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Into Inclusive Urban Spaces: Insights from User Behavior and Perceptions in Cagayan de Oro City, the Philippines

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ABSTRACT

Urban green public spaces (UGPS) are essential for promoting social inclusion, well-being, and sustainable urban development. However, uneven spatial distribution often leads to unequal user experiences and perceptions. This study examines how spatial equality influences user behavior and attitudes toward UGPS in Cagayan de Oro City, Philippines. Using a multi-method approach, the study integrated a citywide accessibility assessment of 7,164 grid cells with survey data from 417 park users. substantial spatial inequality, with 95.7% of grid cells classified as having no access to UGPS and a Gini coefficient of 0.988, indicating a highly uneven distribution of accessibility. Despite these disparities, higher accessibility was generally associated with more frequent and longer visits. Perceived access and linkages consistently influenced visitation frequency and duration, while comfort, image, and sociability, were associated with longer stays. shape usage patterns, highlighting complex relationships. Findings emphasize that inclusive use depends on both spatial distribution and perceived quality, not solely spatial equality. The study highlights the importance of integrating accessibility planning and user-centered placemaking strategies to promote equitable and inclusive UGPS.

1. INTRODUCTION

Urban green public space (UGPS) are essential components of sustainable urbanism because they provide ecological services, support recreation, and foster social inclusion. However, sustainability depends not only on the amount of green space but also on its design, accessibility, and capacity to accommodate diverse users. Scholars emphasize that green spaces act as social infrastructures linking ecological health with community vitality, influencing physical activity, mental health, and civic engagement [1, 2]. The challenge for rapidly urbanizing cities, therefore, lies in maintaining spatial balance, ensuring that UGPS remain equitably distributed and inclusive despite pressures from densification and land conversion.

Although urban greening efforts are more prevalent in developed nations, similar studies are needed in the Global South, particularly in Asia, to address inequities in the availability, accessibility, and quality of UGPS [3, 4]. In these regions, where rapid urbanization and social inequality converge, access to quality green spaces is often produce uneven access, with disparities observed between income groups, neighborhoods, and social classes [5, 6]. As built-up areas intensify, green space provision often declines, resulting in unequal exposure to environmental and social benefits [7]. Ensuring that UGPS remain equitably distributed and socially inclusive is therefore critical for sustainable urban development, particularly in rapidly growing cities across the Global South. Understanding the underlying processes driving these inequities is essential to inform effective urban planning strategies.

In response, urban scholars and practitioners advocate placemaking, a participatory, design-oriented approach that transforms ordinary spaces into meaningful places [8, 9]. Placemaking recognizes the interplay between form, function, and experience, creating spaces that are not only accessible but also sociable and emotionally resonant [10, 11]. Aesthetic and architectural expressions can reinforce urban identity [12], while place-based experiences extend beyond function to encompass cultural and touristic value [13]. Collectively, these perspectives frame UGPS as dynamic environments that connect ecology, culture, and community. Ensuring spatial equality, defined as the fair distribution of green spaces relative to population and need, is therefore central to sustainable and inclusive urban planning.

Although numerous studies have examined spatial accessibility to UGPS and its influence on visitation patterns, much of the literature has focused on objective measures of access, such as proximity, distance, and service coverage.

Conversely, studies on perceived park quality have largely emphasized user satisfaction and place experiences independent of broader accessibility conditions. Consequently, the combined influence of objective spatial accessibility and users' perceptions of park quality on park use behavior remains insufficiently understood. This gap is particularly evident in rapidly urbanizing cities of the Global South, including the Philippines, where empirical evidence integrating spatial and perceptual dimensions of UGPS use remains limited.

To address this gap, the present study examines how spatial accessibility and perceived park quality jointly shape user behavior and experiences in UGPS in Cagayan de Oro City, Philippines. By integrating a citywide spatial accessibility assessment with survey-based measures of perceived park quality, the study investigates how accessibility and perceptions of sociability, comfort and image, uses and activities, and access and linkages relate to visit duration and visit frequency. The findings contribute to a more comprehensive understanding of UGPS utilization and provide evidence to inform placemaking strategies that promote equitable, accessible, and socially inclusive UGPS.

