Mental Well-being Urban Characteristics as a Guide to Sustaining Distinct Valued Urban Areas Case Study: Zamalek Island, Cairo, Egypt

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Abstract

Mental well-being is an essential need that affects every aspect of life, positively or negatively, and is affected by the surrounding environment. People are exposed to environmental stressors that could potentially contribute to increased stress and impair mental health, so urban communities can be designed to set people up for mental well-being or mental disorders. This research aims to identify the "Mental Well-Being Urban Characteristics MWUC" as a guide to help urban designers, architects, and decision-makers evaluate and sustain healthy urban communities that reduce stress and improve feelings of life satisfaction, and comfort. Based on a profound theoretical analysis, the research provides the MWUC, scientifically based on a comparative analysis conducted between previous studies concerned with healthy urban areas. Furthermore, to investigate and prove the efficiency and applicability of the MWUC for the Egyptian distinct valued urban areas, an urban analysis has been conducted on Zamalek Island by applying the MWUC, and a questionnaire was designed and implemented with Zamalek's' users. The results identify that the results of the questionnaire and the urban analytical study of MWUC on Zamalek Island were compatible except for the distribution of green urban spaces and street lighting during the day. The findings revealed that users' participation should be integrated with the MWUC in the monitoring process. Hence, the MWUC is a guide that is expected to have the ability to evaluate and monitor the effect of Egyptian distinct valued urban areas on mental well-being.

Keywords: Mental well-being, Built environment, Healthy urban areas, Life satisfaction, Stress reduction.

1. Introduction

Some valuable words are the best to start this research with: Winston Churchill states, "We shape our buildings, and afterwards, our buildings shape us" [1]. The World Health Organisation WHO (2024) states, "There is no health or sustainable development without mental health; mental health is too important to be left to the professionals alone, and mental health is everyone's business"[2]. These words draw our attention to the importance of the built environment's impacts on our mental health, as our minds are affected by our surrounding environments and the built environment affects our minds. Interaction with the places where we live, work, or play influences positively or negatively our physical and mental health. Hence, cities and communities can be designed to set people up for mental well-being or mental disorders [1, 3-5].

Urbanization is a vital threat that affects mental health. As with growing urbanization, uncontrolled urban development increased, that negatively affected the built environment. In addition, more and more new communities have been built without regard for the citizens' needs, especially psychological needs. Consequently, people are exposed to environmental stressors that potentially increase stress and impair mental health [6-9]. According to WHO, in 2019, one in every eight people around the world had a mental disorder, and in 2020, the number increased by 28%, and this percentage is rising every year [10]. Hence, urban design is regarded as a tool capable of influencing mental health well-being [6-9].

Based on the above and the new urban agenda, rapid urbanization has promoted the rise of sustainable development and resilience that encourage the implication of urban development, policies, or recommendations for a healthy built environment to promote psychological needs; mental health well-being, which is an urgent and vital need of human beings [6,9]. Egypt generally and Cairo specifically suffers from urban transformation that cannot provide a quality of life for new communities and distinct valued urban areas on economic, social, environmental, and urbanism levels, which reflects as a stressor on human mental well-being, increases feelings of stress, and discomfort [11], where the experience of place is essential to our physical and psychological health [5]. According to the World Happiness Reports, Egypt was ranked 120 out of 157 countries from 2013 to 2015 (Helliwell et al. 2016), and 129 out of 146 countries from 2019 to 2022 [12,13].

Based on the literature review of healthy urban areas and mental well-being, most of the studies have focused on two major topics; firstly, the general evidence regarding the impact of spatial planning on mental well-being or mental disorder [3-7,9,11,14-21]. Secondly, the impact of one feature of the built environment, or natural environment, or social aspects on mental well-being [22-26]. Additionally, most of the studies depend on one method to prove their hypothesis; a questionnaire with users of the place about their feelings of happiness, anxiety, stress, etc..

Hence, the research aims to identify the "Mental Well-Being Urban Characteristics MWUC" as a guide that can help urban designers, urban planners, architects, and decision-makers evaluate and monitor the impact of the built environment of distinct valued urban areas on mental well-being; stress reduction (brain comfort) and life satisfaction enhancement, to improve and sustain the built environment for enhancing the mental well-being of the users. As shown in Fig. 1, the MWUC guide was composed based on identifying mental well-being and its relation to the built environment, and a comparison was conducted between previous studies concerned with healthy urban areas. Following that, an applied study was conducted to prove the efficiency and applicability of the MWUC for Egyptian distinct valued urban areas. The applied study is divided into two parts; the first part, applying the MWUC by an urban study conducted on one of Cairo's distinct valued urban areas; Zamalek Island. The second part is concerned with a questionnaire with Zamalek's users (visitors, students, employees, and urban experts), which was designed and implemented by converting the MWUC into questions. The research methods are a field survey (observation) for the urban study of Zamalek Island, and a questionnaire was analyzed by the SPSS program.
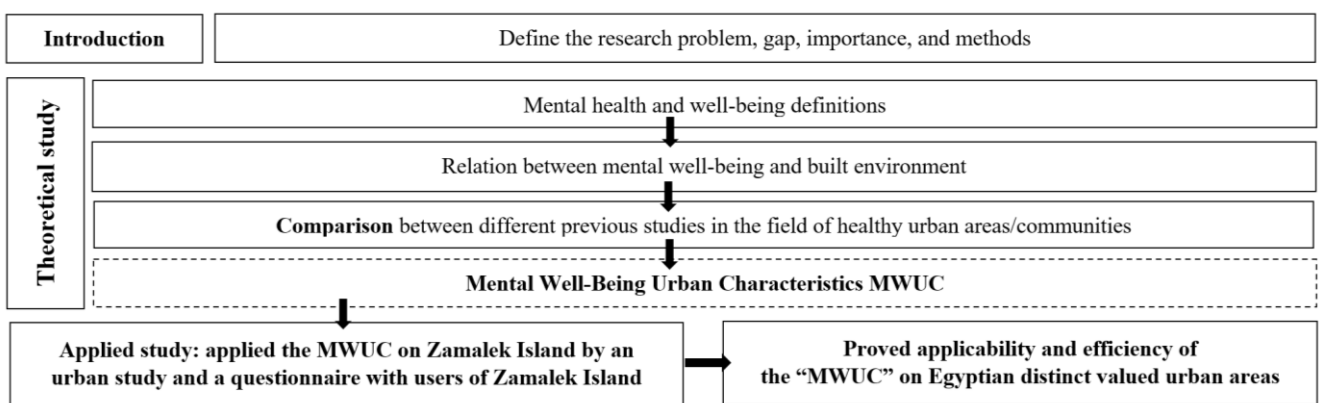

Fig.1 Research structure

2. Literature Review

This section is concerned with mental health and well-being definitions, the relation between mental well-being and built environment, and a comparison between previous studies in the field of healthy urban areas and communities related to mental well-being.

2.1. Mental health and well-being definitions

WHO (2023) determines that health is not just a state of illness absence, but a complete state of well-being; physical, social, and mental. "Mental Well-Being MWB" is a state of well-being in which humans can function successfully, cope with life issues, contribute positively to the community, and work productively. On the other hand, a mental disorder is a change in mood, behaviour, and thinking that leads to impaired functioning [3,6,17]. Hence, as shown in Fig. 2, MWB is linked to physical and social well-being, because MWB is considered a completeness concept that is between emotional well-being, good functioning which means good physical health, and personal growth in social life [16,27].

MWB has eight aspects; emotional well-being, life satisfaction, optimism and hope, self-esteem, resilience and coping, spirituality, emotional intelligence, and social connection [27]. Therefore, MWB is a complex concept, that could be divided into three categories; hedonic (mood enhancement), psychological (stress reduction, cognitive restoration, and life satisfaction), and social interaction. Hedonic well-being is a short-term state resulting from achievements and avoiding pain. Psychological, and social well-being is a long-term state depending on the good experiences. For instance, a short walk in outdoor spaces provides pleasure (hedonic well-being), also provides stress reduction, and life satisfaction if it becomes a daily routine (Psychological well-being), and, increases social interaction (social well-being) [3,16]. This research is focused on psychological well-being, which is concerned with stress reduction (brain comfort) and life satisfaction, as urban areas have a long-term effect on their user's well-being based on their experience of the place.
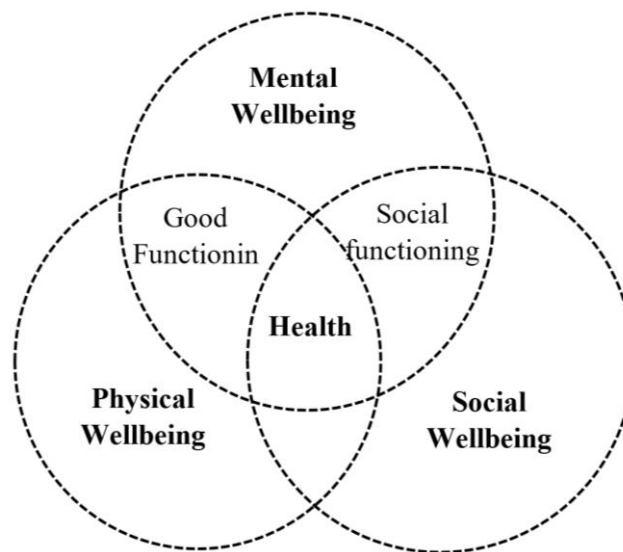
Fig. 2 Relation between types of health.
Source: Authors based on [3,6,16,24,27].

