

# Preference Assessment and Prioritization of the Urban Green Space Features Using Qualitative Evaluation and AHP Decision Model



Mohd Sanusi S. Ahamad, Rabi'ah Ahmad and Abdul Nasir Matori

**Abstract** The global rapid urbanization process has forced the issue of urban green space to be importantly addressed with regards to promoting leisure opportunities, health benefits and aesthetic enjoyment of urban residents. Urban green spaces such as the public parks are very influential in contributing to the quality of life to communities in various ways. Their features represent the physical activity patterns, perceptions and the preferences of park users. At present, there is no attempt to explore the importance of these features in designing sustainable urban community parks. This paper uses the qualitative assessment to analyze the preferences of park users and expert decision makers to prioritize the urban green space features. The preferential statistics and the AHP-decision model were applied in the urban green space study of two prominent recreational parks in Ipoh, Malaysia. The results have indicated that the people's aspiration towards an ideal public park has led to the associated changes and demands upon available green features. The outcome of the prioritize study shows that safety feature attributes are ranked as a most important attribute, followed in sequence by other attributes viz. maintenance, accessibility, property value, signage and lighting, visual pattern, facilities, location and water bodies. The prioritized feature attributes are considered significant in selecting the factors of urban green space in relation to urban residential living areas. It can positively assist in defining the components of future urban green space features in the global urbanization policy.

**Keywords** Urban green space • Analytic hierarchy process • Qualitative assessment • Spatial classification

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F. Mohamed Nazri (ed.), *Proceedings of AICCE'19*, Lecture Notes in Civil Engineering 53, [https://doi.org/10.1007/978-3-030-32816-0\\_4](https://doi.org/10.1007/978-3-030-32816-0_4)

## 1 Introduction

In the urban areas, the green spaces characterized as parks, gardens, greenways, or forests represents an important contributor to the natural environment. It serves to provide multiple functions as it gives the natural features environment that influences every aspect of our lives. The urban green space is observed as the visible element for people to recognize the landscape structure of a cityscape [26]. Dunnet et al. [15] defined urban green space as land that consists predominantly of unsealed, permeable, ‘soft’ surfaces such as soil, grass, shrubs, and trees with the emphasis on the ‘predominant’ character since green spaces may also include buildings and hard surfaced areas. It includes all areas of parks, play areas and other green spaces specifically intended for recreational use, as well as other green spaces with other origins. The World Health Organization [52] defined urban green spaces as places with ‘natural surfaces’ or ‘natural settings’ which are public parks and including ‘blue space’ that represents water elements such as ponds. In general, green space occupies 25–30% of the urban land use and is part of the element that influenced the urban features [47].

Many studies have presently pointed urban green space as a resource to balance the urban growth with its enormous benefit to the urban environment [9, 12, 14, 18, 22, 32, 36, 38]. These studies have explored the correlation between green spaces and quality of life from environmental, social and economic perspectives. Their significance as an important resource which provides direct and indirect benefits to ecosystem services and improves physical, psychological, emotional, social and material wellbeing. In addition, past researches have revealed that urban green space representing part of urban nature fulfills the important of immaterial human needs in terms of emotional, psychological, social and economic benefits [7, 19].

Urban green space specifically refers to “public open space” or “public park” in an urban setting. The word “park” is frequently used in connection with urban green space as it is an area of land mostly provided for recreation and promotes physical and social interaction within the community. A “public park” covers public playground, public/community recreation center or area, and other public areas, created, established, designated, maintained, provided or set aside by the town authority, for the purposes of public rest, play, recreation, enjoyment or assembly, and all buildings, facilities and structures located thereon or therein [50].

The trends for public parks have been part of the performance indicators in human development [16]. There is a need to determine the significant characteristics of how urban green features were associated with park visitors and responsive to the needs of the local community as well as part of sustainable urban landscapes. It is possible to investigate the physical features of urban green space and its contribution to the users’ active and passive activities and their functional attachment to the park. Hence, it is important to understand urban green space features attribute to ensure parks are designed to maximize opportunities for people across a range of demographic groups engaged with various activities. It is important to understand how green space provides meaningful experiences to urban residents

and certain physical features of green space can promote the development of Sense of Place and improve users' experiences in the green space [29].

Green space features have the restorative ability and create positive experiences within both natural and built environment. The feature attributes of parks such as size, design, usage, location, and activities are the main decisive factors that determine the satisfaction level of the users or community. The effectiveness or sustainability of recreational parks can be measured by prioritizing the features of urban green space using specific decision-making model. For that reason, this study explores and attempt to relate how the attributes of green space feature affect physical activity patterns, perceptions, and preferences of the park users.

This paper relates the problem associated with the status of urban green space in the Ipoh city, Malaysia. The increasing urban climate change has made the development in Ipoh city coherent with other cities in Malaysia. Hence, the changes in the physical environment have led to associated changes in the aspirations and demands upon existing green spaces [24]. It has been the intentions of the Ipoh City Council to create a green and safe city concept viz. 'Quality living that provides the urban residents with physical facilities and better amenities including good recreation areas, social activities, and health'.