2. LITERATURE REVIEW

2.1 Urban transformation and the changing role of urban green public spaces

Urbanization has emerged as a defining force reshaping the physical and social structure of contemporary cities. Rapid land conversion and spatial intensification have transformed agricultural and natural landscapes into industrial and commercial areas, altering the configuration of residential, work, and recreational spaces [14, 15]. This transformation has led to the fragmentation and reduction of UGPS, affecting ecological functions, social value, and contribution to human well-being [16]. Understanding these patterns is essential for the effective planning and management of UGPS, particularly in promoting environmental resilience and supporting inclusive and accessible urban experiences [17, 18].

Rapid urbanization continues to transform the physical and social fabric of cities, especially in developing regions where land conversion and densification reshape community environments [15, 16]. These transformations often result in the decline of UGPS quantity and quality, threatening cities' ability to foster sustainable living and well-being. Compact development can enhance efficiency but also risks reducing green space per capita, particularly in high-density areas [19]. Similarly, the shift from agricultural to industrial and service economies reshapes urban form and lifestyle, leading to unequal spatial and social conditions across neighborhoods [14].

2.2 Placemaking, perceived quality, and the human experience of space

Poor maintenance, insufficient amenities, or perceived insecurity discourage participation in UGPS, particularly among vulnerable groups [20]. Placemaking thus bridges spatial form and lived experience. The Project for Public Spaces [11] identifies four key qualities of successful public spaces, access and linkages, comfort and image, uses and activities, and sociability, which together define a space's ability to attract, retain, and connect users. The four qualities in place matrix serve not only as indicators of design quality but also as reflections of how users perceive value and belonging within UGPS. Integrating these perceptual dimensions into UGPS evaluation links subjective experience with behavioral outcomes, enabling a more holistic assessment of inclusivity and performance [21].

Empirical evidence further highlights the importance of perceived quality in shaping UGPS use and benefits. For example, a study in the United Kingdom claims that spending two hours a week in neighborhood parks and other green areas, either all at once or in small amounts, can considerably enhance self-reported health and well-being [22]. These qualities underpin the concept of placemaking, a people-centered process that transforms physical settings into meaningful places through participatory design and community engagement [9, 23, 24]. Placemaking emphasizes that a place's identity and function arise from human experience rather than mere physical form.

These insights underscore that human experience is not only shaped by design and perception, but also by the spatial conditions that structure access and opportunity within the city. The notion of place image, the visual, reputational, and emotional representation of a location, further extends this understanding of how people relate to UGPS. A space's aesthetic appeal and perceived safety shape attachment, visitation, and investment decisions [25, 26]. Through participatory mapping and public-participation GIS, researchers have integrated social perceptions with spatial data to visualize users' experiences and preferences [21, 27, 28]. These methods reveal that spatial form and social meaning are deeply intertwined: when design fosters comfort, safety, and opportunities for interaction, it enhances both perception and use.

2.3 Accessibility, spatial equality, and inclusive urban experience

Accessibility stands at the center of spatial justice and inclusive urban planning. It denotes both the physical ease of reaching destinations and the social opportunity to participate in public life [29]. Yet accessibility and equality remain unevenly distributed. High-density and low-income districts frequently lack sufficient green space, whereas affluent areas enjoy oversupply [6]. Global frameworks such as the World Health Organization's urban-health guidelines and Sustainable Development Goal 11.7 advocate universal access to safe, inclusive, and accessible green spaces within a five-minute walk [30]. Despite these standards, empirical studies continue to expose gaps caused by governance weaknesses, spatial-planning inconsistencies, and socio-economic inequities [20].

Importantly, accessibility alone does not guarantee use. Behavioral engagement depends on both spatial and experiential qualities, such distance and connectivity, as well as comfort, safety, and sociability. Well-maintained amenities such as shaded seating, lighting, and recreational facilities enhance users' sense of safety and encourage longer stays [2]. Conversely, fear of crime, environmental stressors, or lack of maintenance can reduce visitation even in well-connected parks [31, 32]. Inclusivity therefore emerges from the intersection of spatial equality, the fair distribution and access of green spaces, and perceived quality, the subjective evaluation of comfort, image, and sociability. For UGPS to function as equitable commons, urban policies must integrate spatial equity with user-centered design and governance mechanisms that sustain participation and trust.