2.2. Relation between mental well-being and built environment

MWB is a complicated human need that reflects how we live well or how to have a pleasant life and is affected positively or negatively by every aspect of our lives, and surrounding environments. Consequently, the quality of life is considered an essential variable in the relationship between the built environment and users' mental needs. So, the built environment's design quality enhances a good perception of the environment which reflects on the user's psychological state, as high-place qualities give value to users in terms of assisting and supporting them in leading healthy, prosperous, and environmentally friendly lifestyles. Thus, users satisfied with their lives, and being happy. Hence, the high quality of urban life promotes and advances mental well-being, as in Fig. 3 [3,5,9,11,17,].
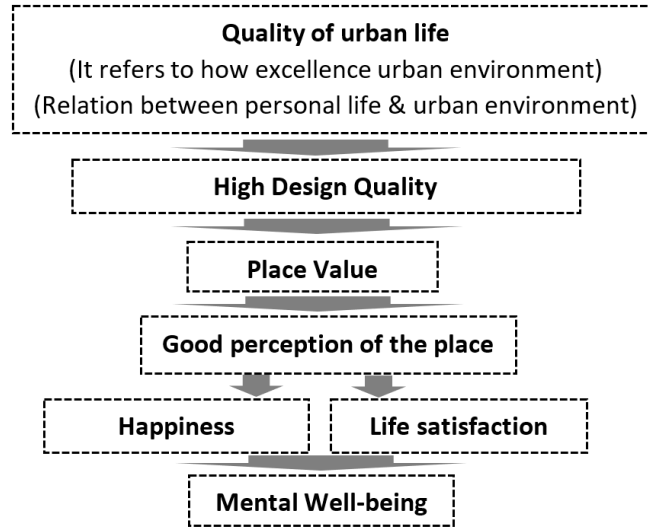
Fig. 3 Relation between mental well-being and built environment.
Source: Authors based on [3.5.9.11.17.25].

2.3. A comparison between previous studies of healthy urban areas

According to the literature review in the field of healthy places and mental well-being; the majority of previous studies of healthy urban communities are focused on two branches. Firstly, some studies are concerned with the impact of one urban variable, such as density, green urban spaces, pedestrian streets, etc., on enhancing mental well-being [1,9,15,22,24-26,28]. Secondly, the other studies are concerned with identifying the urban features of healthy urban areas that enhance positively mental well-being [3-7,11,14,17-21]. As this research aims to provide the most effective "Mental Well-Being Urban Characteristics MWUC" as a guide to evaluate and monitor whether the urban area is good for mental well-being or not, a comparison has been conducted between twelve previous studies focused on the general urban evidence and characteristics of healthy urban areas and neighborhoods that have a positive impact on enhancing mental well-being, as shown in Table 1. The healthy urban characteristics are divided into four domains; land-uses, green urban spaces, streets and transportation, and urban patterns. In addition, the healthy urban characteristics are classified into five effective categories for enhancing mental well-being depending on the repeated times of each characteristic to the total number of previous studies; very weak (0% - 20%), weak (21% - 40%), medium (41% - 60%), high (61% - 80%), and very high (81% - 100%). The research focuses on the two effective categories, high and very high, as the most effective healthy urban characteristics for mental well-being. According to Table 1, all urban pattern characteristics are excluded, as their priority based on previous studies ranges between weak and very weak effects on mental health.

Table 1. A comparison between previous healthy urban areas studies

	Healthy Urban Characteristics	[4]	[7]	[3]	[14]	[18]	[6]	[19]	[20]	[11]	[17]	[5]	[21]	Frequency	Percentage
Land-uses	• Mixed land-uses	+	+	+		+			+	+		+	+	8	66.7%
	• Active block facades: changing the user view every 5 seconds with new interesting views					+	+				+	+		4	33.3%
	• Considering short-distance trips to facilities: the average walk to reach any facilities is 5 to 20 mins and not over 30 mins by car.	+	+		+	+	+						+	6	50%
Green Urban Spaces	• Diversity of green urban spaces, such as: o Places to gather. o Wide spaces enhance physical exercises. o Green buffer bet. Private & public. o Food growing spaces. o Attractive green areas and greenways (front gardens, yards, lakes, waterways, parks, etc.).	+		+	+	+	+	+	+	+	+	+		10	91%
	• Spaces bet. Buildings should be safe.			+	+	+								3	25%
	• Enhance convenience outdoors for different seasons.			+										1	8.3%
	• Ensure daily exposure to green space o Visual access to green urban spaces by Street trees, views from windows, public or private gardens, green areas around/near buildings, etc.) o Physical access to green urban spaces.		+	+		+	+	+	+			+	+	8	66.7%
	• Rich in biodiversity with a variety of plant types.			+					+					2	16.7%
	• Well Maintained & the quality of urban green spaces.			+	+	+		+	+		+	+	+	8	66.7%
	• Keep noisy activities away by green spaces as a buffer (Front porches, gardens, or yards).	+		+	+	+	+	+	+		+	+		9	75%
	• Location/position of green spaces o Short-distance trips to green spaces (5 to 20 mins) (time/distance). o Distributing green urban spaces in urban areas.	+	+	+	+	+	+			+			+	8	66.7%
	• Proportion of comfortable urban spaces from 1:3 to 1:6.					+								1	8.3%
Streets & Transportation systems	• Public transit stops nearby.	+	+	+		+	+			+		+	+	8	66.7%
	• Public transport links or routes (bus routes).			+		+	+			+		+	+	6	50%
	• Non-motorized transport o Pedestrian paths: Well maintained - Wide sidewalks - Handicap consideration. o Cycling lanes & bicycle parking.	+	+	+		+	+		+	+	+	+	+	10	91%
	• Good street lighting (day-night).	+	+	+	+	+					+	+	+	8	66.7%
Streets & Transportation systems	• High street Connectivity: a choice of destinations within a reasonable distance for walking/commuting, to change views & routes on every trip.	+	+			+						+	+	6	50%
	• Traffic calm features (Longer times to cross the street and reducing vehicle speeds).			+		+						+		3	25%
	• Natural Surveillance: windows overlook pedestrian & Cycling areas.			+	+	+					+	+		5	41.7%
	• Parking spaces/areas		+			+				+				3	25%
	• Enhance active design by using stairs & ramps.			+		+								2	18%
	• Facades of buildings visible from the street.					+								1	8.3%
	• Good quality of street furniture.					+						+		2	16.7%
	• Street wall									+				1	8.3%

Urban Pattern	Density	o Number of long sight lines: the ability to see at least 300m "about three blocks" o Street canyon (height/width) (proportions of the sky visible looking across the street)															
		o Low population density	+					+		+					3	25%
		o Residential density Medium 500 to 1000 person per ha. High 100 to 300 person per ha.		+		+		+					+	+	5	41.7%
	• Grid pattern: Fine-grain streets reduce long monotonous blocks.					+										1	8.3%
	• Compact Pattern			+		+	+						+		4	33.3%
	• Buildings close to the street.		+												1	8.3%
	• Ensure good ventilation in buildings.			+				+		+					3	25%
	• Clustering buildings together.			+											1	8.3%
	• Legible places: good visual components to enhance a good perception of the city.							+				+			2	16.7%
	• Height: prefer medium height.							+	+	+					3	25%

■ Very high effect   ■ High effect   ■ Medium effect   weak effect   Very weak effect

3. Mental Well-Being Urban Characteristics MWUC

The MWUC is considered a guide to evaluate and monitor whether distinct valued urban areas enhance mental well-being or not; stress reduction and life satisfaction enhancement, to sustain and improve urban areas in a positive way for human mental well-being. The MWUC, is composed based on Table 1, and consists of the most effective health urban characteristics for three main domains; land uses, green urban spaces, and street and transportation as shown in Table 2.