The two urban public parks selected in the case study were the favorite outing destination among the locals and represents the family parks that attracts hundreds of people daily. The study is intended to identify the design attributes of the parks that will be sustainable for the people's choice. It examines how urban green space features meet the purposes and needs of urban residents by determining the effectiveness and patterns of green space based on standard criteria that measure their quality.

## 2 Methodology

The study area is two prominent recreational parks situated in the heart of Ipoh city of Perak, Northern part of Peninsular Malaysia. It is popularly known as the Bougainvillea City referring its famous flower symbol and the fourth biggest in Malaysia covering 643 km<sup>2</sup> with over 750,000 inhabitants. It is surrounded by beautiful limestone outcrops with wonderful cave temples. The city is one of the fascinating tourist destinations in the Peninsular of Malaysia, famous with heritages, cultures, and natures. Two prominent recreational parks i.e. King Abdul Aziz Recreational Park (Park A) and D. R. Seenivasagam Recreational Park (Park B) in the heart of Ipoh city was chosen as the study area (Fig. 1). The parks (study area) are abundant with greenery and attractions and popularly known as the oasis within Ipoh's city life. Each park has its own significant character that attracts users.

The indicators to measure the green space features were acquired from comparative works of literature that reviews the attributes affecting urban green space. A summary of commonly used quality measurement of urban green space/parks was identified and proposed as the framework indicators in establishing the basis of



**Fig. 1** Ipoh city and the urban green spaces (recreational parks)

green space measurement (Table 1). These common feature attributes were identified as:

1. Natural Setting—Visual scenery with unique values that enhances the character of an area that gives users attractiveness, sense of being away from their usual setting, sense of fascination, happiness, leisure, spirituality, affection, and balance of sun and shade.
2. Design—Provides the diversity of activities offered and variety in the form, color, and texture of landscape elements which includes the presence of walking paths, shade, water features, birdlife, lighting, sporting facilities, and playgrounds.
3. Location—Visiblens and identifiable of the park which is located close to major public transport routes that are easily accessible and not isolated.
4. Facilities—Built features within parks that create opportunities to engage in specific games and activities.
5. Amenities—Supporting facilities that are identified as important characteristics in the park. It represents the equipment or services that are provided in parks.

**Table 1** Common adopted feature attributes of green space in the works of literature

No	Authors/sources	Common feature attributes									
		Natural setting	Design/size	Facilities	Amenities	Water element	Accessibility	Location	Safety	Maintenance	
1.	Jennings et al. [26]	*	*		*		*	*	*	*	
2.	Andrew et al. [4]	□	□	□		□			□		
3.	Edwards et al. [17]	□	□		□			□	□		
4.	Rostami et al. [44]	*	*	*	*	*	*	*	*	*	
5.	Siti Rashidah et al. [48]	□	□	□	□		□		□	□	
6.	Kaylin and Jeff [29]	*	*			*		*			
7.	Zengel and Dogrusoy [54]	□	□	□	□		□		□	□	
8.	Nurul et al. [42]	□	□	□	□	□	□	□	□	□	
9.	Ozdemir and Polat [43]	□	□			□			□	□	
10.	Ajau et al. [13]	□	□	□				□			
11.	Atefeh et al. (2014)	□	□	□		□		□	□		
12.	Jamirsah [25]	□	□	□	□		□		□	□	
13.	Blanck et al. [10]	□		□	□		□		□	□	
14.	Mohd [37]			□			□		□	□	
15.	Abdul et al. [1]	□	□	□	□	□	□	□	□	□	
16.	Ariane et al. [5]	□	□	□	□		□		□	□	
17.	Sofia and Alpopi [49]	□	□	□	□	□	□	□			
18.	Bakti [8]	*	*	*	*	*	*	*	*	*	
19.	Abkar et al. [2]	□	□			□		□	□		
20.	Grahn and Stigsdotter [20]	□	□	□	□		□		□	□	
21.	Bo Chen et al [11]	*	*			*		*			
22.	Andrew et al. [3]	□	□	□	□			□	□		
23.	Hillsdon et al. [23]	□	□	□	□		□		□	□	
24.	Muderrisoglu and Oguz [39]	□		□	□				□	□	

6. Accessibility—Gives an opportunity for movement through the park environment physically and visually.
7. Water Element—Attributes of visual amenity that gives design integrity and enhances the natural elements within the surrounding environment.
8. Safety—Safe green space and recreation facilities are the key to community wellness and have a direct relationship to their usage rate.
9. Maintenance—Crucial to ensuring areas are attractive and well-kept for the enjoyment of both residents and visitors.