3. MATERIALS AND METHODS

3.1 Conceptual framework

This study conceptualizes users' engagement with UGPS through a framework linking greenspace exposure, perceived place quality, and inclusiveness (Figure 1). Greenspace exposure reflects both spatial accessibility and users' actual behavior (frequency and duration of visits), representing the opportunity and extent of contact with UGPS. Exposure influences perceived place quality, captured through four placemaking dimensions: sociability, access and linkages, uses and activities, and comfort and image. These perceptions shape how users evaluate the experience and functionality of UGPS. Finally, inclusive engagement outcomes are examined by comparing exposure and perceptions across demographic and socio-economic groups, reflecting how different populations benefit from UGPS. Overall, the framework positions exposure as a driver of perception, and perception as a pathway to inclusive and equitable participation in UGPS.

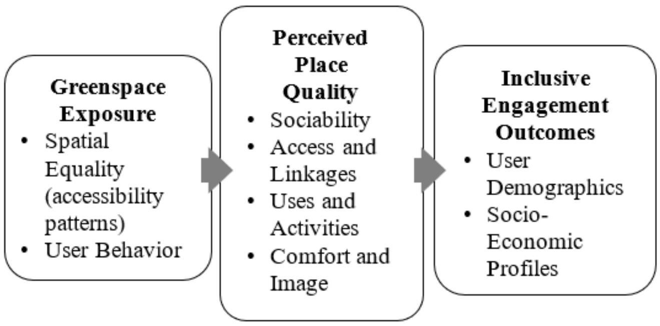


Figure 1. Conceptual framework linking greenspace exposure, perceived place quality, and inclusive engagement, adapted from previous studies and planning frameworks [11, 33]

3.2 Study area

The study was conducted in Cagayan de Oro City, Philippines, one of the highly urbanized cities considered as the primary entryway to Northern Mindanao and has been the region's center for commercial, industrial, and political growth. The ecology of the city is a combination of coastal and highland landscapes. The city is characterized by more extensive edge and outlying expansion compared to other metropolitan centers like Manila and Cebu, resulting in a less compact and more spatially fragmented urban form [34]. Cagayan de Oro's rapid horizontal growth presents a more complex environment for integrating green spaces into the urban fabric. Its expansion has largely followed an east–west corridor along the coastline, with new edge patches concentrated west of the Cagayan River and outlying development spreading toward the southern interior. This pattern of spatial dispersion offers an ideal setting to examine how spatial equality interacts with residents' perceptions and usage behavior, providing insights into the challenges and opportunities of fostering inclusive and equitable green space experiences amid rapid urban growth.

3.3 Data collection and sources

3.3.1 Primary data

Primary data were collected through on-site convenience sampling at the four UGPS. A total of 417 respondents were surveyed on-site across the four UGPS between July and September 2023, covering both weekday and weekend periods to capture a broad cross-section of users. Although non-probabilistic, this sampling approach was appropriate for the dynamic flow of park visitors and allowed the survey to reflect actual user presence during data collection. To reduce potential sampling bias, surveys were collected across multiple park locations, during both weekdays and weekends, and at different times of day, including peak visitation periods.

Sociodemographic profile, including age, gender, and income, was recorded and subsequently examined to assess the diversity of respondents across survey locations and periods (Table A1). However, because convenience sampling was employed, the sample cannot be assumed to be statistically representative of the broader urban population or individuals who do not use UGPS. Therefore, the findings should be interpreted as reflecting the experiences and perceptions of surveyed UGPS users rather than all city residents. Participation was voluntary, informed consent was obtained prior to participation, responses were collected anonymously, and no personally identifiable information was recorded in accordance with standard ethical research practices.

The user survey was conducted across four major public parks in Cagayan de Oro City, Gaston Park, Plaza Divisoria, Vicente de Lara Park, and Rio de Oro Boulevard, each representing a distinct typology and function. Gaston Park, located in the historic civic core, features open lawns and a central fountain that attract visitors for cultural and community activities. Plaza Divisoria, a linear park embedded within a commercial district, functions as a vibrant pedestrian zone for students, workers, and families. Vicente de Lara Park, shaded by mature trees near the Provincial Capitol, serves as a quiet refuge for employees and nearby residents. Meanwhile, Rio de Oro Boulevard, a newer riverside park along the Cagayan River, offers wide walkways and viewing decks frequented by joggers, cyclists, and families.