Table 2. The MWUC and its way of assessment

MWUC		Assessment
Mixed land-uses		$LUM = - \sum (P_i * \ln P_i) / \ln n$
Green Urban Spaces	• Diversity of green urban spaces, for instance: o Places to gather o Attractive areas (lakes, waterways, front gardens, etc) o Wide spaces enhance physical exercises o Green buffer bet. Private & public o Food growing spaces	• Identifying the number of green urban spaces categories.
	• Daily exposure to green space through: o Visual access to green urban spaces (Street trees, views from windows, gardens, green areas around & near buildings, etc) o Physical access to green urban spaces	• Visual access: the ability to view green areas by walking or cycling or from windows (observation by field Survey). • Physical access: public & not private or gated access (observation by field Survey).
	• Well-maintained urban green spaces • Keep noisy activities away by green spaces as a buffer	• Field Survey (Observation)
	• Distribution and location of green spaces	• Short-distance trips to green spaces (5 to 15 mins (time/distance)) or (400 m to 1 km) • Distribution of green areas: dispersed or clustered
Streets & Transportation system	• Public transit stops nearby	• Short-distance trips to public transit stops within a maximum of 400 m.
	Non-motorized transport: o Pedestrian paths: well maintained - Wide sidewalks - Handicap consideration o Cycling lanes & bicycle parking	• If it exists or not and identify it on maps • Identifying the path width and its degree of maintenance.
	• Good street lighting (day-night)	• Field Survey (Observation)

Source: Authors based on Table 1, and [29]

3.1. Mixed Land-uses

Mixed land-uses are an important urban feature in enhancing and improving mental health. The diversity of interesting and needed land-uses integrated with residential urban areas enhances active travel (walkability), which improves poor mental health (Public Health Agency of Canada, 2017; UK Green Building Council, 2016; Centre of Urban Design & Mental Health, 2022;). Mixed land-uses are measured by the entropy index (LUM equation), which determines the degree of mixed land-uses, and its value ranges between 0 to 1; where (0) implies homogeneity land uses (one category – very high segregation), and (1) implies heterogeneity (different land-uses categories – very low segregation), as shown in Table 2 (Alourafi, and Alrawi 2020; Bordoloi 2013).

$$\text{LUM} = - \sum (P_i * \ln P_i) / \ln n \qquad P_i\text{: Ratio of each land-use} \qquad n\text{: Number of land-uses categories}$$

Table 3. Entropy index levels and their impact on enhanced mental well-being

Entropy index levels	Segregation levels	Mixed land-uses levels	Impact on health
0 - 0.2	Very High segregation	Very low heterogeneity	Low
0.21 – 0.40	High segregation	low heterogeneity	Medium
0.41 – 0.60	Medium Segregation	Medium heterogeneity	High
0.61 – 0.80	Low Segregation	High heterogeneity	Medium
0.81 - 1	Very low segregation	Very high heterogeneity	Low

Source: Authors based on [29]

3.2. Green urban spaces

Availability and integration of green urban spaces with residential urban areas enhance improving mental well-being and quality of life, as daily exposure to urban green features enhances the feeling of comfort, reduces stress, and increases social interaction (Public Health Agency of Canada 2017; UK Green Building Council 2016; Centre of Urban Design and Mental Health 2022). The green urban spaces characteristics that have a positive impact on mental well-being based on the previous studies in Table 1 are:

o Diversity of green spaces can be assessed by identifying and counting different green area categories, for instance, Places to gather, lakes, waterways, front gardens, yards, etc.
o Exposure to green urban space is divided into two types; visual access and physical public access. Visual and physical access to green urban spaces is assessed with a field survey (observation) to identify places that have good or poor visual exposure to urban green spaces, and whether the green urban spaces are gated or not.
o Well-maintained urban green spaces reflect the quality of design, which enhances the good perception of places, improving poor mental health and life satisfaction, as quality is more important than quantity.
o Keep noise away by using green buffers, such as front porches, gardens, or yards, to promote quietness and reduce stress, and identified by a field survey.
o Green urban spaces should be dispersed and not clustered in one place to achieve equity and a suitable travel distance for all users; the perfect walk distance is 400 m to 1 km within 15 minutes.

3.3. Streets and transportation system

Enhancing connectivity with safe and efficient street networks encourages mental well-being (Public Health Agency of Canada, 2017; Harrison, 2017; Centre of Urban Design & Mental Health, 2022) by achieving:

o Nearby public transit stops within every 400m enhance the good accessibility of the urban areas for all users, improving life satisfaction, reducing stress, and providing safety and easy access.

- o Availability and well-maintained non-motorized transport promotes physical activities and enhances mental well-being.
- o Good street lighting during the day and night enhances safety and security, improves mood, and reduces stress.

4. Applied study

This section is concerned with proving the applicability and efficiency of the MWUC as a guide in enhancing mental well-being in the Egyptian distinct valued urban areas. This section is divided into four parts; research methods, study area selection, urban study for the study area, and results of a questionnaire with users of the study area.

4.1. Research method

Proving the applicability and efficiency of the MWUC by two methods: firstly, an urban study based on a field survey was conducted in the study area, to assess and investigate the availability and efficiency of MWUC in the study area. Secondly, a questionnaire was designed and implemented with users of the study area to investigate and prove that the MWUC enhances Egyptian human mental well-being. Thus, proving the efficiency of MWUC for Egyptian distinct valued urban areas.

4.2. Study area selection

The research focuses on Egyptian distinct valued urban areas at the center of Cairo city, which have distinctive historical values based on the National Organization for Urban Harmony. These urban areas are Zamalek Island, Garden City, Maadi, Masr El-Gedida, Khedive Cairo, and Historical Cairo. The Research selected the study area "Zamalek Island" because of its location, which is an island separated from the rest of Cairo city by the Nile that might positively contribute to human mental well-being, in addition, the diversity of green urban spaces, mixed land uses, availability of public transportation, and gathering places that enhance social interaction.

4.3. An urban study for Zamalek Island, Cairo City (Field survey study)

Zamalek Island, known as El-Gezira, was built in the 1800s as a garden for Khedive Ismail and is located in the middle of the Nile River between downtown Cairo and Giza. It is seen as a separate urban area from the rest of the city, as the Nile River borders it on all sides (Zayda, 2016). Zamalek Island is divided into two parts: the northern part which has mixed land-uses; residential buildings, residential-commercial or administrative buildings, etc., while the southern part contains recreational and cultural services. The main popular streets are 26 July Street and Abu El-Feda Street (Zayda, 2016). Based on the MWUC, the analysis will be divided into three parts: mixed land-uses, green urban spaces, and streets and transportation systems.

4.3.1. Mixed land-uses: The heterogeneity of land-uses on Zamalek Island is medium on enhancing mental well-being based on the entropy index (0.7), which reflects that the diversity of land-uses is higher than the good average (0.41 – 0.60). In addition, Fig. 4 shows the distribution and percentages of Zamalek land-uses that ensure most services, including education, administration, commercial, and some recreation services, are integrated and mixed with residential buildings within suitable distances, except the recreation and culture services, which are clustered in the southern part, and segregation from residential buildings. consequently, most of the users' needs are available and at an appropriate distance except for recreation and culture services. Hence, Zamalek land-uses contribute partially to users' feelings of comfort, satisfaction, and stress reduction.

4.3.2. Green urban spaces: Fig. 5 shows that there is a diversity of green urban spaces, which are divided into four categories: public gardens, gathering places (clubs and gathering points of cafes and restaurants), public green areas (street islands), and small gardens inside the embassy's boundaries. In addition, it is noticed that the distribution of the majority of green urban spaces is clustered in the southern part of Zamalek Island, and a few are along the border of the island in front of the Nile. Hence, not all the users could reach the green urban spaces by walking within 400 meters (5 minutes) based on the effect boundaries, as shown in Fig. 5. Most of the noisy activities are concentrated on the main streets; 26 July, and Abu El-Feda without green buffers, but in local streets, there are green buffers in front of most of the buildings, as shown in Fig. 6, separating the streets and noisy activities.

Exposure to green urban spaces, as shown in Fig. 5, is good for visual access and bad for physical access. Visual access is good for the buildings and gathering points of cafes and restaurants on the border of the island, which have high visual access to the Nile River. In addition, few buildings and cafes have good visual access to gated public gardens; Aquarium garden, and public gathering places (El-Gezira Club). The other buildings in the heart of the island have moderate visual access; see only the street trees. In addition, the visual view is good when users walk through streets, as the majority of Zamalek streets are full of trees, as shown in Fig. 7 and few of these streets have visual access to the Nile. Physical access is gated to all green urban spaces on Zamalek Island. As the clubs are for members only, the public garden should be paid for with a ticket at the entrance, and gathering points at cafes, and restaurants over the Nile should eat or drink something to sit and enjoy the view of the Nile. The maintenance of green urban spaces is good, as all green urban spaces are gated and have periodic maintenance.

Based on the above, some elements contribute positively to mental well-being: diversity of green urban spaces, good visual access to green urban spaces from buildings, cafes, or on the walk, and good periodic maintenance. On the other hand, the physical access and clustered of green urban spaces in the southern part contribute negatively to human well-being.

4.3.3. Streets and transportation system: public transit stops in Zamalek Island are limited, as shown in Fig. 8; there are two metro stations, one near Cairo Opera House at the southern entrance of Zamalek Island and the other at Ismail Mohamed Street near the educational services: Faculty of Art Fine and the Faculty of Art Education. While the bus and minibus stops are located only at Zamalek entrances; the southern entrance at Cairo Opera House and the northern entrance at 26 July Street. Metro stations and bus stops are not enough because the effect boundary of stations within 400 meters does not cover all of Zamalek Island, so the user should walk more than 5 minutes or reach the metro station and bus stops by car or taxi, as shown in Fig. 8. The effect boundaries of the metro station on the Ismail Mohamed Street and the bus station on 26 July Street are very near to the educational services, so it is useful for the students. Hence, easy to access Zamalek Island by public transportation, as most of the public transit stations are at its entrances on the south and north, but it is an obstacle to moving inside it from place to place by public transit.

Regarding pedestrian paths, as shown in Figs. 9 and 10, all main streets, for instance: Abu El-Feda, 26 July, Hassan Sabry, and Gezira, have pedestrian paths with widths ranging from 2 to 4 meters with few obstacles. The local streets "inside streets" have pedestrian paths with widths ranging from 0.5 to 2 meters with obstacles, this forces users to walk on the asphalt road, which is not safe and not comfortable due to the intervention of vehicles with pedestrians. In addition, the majority of pedestrian paths are not well maintained. Zamalek streets do not have any cycle lanes, but sometimes the users ride a bicycle with interventions with the vehicles.