### 2.1 Qualitative Assessment-Usage Pattern of Public Green Space

The qualitative assessment adopts the preference analysis that involves direct interviews with park visitors using questionnaires via a series of interviews and thorough observation over both study area. The public perception towards green space area was evaluated to determine what users want from urban green spaces and the extent to which the urban green spaces meet their expectations. The survey was administrated over a month period with a total number of 200 respondents (100 from each park). The questionnaire was designed to comprise the dependent variables, such as their gender, age range, the time frame of travel, mode of transport, and the frequency of visit, the independent variables such as the safety, and security. In comprehending the design qualities, the social attributes that encourage social mingling (i.e. personal information and social preference) and green space properties (i.e. green space design character and attributes features) were measured through documented responses (Fig. 2). The green inventories were carried out to map the characteristics of green spaces (parks). They were observed during weekdays, weekend and public holidays to capture the different usage patterns of



Fig. 2 The classified categories of green space variables measured

different times of day (morning and evening) and on different days of the week. The unit of analysis of the target group is the age group range of the urban park visitors/users.

The frequencies analysis was analyzed using the SPSS statistical software to determine the usage pattern of public green spaces in relation to the design characteristics and user' visit frequencies. Table 2 gives an overview of the number of users involved in activities for both parks. Trip characteristics and park activities (e.g. travel distance, length of stay, the frequency of visits, mode of transport, and perception of safety, aesthetics quality and facilities) were analyzed to see the trend of the visitors' preferences.

**Table 2** Descriptive statistic of people involved in the activities within green space settings

Variables measured	Park A			Park B		
	Gender			Gender		
Age group	Male	Female	%	Male	Female	%
	62	38	100	69	31	100
<i>Age category</i>	<i>No of visitors</i>					
20 and below	8			5		
21–29	40			44		
30–39	18			27		
40–49	20			19		
50–59	12			4		
60 and over	2			1		
<i>Travel distance</i>						
Less than 5 min	8			6		
5–10 min	35			20		
10–15 min	32			40		
15–20 min	17			13		
20–30 min	8			15		
More than 30 min				6		
<i>Mode of transport</i>						
On foot	4			4		
Bicycle	7			8		
Motorbike	39			50		
Car	50			38		
<i>Visit frequency</i>						
Daily	8			25		
Weekly	44			40		
Monthly	29			17		
Occasionally	5			9		
Rarely	14			9		

(continued)

**Table 2** (continued)

	Park A			Park B		
Variables measured	Gender			Gender		
Age group	Male	Female	%	Male	Female	%
<i>Stay timeframe</i>						
Less than 30 min	1			5		
30 min–1 h	41			52		
1–2 h	52			38		
2–4 h	6			5		
<i>Visitors preference of safety</i>						
Often	47			25		
Sometimes	51			58		
Never	2			16		
No opinion	0			1		

## 2.2 AHP-Pairwise Decision Making

The decision problem was structured in a hierarchy where the overall goal of the decision is to prioritize nine (9) common features of urban green space. The pairwise questionnaires were distributed to twenty (20) decision makers (DM) who are professionals indirectly or directly involved in green space planning from the institution of higher learning (IHL), senior officers the local municipality and the state planning agency. The questionnaire allows decision makers to make pairwise comparisons between criteria (green space features). It measures the relative importance between two criteria in a subsequent manner based on the continuous AHP 9-point scale i.e. ranging from the scale (1) ‘equal importance’ to the scale (9) ‘extremely important’ [46, 45].

The AHP-Excel<sup>®</sup> Template tool [30] was used in the decision-making processes. The software template derives ratio scales from paired comparisons of criteria and allows for some small inconsistencies in judgments. Inputs can be actual measurements or subjective opinions. The output form will be priorities (weightings) and a consistency ratio that was mathematically calculated using the solution of an eigenvalue problem [30]. The pair-wise comparisons results are arranged in a matrix. The first (dominant) normalized right eigenvector of the matrix gives the ratio scale (weighting), the eigenvalue determines the consistency ratio. A sample input summary of one decision maker (DM1) is provided in Table 3. The AHP decision model measured the effectiveness of the present recreation areas by prioritizing urban green space features. The relative preference of decision makers towards criteria affecting the design of green space feature is presented as the preference weight.



**Table 3** Sample pairwise comparison of one decision maker (DM1)

AHP Analytic Hierarchy Process				N = 9	Input	9
Objective:		Ranking of Urban Feature Criteria				
Please compare the importance of the elements in relation to the objective and fill in the table: Which element of each pair is more important, A or B, and how much more on a scale 1-9 as given below.						
Name:DM1 (USM)		Weight 1	Consistency Ratio	a: 0.1; CR: 8%	Scale 1	
Criteria				More important?	Scale	
i	j	A	B	A or B	(1 - 9)	
1	2	Visual Pattern	Rec. & Sport Fac.	B	7	
1	3		Access & Connect.	B	5	
1	4		Sign & Lighting	A	3	
1	5		Water Bodies	A	1	
1	6		Location	B	8	
1	7		Safety	A	5	
1	8		Maintenance	B	3	
2	3		Recreational & Sport Facility	Access & Connect.	A	3
2	4	Sign & Lighting		A	7	
2	5	Water Bodies		A	9	
2	6	Location		B	2	
2	7	Safety		A	8	
2	8	Maintenance		A	5	
3	4	Access & Connection	Sign & Lighting	A	6	
3	5		Water Bodies	A	8	
3	6		Location	B	5	
3	7		Safety	A	7	
3	8		Maintenance	A	8	
4	5	Signage & Lighting	Water Bodies	A	3	
4	6		Location	B	9	
4	7		Safety	A	2	
4	8		Maintenance	B	1	
5	6	Water Bodies	Location	B	9	
5	7		Safety	A	2	
5	8		Maintenance	B	2	
6	7	Location	Safety	A	9	
6	8		Maintenance	A	8	
7	8	Safety	Maintenance	B	2	
1	9	Visual Pattern	Property Value	A	1	
2	9	Rec. & Sport Fac.	Property Value	A	6	
3	9	Access & Connection	Property Value	A	6	
4	9	Signage & Lighting	Property Value	A	2	
5	9	Water Bodies	Property Value	A	2	
6	9	Location	Property Value	A	8	
7	9	Safety	Property Value	A	2	
8	9	Maintenance	Property Value	A	3	