A structured questionnaire was developed to operationalize the study's conceptual framework by capturing respondents' sociodemographic characteristics and their perceptions of UGPS performance across four placemaking dimensions: access and linkages, comfort and image, uses and activities, and sociability. The instrument was adapted from established public-space quality frameworks [35, 36] and consisted mainly of closed-ended items. The questionnaire included three components relevant to this analysis: (1) demographic and socio-economic characteristics; (2) park-use behavior, including purpose of visit and frequency of use; and (3) perceived UGPS quality, assessed using a Likert-scale instrument across four placemaking dimensions—access and linkages, comfort and image, uses and activities, and sociability (Table 1). These sections collectively enabled the questionnaire to align empirical measures with the study's conceptual framework.

Perception items were aggregated into four latent constructs, sociability, access and linkages, uses and activities, and comfort and image, providing a multidimensional measure of park performance aligned with the study's emphasis on inclusive and user-centered green space planning.

Table 1. Likert scale interpretation and mean score classification

Interpretation	Scale	Lower Limit	Upper Limit
Very Low	1	1	1.80
Low	2	1.80	2.60
Moderate	3	2.60	3.40
High	4	3.40	4.20
Highest	5	4.20	5.00

3.3.2 Secondary data

The analysis used secondary data obtained from the City Planning Office. The index reflects the relative sufficiency of UGPS access by incorporating population distribution, 300-meter service catchments, and buffer-based travel distances. To enable grid-based analysis, a uniform fishnet grid with 100 m × 100 m resolution was used, resulting in 7,164 grid cells [37, 38]. The centroid of each grid cell was used as the representative spatial unit for analyzing UGPS accessibility and spatial autocorrelation. This 100-meter resolution was selected to reflect the fine-scale urban variation typical in densely built environments. The fishnet centroids served as reference points for associating spatial characteristics with each grid cell.

Spatial accessibility to UGPS was assessed using the buffer-based two-step floating catchment area (2SFCA) method. A 300-m Euclidean buffer was generated around each UGPS to represent a walkable catchment area. Residential grid cells located within the buffer were considered to have access to the corresponding UGPS. Population estimates were assigned to each residential grid cell, and the total population within each catchment was used to calculate a supply-to-demand ratio. This is expressed in Eq. (1), where R_j is the supply-demand ratio for UGPS *j*; S_j as supply (area of UGPS *j*), P_k as the population in residential grid cell *k* within the buffer; d_{kj} is the distance from the grid cell to UGPS *j*; and d_0 is the catchment threshold.

$$R_j = S_j \Big/ \sum_{k \in \{d_{kj} \leq d_0\}} P_k \tag{1}$$

This ratio was distributed to all intersecting grid cells, with overlapping values from multiple UGPS summed to produce an accessibility score (A_i) for each cell. Accordingly, the accessibility score of location *i* is expressed in Eq. (2) as follows:

$$A_i^F = \sum_{j \in \{Dist\ (i,j) \leq d_0)} R_j \tag{2}$$

The resulting spatial surface captures walkable UGPS accessibility across the urban landscape, enabling identification of areas with insufficient green space provision. These scores then serve as the basis for evaluating the spatial equality of UGPS access across the study area.

The accessibility to the UGPS in each residential area was evaluated using Eq. (3) to observe their relative accessibility index (E_i) level, where R_j is the supply-demand ratio and max (R_j) is the maximum supply-demand ratio between UGPS and population demand; A_i is the accessibility score for each residential unit. The classification used in this study is adapted from related research with a six-level typology based on the alignment between UGPS supply and population demand (Table 2) [39]. To provide an overall measure of distributional inequality the Gini coefficient was calculated using the grid-level accessibility scores derived from 2SFCA.

$$E_i = \frac{max(R_j)}{max(A_i)} \times A_i \tag{3}$$

Table 2. Interpretation of six levels of the UGPS accessibility index

Accessibility Level	E_i Value Range	Interpretation
No Access	$E_i = 0$	No UGPS supply available to meet population demand
Very Poor Access	$0.25 > E_i > 0$	Extremely low supply relative to high demand
Poor Access	$0.5 > E_i \geq 0.25$	Limited supply relative to demand
Moderate Access	$0.75 > E_i \geq 0.5$	Supply present but not yet sufficient to meet demand
Adequate Access	$1 \geq E_i \geq 0.75$	Supply generally meets demand
Overserved	$E_i > 1$	Supply exceeds local demand (overconcentration)