The lighting of Zamalek streets, as shown in Fig. 11, is well-lit during the day, depending on natural lighting with shading by the trees, thus, the pedestrians feel comfortable, and safe and reduce their stress. At night, most of the local streets are dark; not enough lighting poles, and there are no night activities, so it is not safe for pedestrians. The main streets are lit at night by lighting poles and night-time activities.
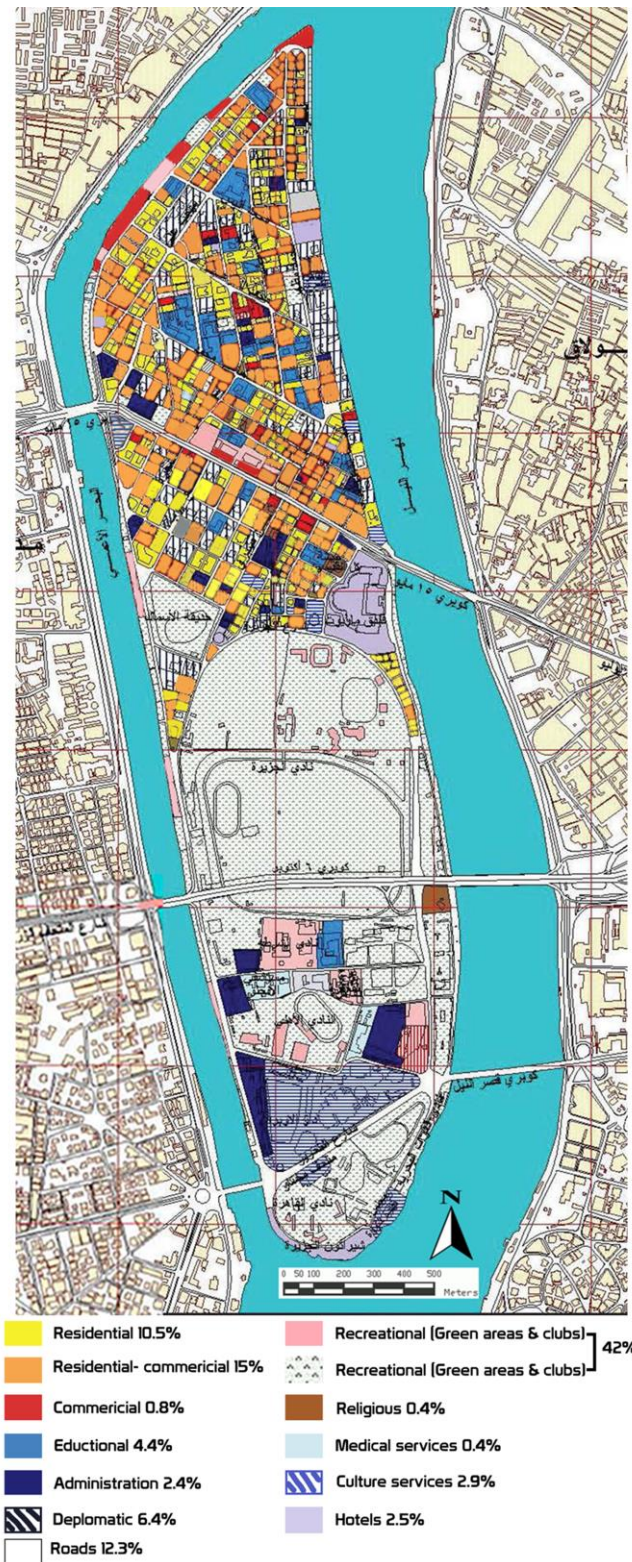
Fig. 4 Zamalek land-uses
Source: Authors based on (Ministry of Housing, Utilities and Urban Communities 2002)
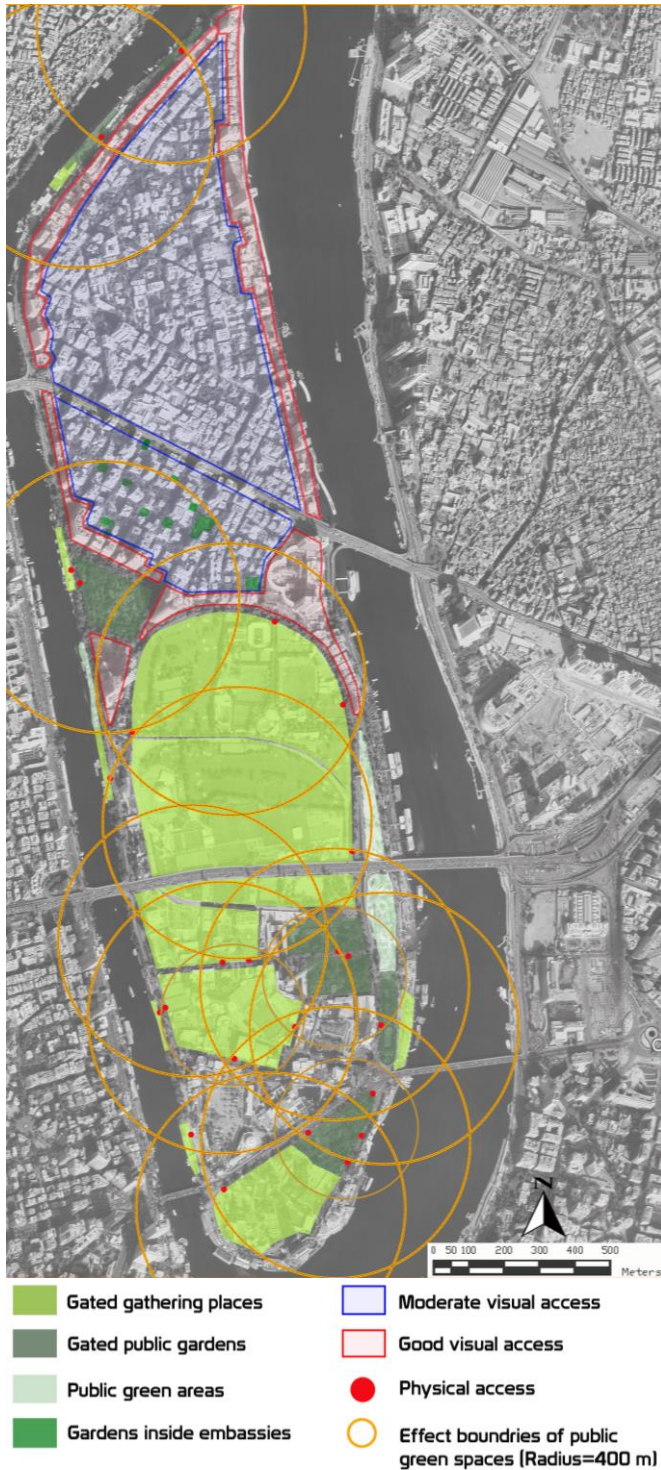
Fig. 5 Zamalek green urban spaces (Access, Distribution, categories)
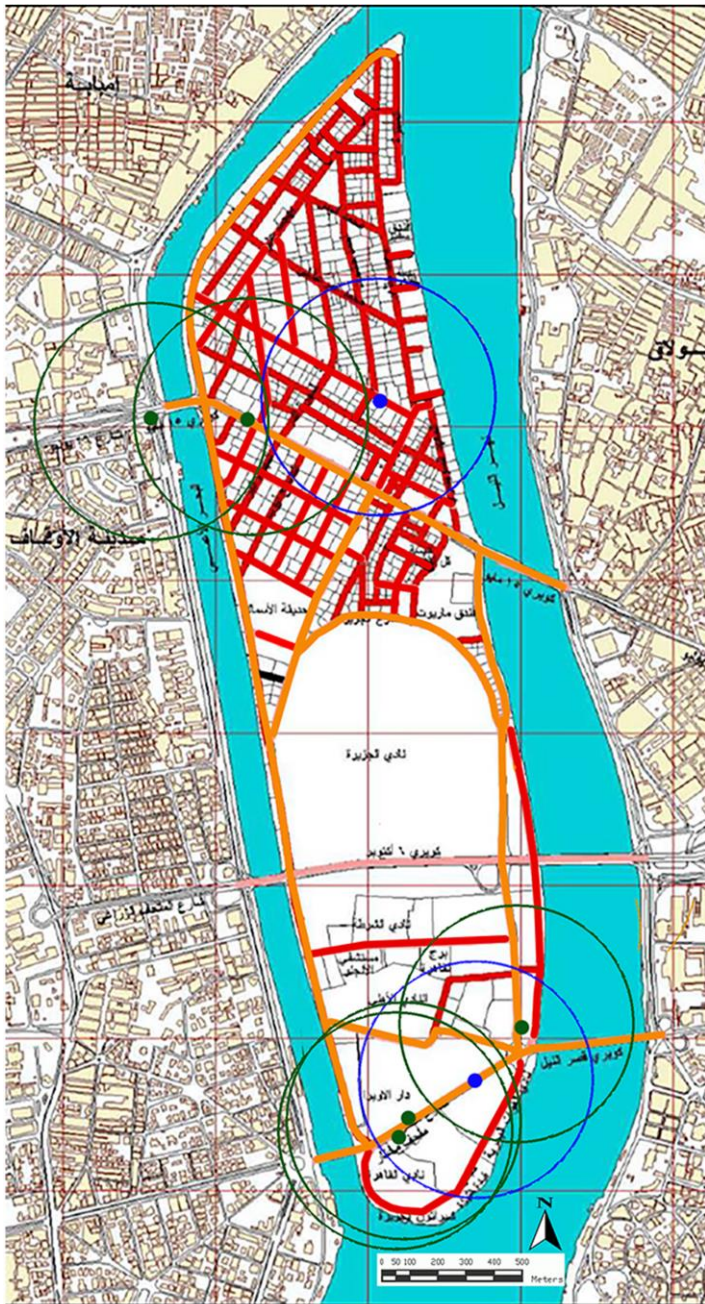Source: Authors