### 3 Results and Discussion

#### 3.1 Derived Maps of Green Space Features

Park A (King Abdul Aziz) accommodates attractive green urban space features. This community park has remarkable values in terms of environment and human health as well as the economy for the city. Almost 70% of the park is covered by the majestic rain trees and natural surroundings. The resultant 7 reclassified features of the park are highlighted in Fig. 3. Table 4 described the actual distributions of the human made, and the natural features.

Park A (D. R. Seenivasagam), located in the heart of Ipoh is categorized as a local park in accordance with its size and service area to the surrounding. The park has many natural features based on its ecological and aesthetic value (Fig. 4). It is known for its scenic beauty and recreational facilities. The reclassification process has successively produced a total of 23 classes of manmade and the natural features (Table 5). In general, 23.8% of Park A is covered with trees and 12.4% filled with lakes. Other features are proportionally distributed.



Fig. 3 Reclassified features of Park A (King Abdul Aziz)

Table 4 The feature distributions of Park A

	Features	Size (sq. m)	%
1	Undefined and open space	162,539	
2	Track and parkway	4836	9.4
3	Trees (covered)	36,072	70.5
4	Pond (water area)	4629	9.0
5	Concrete space	1578	3.1
6	Sport area	2019	3.9
7	Buildings	2057	4.0



Fig. 4 Reclassed features of Park B (D. R. Seenivasagam)

Table 5 The feature distributions of Park B

	Attribute features	Size (sq. m)	%		Attribute features	Size (sq. m)	%
1	Surrounding road	567	0.5	13	School area	13,017	10.9
2	Lake	14,822	12.4	14	Bridge	103	0.1
3	Japanese garden	3165	2.6	15	River network	487	0.4
4	Bicycle park	416	0.3	16	Surrounding buildings	15,192	12.7
5	Playground	1509	1.3	17	Monument	113	0.1
6	Small island	9136	7.6	18	Shops	984	0.8
7	Public park	5682	4.8	19	Open Field	13,244	11.1
8	Park area	133,193	–	20	Public toilet	656	0.5
9	Joint area	23,132	–	21	YMCA field	8918	7.5
10	Bicycle track	425	0.4	22	Jogging track	256	0.2
11	Skating area	1680	1.4	23	Trees	28,433	23.8
12	Motorcycle park	633	0.5				

### 3.2 Qualitative Assessment

The qualitative assessment determines the urban resident’s responses towards their preferences and experiences on the green space features in the parks. The variables being measured were the social attributes (personal information and social preference) and the green space properties (green space and manmade features). This section provides the assessment results of the number of park users, the trip characteristics and park activities such as travel distance, length of stay, the frequency of visits, mode of transport, and perception of safety, aesthetics quality and facilities. Both parks have similar characteristics in terms of location, recreation activities, landscapes, and maintenance. Physical features of green space are related

to functional attachment as it influenced and engaged park user to its surrounding. The functional attachment could be observed from the amount of familiarity, the period of engagement, dependency, satisfaction, and comfort [6]. To become functionally attached, the setting of surrounding must provide a feeling of being familiar with the physical environment, safe and enjoyable to its users. The overall results are presented based on the following functional attachments.

### 3.2.1 Park Visitation

The park visitors are mostly comprised of (>60%) male and (<40%) female (Fig. 5). Man tends to visit parks more frequent than women as most of them are involved in active recreation such as exercise or improve their physical fitness. On the other hand, the purpose of women visiting the parks is significantly more often for contact with nature. People persist coming to the park merely for active leisure such as exercising, improve their physical fitness and provide nature attraction. The green space provides various opportunities for physical activity, enjoyment of nature, social interaction and escape [21]. In addition, the dominant visitors to both parks are the young people of age between 21 and 29 years since this age group prefers active activities. They represent most of the respondents and were identified as significant users of parks for recreational purposes as they enjoy doing physical activities such as playing on equipment, playing games and sport, going for a run, or talking/socializing. The younger generation obviously had more free time to spend in public spaces such as a recreational park [6]. Likewise, the older age group between 30 and 39 years old showed a high percentage of visitors to the park as they were associated with active recreation such as exercising, jogging, playing sports in the park. Then again, the senior citizens (60 years old and above) preferred passive activities such as relaxing and walking.

