- Specific required width/ العرض المحدد المطلوب
 - Specific required length/ الطول المحدد المحدد
 - Direct Sunlight/ ضوء شمس مباشر
 - Natural Air/ الهواء الطبيعي
 - Vegetation/ الحياة النباتية
 - Fences/ الأسوار
 - Materials/ Paving/ مواد / رصف
 - Shading/ تظليل
 - Other (Please Specify)
17. Are there any specific design functions needed for the promenade design?/ هل هناك أي وظائف تصميم محددة مطلوبة لتصميم التند؟
- Services/ خدمات
 - Public toilets/ المراحيض العامة
 - Outdoor gym equipment/ معدات رياضية في الهواء الطلق
 - Parking Spaces/ مواقف السيارات
 - Kids Playground/ ملعب الاطفال
 - Mini shops/ محلات صغيرة
 - Other (Please Specify)
18. Are there any factors that need to be avoided/eliminated promenade designs?/ هل هناك أي عوامل تحتاج إلى تجنب / إزالة تصاميم التند؟
- Vehicle streets/ شوارع السيارات
 - Parking/ موقف سيارات
 - Vegetation/ Trees/ النباتات / الأشجار
 - Mini shops/ محلات صغيرة
 - Kids Playground/ ملعب الاطفال
 - Other (Please Specify)

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