Fig. 6 Green buffer between the building and the road on local streets (El-Aziz Othman St.).
Source: Authors

Fig. 7 Green visual view (street trees) (Al-Sheikh Al-Marsafi St.)
Source: Authors

Fig. 8 Zamalek streets and public stations
Source: Authors based on (Ministry of Housing, Utilities and Urban Communities, 2002)
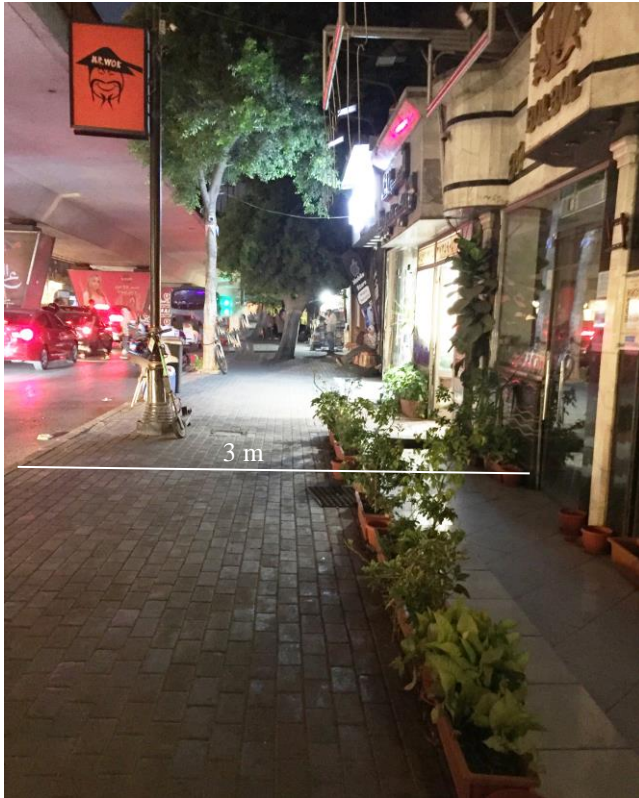

(Bahaa Eldeen Qaraqosh St.)

(Ismail Mohamed St.)
Fig. 9 Pedestrian paths on local streets
Source: Authors

Fig. 10 Pedestrian paths of main streets (26 July St.) with obstacles (furniture of stores)
Source: Authors

Street lighting at night (lighting only in front of stores) (Bahgat Ali St.)

Street lighting during the day (Gezira St.)

Fig. 11 Street Lighting at night and during the day
Source: Authors

4.4. Results of questionnaire

By converting MWUC into questions, A questionnaire has been designed and implemented on Zamalek Island, with a targeted sample of 60, divided into four groups: Zamalek's visitors, Zamalek's employees, Zamalek's university students, and the last group is urban design and architectural experts have been working at the Architectural Department, Faculty of Fine Arts, Helwan University, or on any project related to Zamalek Island. The targeted sample was selected using random stratified cluster samples. The

study has not been conducted with Zamalek's residents due to the difficulty of contacting them. In addition, the majority of them refused or were afraid to do the questionnaire, due to the urban interventions that have been happening lately on Zamalek Island.

The purpose of the questionnaire is to measure and prove the efficiency and applicability of the MWUC in enhancing mental well-being: enhancing feelings of comfort and satisfaction and reducing stress, in Egyptian distinct valued urban areas, by applying the questionnaire on Zamalek Island. The questionnaire consists of four parts.

- o Effect of mixed land-uses on feeling comfortable and satisfied.
- o Effects of green urban spaces on feeling comfortable and satisfied.
- o Effect of streets and transportation systems on feeling comfortable and satisfied.
- o Increasing or decreasing the degree of user comfort and satisfaction through the years.

The statistical analysis was performed using the SPSS program; mean, and relative importance index analysis. Based on the analysis of SPSS, the reliability analysis is 0.879, as shown in Table 4.

Table 4 Reliability Test

Cronbach's Alpha	N of Items
0.879	24

4.4.1. Mean analysis

Based on the statistical analysis, the mean analysis classified the variable into 3 impact levels on the mental well-being of Zamalek Island users; level (1): high positive impact on mental well-being with an average of more than 4, level (2): medium positive impact on mental well-being with average ranging between 3.1 to 4, and level (3): low positive impact on mental well-being with average 3 and less than 3. Figure 12 shows the diversity of green urban spaces of Zamalek Island as the most impact urban element in improving and enhancing users' mental well-being, while all other elements have varying impacts between levels (2) and (3). In addition, the user's feeling of comfort and satisfaction at Zamalek Island has decreased through the years, with an average of 3.12 at level 2, which reflects the decreasing degree of Zamalek Island as healthy urban areas that have a medium positive impact on mental well-being.

Based on Figure 13, almost all users except Zamalek's visitors agreed that the impact of mixed land-uses on the contribution of feeling comfortable and satisfied, enhancing mental well-being, is at level 2, medium positive effect. Zamalek's employees and Zamalek's university students agreed that the availability effect of all users' needs from land-uses is at level (1), high positive impact, in contributing feelings of comfort and satisfaction, which enhances mental well-being, but urban experts and Zamalek's visitors agreed at level 2.

Figure 14 shows that all of Zamalek's users agreed at impact level (3) regarding the effect of physical access to green urban spaces, and activities noise to enhance mental well-being. Zamalek's urban design experts and university students agreed that the degree of short-distance trips to green urban spaces, and the effect of small gardens in front of buildings have an impact level in enhancing mental well-being higher than the opinion of Zamalek's visitors, and employees. In addition, Zamalek's employees, and university students agreed that the degree of visual access to green urban spaces, and effect of visual access on feeling of comfort and satisfied have higher impact that Zamalek's urban design experts, and visitors. While all other elements almost all Zamalek's users agreed in their opinion, three user categories agreed with their opinion except one category.

According to Figure 15, Zamalek's university students agreed that all elements of streets and transportation system have an impact level (2), medium impact, on enhancing mental well-being except the validity degree of Zamalek's street to bicycle have a low impact, level (3), because most of the students depend on buses, and mini-buses stops more that new metro station at Ismail Mohamed street,