There is also an explicit relationship that correlates park visitation with proximity, traffic connectivity, aesthetics scenery and personal safety [35]. Neuvonen et al. [40] points out that the number of visits to green space is linked to park

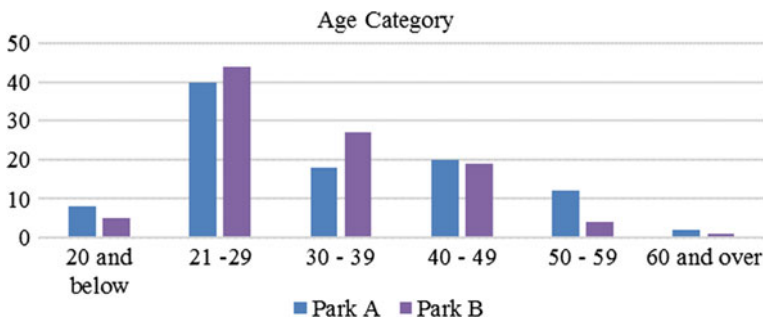


Fig. 5 Park visitation

characteristics and park quality. Park with better qualities attracts more visitors from a wider area and parks containing a variety of features and amenities may support a wider range of activities. Likewise, the two parks being assessed have shown a high number of visitations and designed to attract all races, ages, and cultures to socialize.

### 3.2.2 Travelling Distance and Mode of Transport

People go to the park for recreation and leisure activities that are associated with several factors such as demographic characteristics, type of physical activity to undertaken at the destinations and availability of local opportunities [34]. The distance traveled to a recreational park depends on the demographic characteristics, road network, and physical activity behavior and green space characteristics. It was observed that 35–40% of the park users travel within the range of 5–10 min to reach their respective parks (Fig. 6). They are mostly the local communities of the nearby areas. Motorbike is the most popular mode of transportation by visitors in Park B. It also correlates with the park visitors’ age as indicated in Fig. 5. Most of them are young people aged 21–29 years. Alternatively, 35–50% of them traveled by car in which they represent groups such as families, friends, relatives. Nevertheless, 4–8% of the park visitors still ride bicycles or walk to the park.

The findings show that motorbikes and cars are the most popular mode of transportation to the parks. This indicates that the park visitors traveled some distance to the parks. Furthermore, motorbikes and cars have been the major their means of transportation. The usage of bicycles or walking is less than 10% for both parks. Although, the park visits and proximity are inversely related i.e. the closer

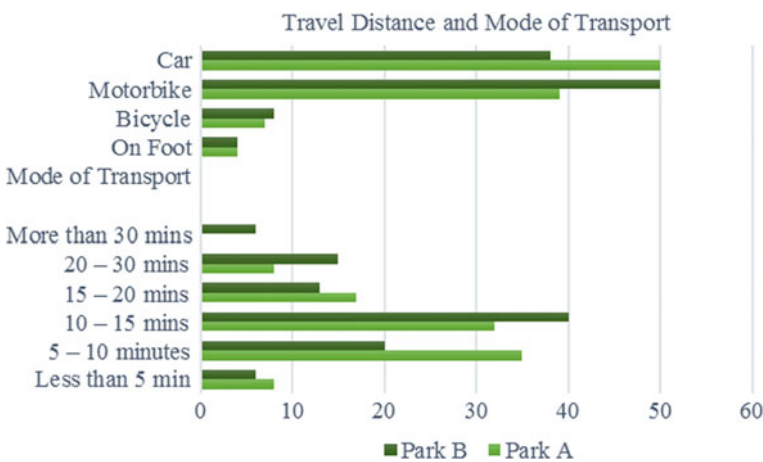


Fig. 6 Travelling distance and mode of transport

the distance attracts more people to visit. But, if the visitors liked coming to the park, then the distance traveled is not an important issue.

### 3.2.3 Frequency of Visit

The green space characteristics and environment are always associated with park use and physical activities [28, 34]. Martin et al. [33] claimed that the combined socio-demographic characteristics of the park visitors and the biophysical attributes of the greenspaces are important in influencing the frequency of visit. Besides, the accessibility and proximity are also related to the increased use of the green space. The results in Fig. 7 indicates than 40% visited the parks at least once a week, 17–28% on monthly basis, 8–25% visit on daily basis, and 9–12% coming to the park occasionally and rarely. The higher proportion of attendance during the weekend demonstrates that many of them visit the park to perform physical activity and other recreational opportunities or engaged in specific park features.

The frequency to daily, weekly or monthly use pattern correlates to the types and needs for recreational facilities. Furthermore, there are many other factors associated to higher levels of visitation such as the type of park, location of the park, good road networking, quality in terms of safety and good maintenance, the availability of a wide spectrum of recreational opportunities that include the facilities and amenities plus the natural beauty of the place. In general, both parks have easy access with good road networking with its surrounding and have all the characteristics that attract visitors to come frequently to the park. The users' frequency of park visits affects their functional attachment to the park such as the feeling of security and comfort with the environments.

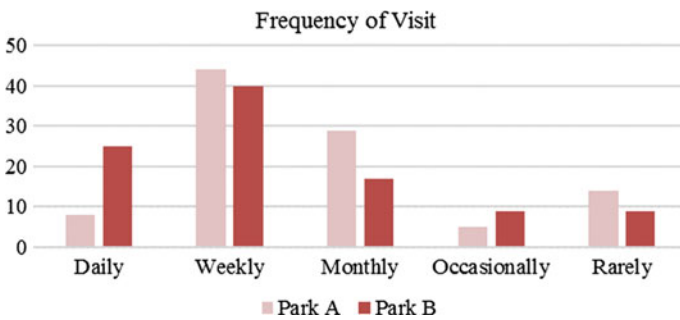


Fig. 7 Frequency of visit

### 3.2.4 Length of Stay and Safety Features

The length of stay in green space and safety parameters are significant in establishing and maintaining the quality of parks. The feeling of safety and security is one of the most important human needs as every person needs to feel safe and secure in order to act and move around freely without being scared and terrified of the environment. This is a tangible reflection towards the community and a major factor in the perception of park users. The time frame of staying in the park influences the visitors’ perceptions of personal safety which indicates the feeling of comfort and secured within the surrounding. The Malaysia Park, Amenity and Recreation Management Society highlights that safety aspect must be emphasized in the design of parks to attend the needs of visitors and sense of place [51]. Safety features of the park include the presence of lighting, law enforcement, location of park near the road, residential and commercial area, the presence of security such as police, security park and safety signboard.

The length of stay and safety indicates that 52% of the respondents come to the park with their family or friends to spend their leisure time mostly for 30 min–1 h (Fig. 8). About 38–40% of respondents spent 1–2 h at the site and 1–6% each spend their leisure time less than 30 min and between 2 and 3 h at the park. Only 25–47% of the park visitors claimed that they always felt safe to be in the park whereas 51–58% other responses said that they sometimes felt safe within the park. Only 2–16% of the respondents said they never felt safe and 1% had no opinion of safety aspects in the park. The length of stay is determined by many factors which relate to the physical and space qualities of the green space such as intangible characteristics, proximity, safety parameters and facilities provided in the park. The longer stay of park users indicates the wider range of activities and attractions

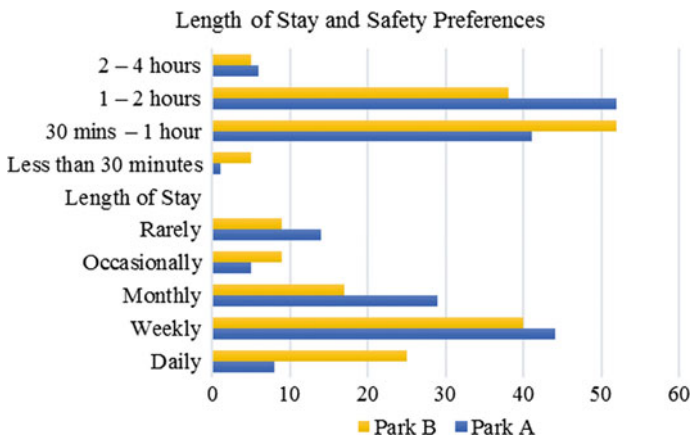


Fig. 8 Length of stay and safety features

within the green space. The safety parameters may involve the physical features in the park which gives perceived security to the users.

Apart from that, the length of stay is also influenced by the age group of visitors. From the findings also indicate that outdoor green spaces still seem to be important recreational venues among the local community. Park users coming with families or friends tend to spend more time in the park together to strengthen the family or friendship bonding among them rather than lone park user. Senior citizens are also likely to spend more time socializing among them after doing exercises.

### 3.3 *Prioritizing the Green Space Features Using AHP Decision*

The prioritized preference weight presents the ranking of green space features significantly in the selection “desirable” urban residential living areas. They were prioritized based on the needs of the public and the environment. The nine [9] features identified in the earlier section represents the decision criteria for a sustainable urban green space. Table 6 shows the final weighted criteria from the 20 decision makers determined by the geometric mean of the eigenvector method (EVM). Consequently, Table 7 summarizes the AHP survey results in the form of an individual score, the geometric mean, consistency ratio and ranking of the nine (9) selected criteria.

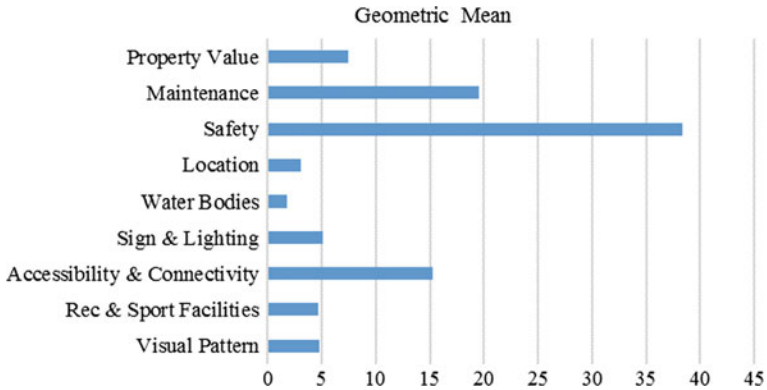
**Table 6** The final weighted criteria from the 20 DMs