which is near educational services. While, all other Zamalek users vary in their impact level between levels (2), and (3), low and medium effect, except Zamalek's employees have a high impact, Level (1), in the contribution of street day lighting on enhancing mental well-being. Figure 16 determines the decreasing change in users' feelings of comfort and satisfaction in Zamalek Island through the years. The average feeling of Zamalek's employees and visitors ranges between 3.1 to 4 (impact level 2), which has decreased, and their mental health is affected negatively more than the opinion of Zamalek's urban design experts, and university students.
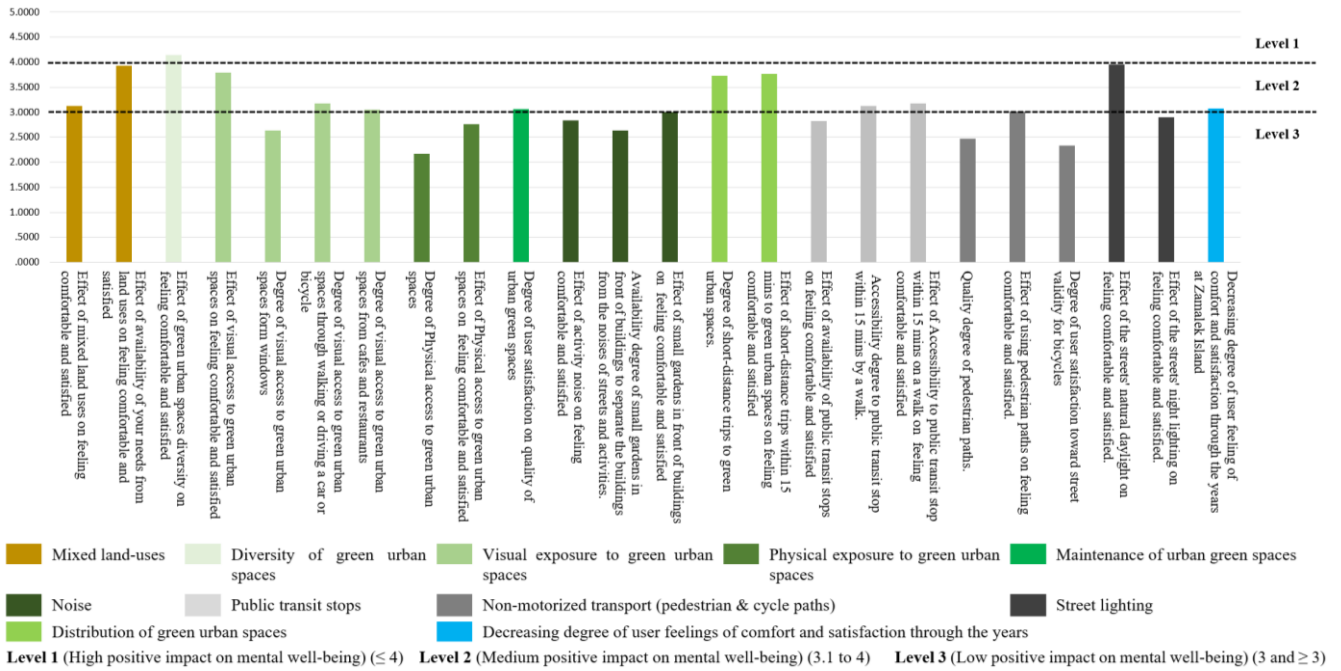
Fig. 12 Mean of the questionnaire questions that reflect the effect of each element of MWUC on enhancing the mental well-being of Zamalek users
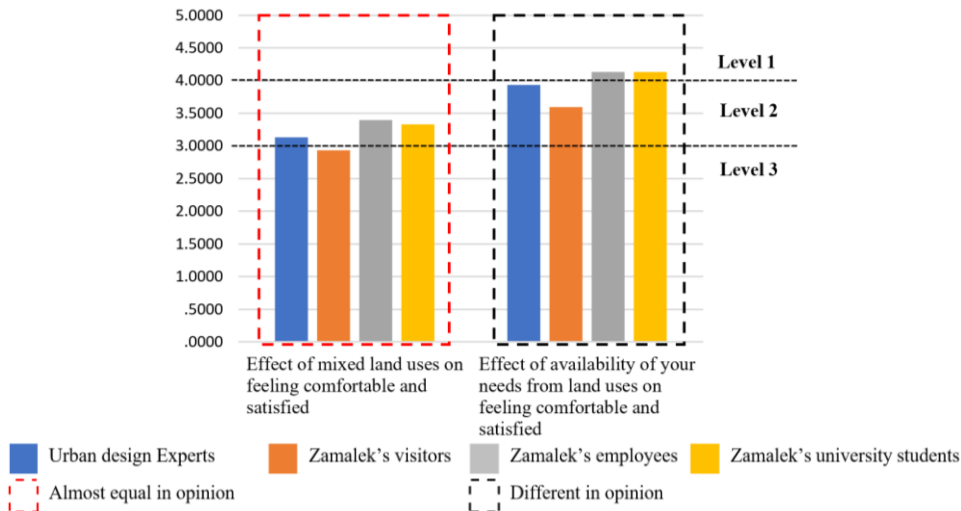
Fig. 13 Average (Mean) of mixed land-uses on enhancing mental well-being for Zamalek Island users
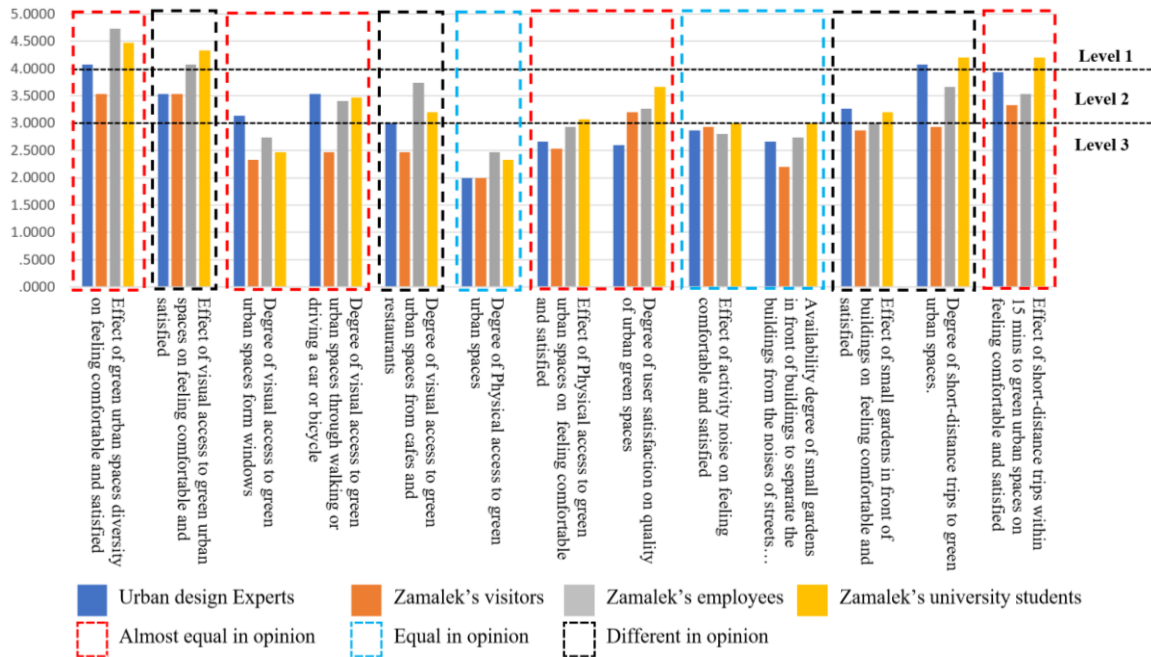
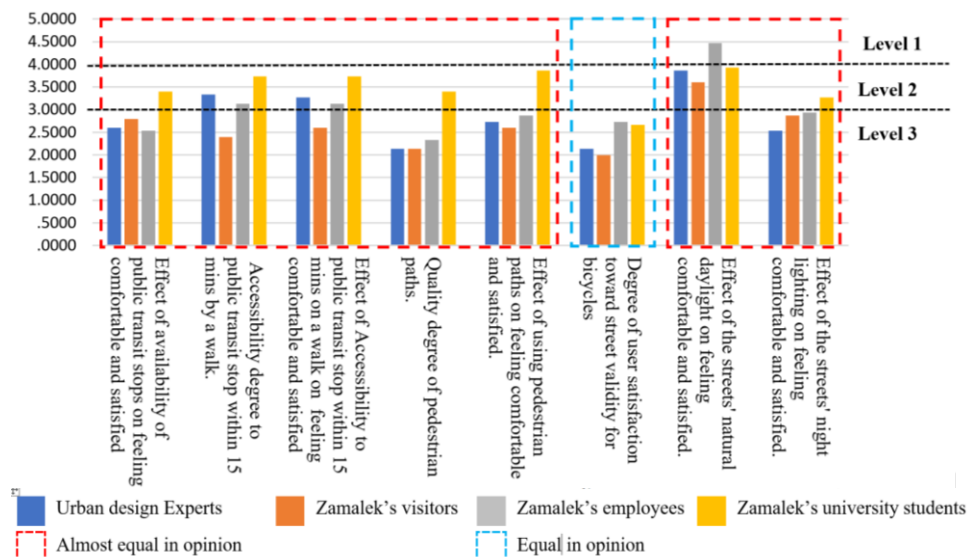**Fig. 14** Mean of green urban spaces on enhancing mental well-being for Zamalek Island users

Fig. 15 Mean of the streets and transportation system on enhancing mental well-being for Zamalek Island users
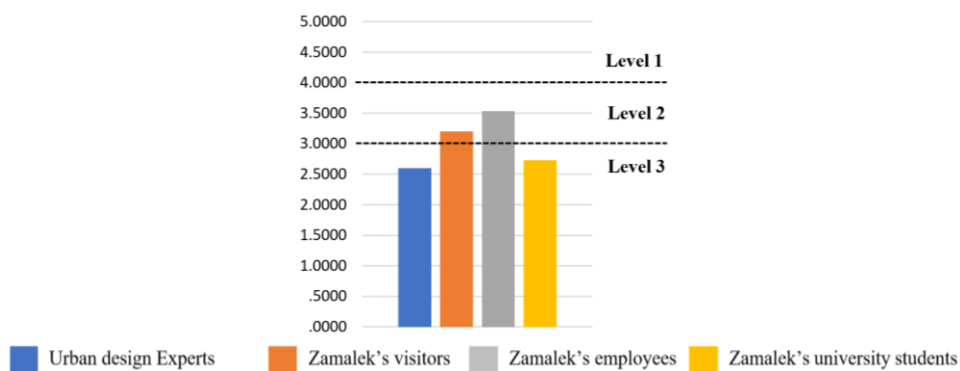

Fig. 16 Mean of decreasing degree of users' feelings of comfort and satisfaction through the years at Zamalek Island

4.4.2. Relative Importance Index RII

According to statistical analysis, RII is classified into three importance levels; very high (0.81 to 1), high (0.61 to 0.80), and neutral (0.41 to 0.60). Table 5 determines that the diversity of urban green spaces at Zamalek Island has the highest important level on enhancing mental well-being; feeling comfortable and satisfied. The mixed land-uses, visual access to green urban spaces, the well-maintained degree and distribution of urban green spaces, nearby public transit stops, and daylighting of streets are at a high level of RII, the second level. Then, all other elements have the weakest effect on mental well-being. Zamalek's users identified that based on RII analysis, the decreasing degree of feelings of comfort and satisfaction through the years for Zamalek Island has the weakest important level, a neutral level (0.60), which implies that Zamalek's urbanism still has a partially medium positive effect on enhancing human mental well-being, but need some urban interventions to improve and provide the elements especially that at a neutral level. The important level hierarchy of the three main domains of MWUC on enhancing mental well-being at Zamalek Island are mixed land-uses, green urban spaces, and streets and transportation systems sequentially, as shown in Fig. 17.