AHP Analytic Hierarchy Process (EVM multiple inputs)				
K. D. Goepel Version 26.07.2014		Free web based AHP software on: <a href="http://bpmsg.com">http://bpmsg.com</a>		
n = 9	Number of criteria (9)		Scale: 1	Linear
N = 11	Number of Participants (20)		a: 0.1	Consensus: 61.10%
Objective: Ranking of Urban Feature Criteria				
Author Rabiah			Date 16-Jun-18	
Table	Criterion	Comment	Weights	Rank
7	Safety	Park Security	43.80%	1
8	Maintenance	Public Facility Maintained	17.80%	2
3	Access & Connect	Park Accessibility	10.30%	3
9	Property Value	Land value	8.90%	4
2	Rec & Sport Fac	Park facilities	6.60%	5
1	Visual Pattern	Aesthetics pleasant views	4.80%	6
4	Sign & Lighting	Park Information	3.70%	7
6	Location	Park Location	2.80%	8
5	Water Bodies	Ponds and wetlands	1.40%	9
Result	Eigenvalue		lambda: 12.558	
Consistency Ratio		0.37	GCI: 0.99	CR: 30.70%



**Table 7** Summary of AHP survey results

No	Decision maker	Criterion										Property value	C. R. (%)
		Visual pattern	Rec and sport facilities	Accessibility and connectivity	Sign and lighting	Water bodies	Location	Safety	Maintenance				
1.	DM1	5	5	15	5	2	3	39	20	7	7	7	7
2.	DM2	7	16	12	6	7	13	12	16	10	10	10	10
3.	DM3	3	6	21	12	8	12	9	25	4	4	8	8
4.	DM4	17	3	11	5	9	12	8	31	4	4	10	10
5.	DM5	12	7	6	6	7	7	23	24	8	8	8	8
6.	DM6	6	5	2	3	21	28	22	3	9	9	8	8
7.	DM7	21	11	4	3	4	14	13	22	7	7	10	10
8.	DM8	3	6	8	4	2	17	31	27	2	2	10	10
9.	DM9	4	25	17	4	3	36	2	5	2	2	8	8
10.	DM10	9	11	11	14	3	5	17	23	7	7	9	9
11.	DM11	17	21	9	16	3	11	16	4	3	3	9	9
12.	DM12	20	25	17	6	3	15	8	5	2	2	5	5
13.	DM13	6	1	5	8	1	5	34	34	6	6	12	12
14.	DM14	2	3	7	17	5	9	45	9	4	4	9	9
15.	DM15	12	5	11	10	7	8	20	18	10	10	4	4
16.	DM16	15	13	13	4	3	12	9	23	8	8	6	6
17.	DM17	3	5	4	2	28	18	25	11	4	4	7	7
18.	DM18	12	26	5	5	11	5	17	12	7	7	4	4
19.	DM19	3	4	3	9	2	5	33	25	16	16	9	9
20.	DM20	16	12	19	4	4	16	12	14	3	3	8	8
Geometric mean		4.75	4.65	15.31	5.09	1.81	3.06	38.37	19.51	7.47	7.47		



**Fig. 9** Ranking of green space features

Figure 9 is the histogram plot of the geometric mean representing the ranked green space features based on the criterion weights. It shows that safety criteria (38.37%) has been identified as the most preferred and was unanimously ranked highest by the decision makers in relation to urban green space (recreational parks) planning in Ipoh city. Safety features refer to people’s perceptions and feelings in recreational park issues that correlate with park activities. The result correlates with the qualitative assessment, where the safety parameter agreed with half of the respondents (park users) that raised the safety issues in the parks.

Perceptions of safety and security may affect the use of recreational areas where most of the visitors would stay 1–2 h in parks to perform their regular activities and enjoying the surrounding nature. The safety level can be upgraded through the placement of security guards, more lighting and having fencing around the parks. Hence, enhancing security and enforcement levels in the park has been the top priority issues considered by decision makers.

Maintenance/park condition is given the second priority (19.51%). The maintenance variables contribute towards community well-being and enjoyment which meets park users need. This relates to cleanliness and condition of green space which includes the maintenance of the facilities and amenities within the park area. McCormack et al. [34] highlight that poor maintenance and condition can discourage park usage and will negatively affect aesthetics, perceptions of safety, functionality and the overall perception of the park quality. Maintenance of green space is an issue raised frequently from park users who would like to see green space environment clean, tidy and requires careful consideration in the design of green spaces. The third prioritized criteria i.e. accessibility and connectivity (15.31%) is regarded as another key determinant of features in green space. Accessibility has been cited in numerous studies that include the distance from home or the form of network routes that “influence how pleasant it can be to move from one area to another, how much daylight, landscape, and beauty we can enjoy” [48].

The property value criterion (7.47%) is preferred by the decision makers since attractive landscapes in urban green space influences the housing prices and it represents the environmental factors that attract buyers. The presence of green space brings many benefits in housing areas in which these elements improve the quality of life, enhancing the environmental quality and conservation tool for sustainable development [53]. Signage and lighting (5.09%) present additional important finding as it forms part of the amenities in green space. This feature is considered as physical characteristics or hard landscapes in the recreation park and considered as the people's perception of safety by the decision makers. The presence of signage enhances perceived safety, friendly and caring others [27] while a lack of signs of human care may remind people of their own mortality and vulnerability to the forces of nature [31]. The visual pattern (4.75%) implies that it has similar important features contributing to the sustainable indicator of urban green space. The visual pattern indicates that people living and working in a busy urban area treasure urban spaces with plants, sunlight, and wind. It is correlated with the natural settings which establish the aesthetic quality of the environments such as plants combine with water elements that can significantly affect self-regulation and restorative healing experiences [2, 41].

Recreation and sports facilities are equally ranked as important (4.65%). The report by IFPRA (2013) has mentioned that facilities and amenities are important features related to park usage and activities. Recreation facilities such as basketball court, football field, jogging track, and children playground are the main attractions of attribute features in a park. Green space provided with recreation and sports facilities were found to be more efficient in stimulating or promoting physical activity [28]. The location of parks (3.06%) is directly related to accessibility and proximity that plays an important role in the local community of all ages and abilities. However, the residents associate the park's location with accessibility, and the proximity is demonstrated through the frequency of their visits and their self-leisure exercises. Nevertheless, as urban parks are places where city residents could experience the beauty of nature, breathe fresh air and socializing with friends, hence the travel distance does not affect people going to parks. Lastly, the water bodies (1.81%) contributed to the production of sustainable urban green space and ecosystem. This feature is significant design elements that enrich the natural landscape and improve the spatial quality of human needs and the surrounding environment.

### ***3.4 The Correlation Between Preference and Prioritization***

The correlation between the qualitative assessment (the urban resident's responses according to their social preferences and experiences of the two parks in Ipoh city, and the relative preference of decision makers towards criteria affecting the design of green space feature attributes) is described in Table 8.

**Table 8** Correlation between the qualitative assessment and the prioritization

No	Prioritization by the decision makers	Preferences by the park users
1.	Safety	Perception of safety, length of stay
2.	Maintenance	Quality and facilities
3.	Accessibility	Mode of transport
4.	Property value	Frequency of visits
5.	Signage and lighting	Aesthetics
6.	Visual pattern	Aesthetics
7.	Facilities	Quality and facilities
8.	Location	Travel distance
9.	Water bodies	Aesthetics

It can be summarized that the safety attribute feature maintained as the most important feature both by the experts and user's perception. It indicates that park activity correlates with the sense of safety. Maintenance and condition relate to park usage and perception of park quality. Green space features require consistent maintenance which includes the collection and removal of waste, the repair of damaged or worn items, the preservation, and conservation of human-made and vegetation features including replacing damaged plants, tree surgery, pruning and grass cutting, quality of pond water.

Accessibility and connectivity are important with regards to the form of network routes that influence people to visit and movement in the park. Inclusively, the other features attributes have the important roles in sustaining urban green space as they are associated with the three main values in human life relationship within the urban green space features i.e. environmental values, social values, and economic values. Thus, the urban green space features must include the environmental characteristics of parks which cover the geographic areas and diversity that displayed the mixture of uses and users of the area. The geographic areas conversely comprise of the activity areas in the green space, the overall park and the surrounding neighborhood.

## 4 Conclusions

This paper assessed the satisfactory level of the park visitors with regards to current green features in the study area. The satisfaction level has a correlation between the urban green space features with the visitor attraction and activities in their quest for healthiness and a place of comfort at all age groups. The significant feature attributes such as natural setting (visual quality), facilities, design, accessibility, location, water element, safety, and maintenance represent the important factors influencing the park's usage and the park's impact (number of visitors). The mix of natural and human-made elements has proved to encourage the attraction and

visitation to urban green spaces. The availability of natural elements such as trees, flowers, and water features provide important insights towards the recreation and parks preferences that should be provided. Prioritizing the features of urban green space based on the expert decisions using AHP-decision making model is perceived as a novel approach towards the planning and development of urban green spaces. Eventually, the park safety features unanimously represent the most important indicator as it indicates that park activities correlate with the sense of safety. Inclusively, the order of priority for the sustainable park planning must include other features such as maintenance, accessibility, property value, signage and lighting, visual pattern, facilities, location, and water bodies. It is apparent that sustainable urban green space features are very significant to the urban environment, landscape, and community recreation. They contributed towards the three predominant values of human life which are environmental, social and economic benefits. Their close relationships with human life were in terms of characteristics, functionality and its outcome towards the appearance of recreational parks.

In conclusion, the findings of this paper provide significant resources for social and urban community development i.e. confidence level and increase the number of park users. It will help in the implementation of sustainable indicator policy on the future urban green space (parks and recreations) in giving the correct priority to the features.

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