Table 5 RII of MWUC for Zamalek Island based on the Questionnaire.

MWUC			Questionnaire Questions that reflect elements of MWUC at Zamalek Island		RII	RII (Average)	Rank
Mixed Land-uses			Effect of mixed land uses on feelings of comfort and satisfied		0.64	0.72	4
			Effect of availability of your needs from land uses on feeling comfortable and satisfied		0.79		
Green Urban Spaces		Diversity of green urban spaces	Effect of green urban spaces diversity on feeling comfortable and satisfied		0.84	0.84	1
	Exposure to green space	Visual access	Effect of visual access to green urban spaces on feeling comfortable and satisfied		0.77	0.64	5
			Degree of visual access to green urban spaces from windows	from windows	0.53		
				through walking or driving a car or bicycle	0.64		
				from cafes and restaurants	0.62		
		Physical access	Degree of physical access to green urban spaces		0.44	0.50	9
			Effect of Physical access to green urban spaces on feeling comfortable and satisfied		0.56		
	Well-maintained urban green spaces		Degree of user satisfaction with the quality of urban green spaces		0.64	0.64	5
	Keep noise activities away by green spaces as a buffer		Effect of activity noise on feeling comfortable and satisfied		0.58	0.58	7
			Availability degree of small gardens in front of buildings to separate the buildings from the noises of streets and activities.		0.53		
			Effect of small gardens in front of buildings on feeling comfortable and satisfied		0.62		
	Distribution and location of green spaces		Degree of short-distance trips to green urban spaces.		0.74	0.75	3
			Effect of short-distance trips within 15 mins to green urban spaces on feeling comfortable and satisfied.		0.75		
Streets & transportation system	Public transit stops nearby		Effect of availability of public transit stops on feeling comfortable and satisfied.		0.57	0.61	6
			Accessibility degree to public transit stop within 15 mins by a walk.		0.63		
			Effect of accessibility to public transit stop within 15 mins by a walk on feeling comfortable and satisfied.		0.64		
	Non-motorized transport	Pedestrian paths	Quality degree of pedestrian paths.		0.50	0.55	8
			Effect of using pedestrian paths on feeling comfortable and satisfied.		0.60		
		Cycle paths	Degree of user satisfaction toward street validity for bicycles		0.48	0.48	10

Good street lighting	During day	Effect of the streets' natural daylight on feeling comfortable and satisfied.	0.79	0.79	2
	At night	Effect of the streets' night lighting on feeling comfortable and satisfied.	0.58	0.58	7
Decreasing degree of user feeling of comfort and satisfaction through the years at Zamalek Island.			0.61	0.61	-

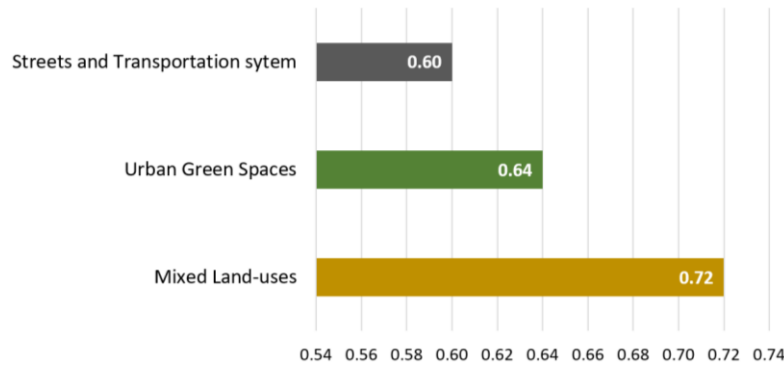■ Importance level (very high)　■ Importance level (high)　□ Importance level (neutral)

Fig. 17 Average of RII for enhancing mental well-being of three main domains of MWUC at Zamalek Island

5. Results and Discussion

Based on the statistics of the questionnaire, Table 6 shows the elements hierarchy of MWUC on enhancing mental well-being; feelings of comfort, and satisfaction, at Zamalek Island, which are classified into three levels based on mean analysis, and their ranks and impact percentages based on RII analysis. Most of the urban green space elements have varying impacts between the three levels, while the elements of streets and transportation systems are between levels (2) and (3). The hierarchy of the three main domains of MWUC are mixed land-uses, green urban spaces, and streets and transportation systems sequentially. Based on RII analysis, the average of the total impact of MWUC on mental well-being is 0.63, which is at the beginning of the high important level (the second important level of RII analysis is from 0.61 to 0.80) and is compatible with the RII result of the decreasing degree of users' comfort and satisfaction at Zamalek Island (0.61). Hence, Zamalek urbanism has a medium positive effect on enhancing mental well-being and needs some urban interventions to be a healthier urban area for mental health.

Table 6 MWUC hierarchy on enhancing mental well-being at Zamalek Island based on the questionnaire.

Level 1 High effect	Level 2 Medium effect						Level 3 Low effect				
1	2	3	4	5		6	7		8	9	10
10.9%	10.3%	9.7%	9.3%	8.4%	8.3%	8%	7.5%	7.6%	7.2%	6.5%	6.3%
Diversity of green urban spaces	Good street lighting during the day	Distribution and location of green spaces	Mixed Land-uses	Visual access to green urban spaces	Well-maintained urban green spaces	Public transit stops nearby	Keep noise activities away by green spaces as a buffer	Good street lighting at night	Non-motorized transport (Pedestrian paths)	Physical access to green urban spaces	Non-motorized transport (Cycle paths)

Source: Authors based on Table 5 and Figure 12

Furthermore, Table 7 shows a comparison has been conducted between the results of the questionnaire with Zamalek's users and the urban study of Zamalek Island, which concluded that most of the results of the two methods are compatible except for the distribution of green urban spaces, and street lighting during the day. The results show that the distribution of green urban spaces doesn't need to be dispersed

or near public transit stops and residential buildings, so green urban spaces could be clustered and positively affect mental well-being based on users' opinions. In addition, Although street lighting during the day is very well-lit and shaded, and has a high positive impact based on the field survey, it has a medium impact on mental well-being based on users's opinions in the questionnaire (RII is high level, and mean at medium level 2). Hence. Street lighting needs a deep study to explain the reason for the difference in the results.

Based on the above, it was concluded that Zamalek Island has a medium positive effect on improving mental well-being, and urban design experts should intervene to improve Zamalek urbanism to be healthier, especially the urban elements that have low effects. Some recommendations should be considered to enhance and improve Zamalek Island's positive effect on human mental well-being: improving non-motorized transport by improving pedestrian paths from any obstacles, providing or identifying suitable safe paths for cycling, providing more public transit stops to reach easily all areas at Zamalek Island, and more lighting poles and maintained the existing ones to more safety and comforting. Regarding urban green spaces, providing free physical and visual access to waterfront urban spaces; not gated or private, and using green buffers or reusing the noisy activities by suitable activities for residential buildings. Furthermore, as shown in Table 7, The research proved the availability and efficiency of MWUC as a guide and simple healthy urban design analysis can help urban designers, architects, and decision-makers in evaluating and monitoring the impact of Egyptian distinct valued urban areas on human mental health to identify if the urban area is healthy or not, to set policies, strategies, and urban intervention projects, etc., that help to provide healthier urban areas. Urban experts can easily apply the MWUC through an urban study based on a field survey, as shown in Table 2, and a questionnaire with users of the study area by using questions that reflect measuring characteristics of MWUC, as shown in Table 5.

Table 7. Results of the questionnaire and MWUC for Zamalek Island

Urban elements		Results of the urban study of MWUC	Results of questionnaire
Mixed land-uses		The degree of mixed land-uses is bad, as the entropy index is 0.7. Furthermore, Figure 4 shows the integration and dispersed distribution of services with residential use, except for cultural and recreational services. (Medium positive effect on mental well-being)	Medium positive impact on mental well-being (RII is high level (0.72)) (Mean: Level 2)
Green Urban Spaces	Diversity of green urban spaces	There are four categories of urban green spaces; thus, the diversity is good, as shown in Fig.5. (High Positive effect on mental well-being)	High positive impact on mental well-being (RII is very high level (0.84)) (Mean: Level 1)
	Well-maintained urban green spaces	All urban green spaces are gated and private, and some of them have periodic maintenance. (Medium positive effect on mental well-being)	Medium positive impact on mental well-being (RII is high level (0.64)) (Mean: Level 2)
	Keep noisy activities away by green spaces as a buffer	Most noisy activities are concentrated on the main streets; 26 July, and Abu El-Feda, without separating buildings by green buffers to decrease noise. While local streets have few noisy activities, and most of the buildings have a green buffer in front of them to keep noise away. (Low positive effect on mental well-being)	Low positive impact on mental well-being (RII is neutral level (0.58)) (Mean: Level 3)
	Exposure to green space — Physical access	All urban green spaces are gated; not free, as shown in Fig. 5. (Low positive effect on mental well-being)	Low positive impact on mental well-being, because the degree of non-gated physical access is low. (RII is neutral level (0.50)) (Mean: Level 3)

MSA Engineering Journal
MSA Engineering Journal (ekb.eg)
ISSN 2812-5339 (print); ISSN 2812-4928 (online)
E-mail: jzus@msa.edu.eg

Exposure to green space	Visual access	Visual exposure and access to green urban spaces, as shown in Figs. 5, 6, and 7, is good; • From the windows of the building, a few buildings have high visual access to the Nile River and gated public gardens, while most of the other buildings have low visual access and have only a view of the street trees and gardens inside the embassies. • From cafes; most cafes and restaurants have high visual access to the Nile River and others have medium views of the trees on the streets or with no views. • Through walking or driving, users have a good visual view, as most of Zamalek's streets are full of trees. (Medium positive effect on mental well-being)	Medium positive impact on mental well-being (RII is high level (0.64)) (Mean: Level 2) Degree of visual access, based on RII: • Neutral from Windows High from cafes, and through walking or driving
	Distribution and location of green urban spaces	All urban green spaces are located on the southern part of Zamalek Island, so they are clustered in one area, except for a few cafes, restaurants, and clubs distributed along the border of the island in front of the Nile with a good view. Based on the effect boundaries, as shown in Fig. 6, it is difficult to reach these places on a walk within 400 meters in 5 to 15 minutes. (Low positive effect on mental well-being)	Medium positive impact on mental well-being (RII is high level (0.75)) (Mean: Level 2)
Streets and Transportation systems	Public transit stops nearby	Users can reach easily Zamalek Island by public transportation, as public transit stops are located at the south and north entrances of Zamalek Island. In addition, the new metro station in the heart of Zamalek Island is near to the educational services. Although, the availability of public transit stations, their effect boundaries within 400 meters are not enough to reach different areas inside Zamalek Island, as shown in Fig. 8. (Medium positive effect on mental well-being)	Medium positive impact on mental well-being (RII is high level (0.61)) (Mean: Level 2)
	Non-motorized transport: Pedestrian paths	The width of pedestrian paths on local streets ranges from 0.5 to 1.5 meters, with a lot of obstacles, as in Fig. 9. Furthermore, pedestrian paths on main streets have few obstacles, with widths ranging from 2 to 3 meters, as in Fig. 10. (Low positive effect on mental well-being)	Low positive impact on mental well-being (RII is neutral level (0.55)) (Mean: Level 3)
	Non-motorized transport: Cycling lanes	Zamalek Island has no cycle lanes, so riding a bike with vehicles is not safe. (Low positive effect on mental well-being)	Low positive impact on mental well-being (RII is neutral level (0.48)) (Mean: Level 3)
	Good street lighting Day	Streets have good natural lighting during the day, with a lot of trees shading people from the sun, as in Fig. 11. (High positive effect on mental well-being)	Medium positive impact on mental well-being (RII is high level (0.79)) (Mean: Level 2)
	Good street lighting Night	The majority of the local streets are dark at night and have few lighting poles, while the main streets are well-lit with activities. (Low positive effect on mental well-being)	Low positive impact on mental well-being (RII is neutral level (0.58)) (Mean: Level 3)
Total Result		The total impact on mental well-being is: 6 Low level + 2 high level +4 medium level Neutral impact (Medium)	Total Impact Average (Medium positive impact on mental well-being) (Average of RII: 0.63) (Average of Mean: (3.1) Level 2) Result of question: Decreasing degree of user feeling of comfort and satisfaction through the years. (Average of RII: 0.61) (Average of Mean: (3.1) Level 2) (Medium positive impact on mental well-being)

Urban elements do not have the same result in the two methods.

Source: Authors

6. Conclusion

Based on a profound theoretical study of mental well-being definition, and its relation to the built environment. In addition, a comparison was conducted between previous studies of healthy urban areas to identify the "Mental Well-Being Urban Characteristics MWUC", as shown in Table 1. The MWUC is a guide, that aims to determine if the urban area has a healthy urban design and a positive impact on human mental well-being or not, to set policies, strategies, and urban projects that contribute to improving urban elements that have a low impact. Then, to prove the applicability and efficiency of the MWUC for Egyptian distinct valued urban areas, an applied study has been conducted using two methods. Firstly, an urban study on Zamalek Island, Cairo has been conducted by applying the MWUC, and secondly, a questionnaire with Zamalek's users has been designed and implemented to prove the efficiency of MWUC, converting MWUC into questions measuring by Likert-scale from 1 to 5. Then, based on a comparison between the two methods' results, as shown in Table 7, the efficiency and applicability of the MWUC for Egyptian distinct valued urban areas have been proved. In addition, the MWUC should be applied with the integration of a questionnaire with the users, because sometimes there is a different between urban study and users' experience. Hence, the users' participation should be integrated with the evaluation of the MWUC to set policies, strategies, and urban projects compatible with users' needs to provide healthy Egyptian distinct valued urban areas. Hence, The MWUC is a guide applied by two methods, as shown in Table 8, an urban study and a questionnaire, to monitor and sustain the effect of Egyptian distinct valued urban areas on mental well-being. Further research is required to improve the applicability and comprehensiveness of MPWUC, for instance, by setting more quantitative indicators, and deep studies addressing the impact and healthy design characteristics of the distribution of green urban spaces, street lighting during the day, and urban patterns.

Table 8. The evaluating and monitoring methods of MWUC

MWUC			
Method one: urban study (field survey study)		**Method two: Questionnaire with users** Likert-scale (0 to 5)	
Mixed land-uses	LUM= - ∑ (P$_i$ * In P$_i$) / In n	Effect of mixed land uses on feelings of comfort and satisfied	
		Effect of availability of your needs from land uses on feeling comfortable and satisfied	
Green Urban Spaces	• Diversity of green urban spaces, for instance: o Places to gather o Attractive areas (lakes, waterways, front gardens, yards, etc) o Wide spaces enhance physical exercises o Green buffer bet. Private & public o Food growing spaces	• Identifying the number of green urban spaces categories.	Effect of green urban spaces diversity on feeling comfortable and satisfied
	• Daily exposure to green space through: o Visual access to green urban spaces (Street trees, views from windows, gardens, green areas around & near buildings, etc) o Physical access to green urban spaces	• Visual access: the ability to view green areas by walking or cycling or from windows (observation by field Survey).	Effect of visual access to green urban spaces on feeling comfortable and satisfied
			Degree of visual access to green urban spaces from windows → from windows
			→ through walking or driving a car or bicycle
			→ from cafes and restaurants
		• Physical access: public & not private or gated access (observation by field Survey).	Degree of physical access to green urban spaces
			Effect of Physical access to green urban spaces on feeling comfortable and satisfied

• Well-maintained urban green spaces	• Field Survey (Observation)	Degree of user satisfaction with the quality of urban green spaces
• Keep noisy activities away by green spaces as a buffer		Effect of activity noise on feeling comfortable and satisfied
		Degree of availability of small gardens in front of buildings to separate the buildings from the noises of streets and activities.
		Effect of small gardens in front of buildings on feeling comfortable and satisfied
• Distribution and location of green spaces	• Short-distance trips to green spaces (5 to 15 mins (time/distance)) or (400 m to 1 km) • Distribution of green areas: dispersed or clustered	Degree of short-distance trips to green urban spaces.
		Effect of short-distance trips within 15 mins to green urban spaces on feeling comfortable and satisfied.

Streets & Transportation system

• Public transit stops nearby	• Short-distance trips to public transit stops within a maximum of 400 m.	Effect of availability of public transit stops on feeling comfortable and satisfied.
		Accessibility degree to public transit stop within 15 mins by a walk.
		Effect of accessibility to public transit stop within 15 mins by a walk on feeling comfortable and satisfied.
Non-motorized transport: o Pedestrian paths: well maintained - Wide sidewalks - Handicap consideration o Cycling lanes & bicycle parking	• If it exists or not and identify it on maps • Identifying the path width and its degree of maintenance.	Quality degree of pedestrian paths.
		Effect of using pedestrian paths on feeling comfortable and satisfied.
		Degree of user satisfaction toward street validity for bicycles
• Good street lighting (day-night)	• Field Survey (Observation)	• Effect of the streets' natural daylight on feeling comfortable and satisfied.
		• Effect of the streets' night lighting on feeling comfortable and satisfied.

Total Results Impact on mental well-being	Total number of elements that have low, medium, and high (if the number of elements that have low impact is equal to the number of elements that have medium and high impact, hence its medium impact on enhancing mental well-being).	Measuring by question and total average results of all other questions that measuring all elements of MWUC, to assure the validity of the effect of urban area on human mental health	Decreasing degree of user feelings of comfort and satisfaction through the years at Zamalek Island (question).
			• Average of all elements for mean and RII analysis: High level: (mean at level 1 – RII at very high level) Medium level: (mean at level 2 – RII at high level) Low Level: (mean at level 3 – RII at neutral level)
	Compared the results of urban study to questionnaire to assure the validity of the impact of urban area on human mental health.		

7. Disclosure statement

No potential conflict of interest was reported by the author(s).

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