3.4 Data analysis and methods

A two-step factor score regression (FSR) approach was used to examine how spatial accessibility influences perceived place quality and how these perceptions in turn shape visiting behavior, while considering demographic variations. The approach was selected because the study involved validated latent perception constructs, objective spatial accessibility measures, and categorical behavioral outcomes (visit duration and visit frequency). Although Structural Equation Modeling (SEM) can simultaneously estimate measurement and structural relationships, integrating multiple latent constructs with multinomial behavioral outcomes and additional observed covariates would substantially increase model complexity and estimation requirements. Furthermore, preliminary model estimation encountered convergence difficulties due to the limited number of park-level units represented in the dataset. Therefore, a two-step FSR approach was adopted as a more parsimonious and robust alternative. By separating the measurement and structural components, FSR reduces sensitivity to model misspecification, improves estimation stability, and facilitates the incorporation of validated latent constructs into subsequent regression analyses [40]. This method involves two main components, factor score extraction and subsequent regression analysis or path modeling [40, 41].

Following the two-step approach are the (1) measurement model through confirmatory factor analysis (CFA) and generated factor scores, (2) used regression-based path modelling to test hypothesized relationships among spatial accessibility, perceived quality, and user behavior (Figure 2) [42].

Step 1 involved estimating the measurement model through CFA. Model adequacy was assessed using threshold values of factor loadings 0.5–0.7, Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI) ≥ 0.90, Root Mean Square Error of Approximation (RMSEA) ≤ 0.08, and Standardized Root Mean Square Residual (SRMR) ≤ 0.08 [43, 44], internal consistency, confirming satisfactory convergent and discriminant validity. Items with weak loadings were removed, and standardized factor scores were generated for subsequent regression analyses. Model diagnostics, including likelihood-ratio tests, Pseudo R^2, and multicollinearity checks (VIF < 5), were employed to ensure robustness. The validated latent constructs were (Access & Linkages, Comfort & Image, Uses & Activities, Sociability) transformed into standardized factor scores. These continuous variables represent respondents' overall perceptions of UGPS quality and were retained as predictors in the multinomial logistic regression (MLR) models.

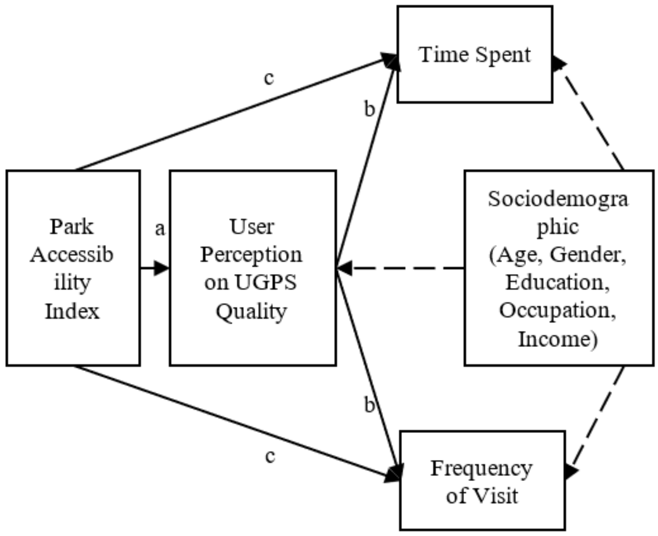


Figure 2. Path analysis model of UGPS accessibility, perceptions, and user behavior

Step 2 is regression-based path modeling that assessed the structural pathways linking spatial accessibility, perceived quality, and user behavior. Firstly, ordinary least squares (OLS) regression models were estimated to test whether park-level spatial accessibility predicted each perceived quality dimension (Path A). This established whether objective spatial equality translated into differences in perceived performance.

Subsequently, two multinomial logistic regression models were then estimated to examine how spatial accessibility, perceived quality, and socio-demographic characteristics jointly influence park use behavior (Paths B and C). The first model predicted the duration of park visits (short < 2 hours, medium 2–4 hours, long > 4 hours as reference), while the second predicted visit frequency (light, moderate, heavy as reference). Predictor variables included the four perception factor scores, the spatial accessibility index, and socio-demographic characteristics. Odds ratios with 95% confidence intervals were computed, and overall model fit was evaluated with likelihood-ratio chi-square tests and Nagelkerke pseudo-R^2.

Although the Test of Parallel Lines for the time spent variable yielded a non-significant result ($\chi^2 = 24.094$, df = 19, p = 0.193), indicating that the proportional odds assumption was satisfied, the behavioral categories in this outcome ("less than 2 hours," "2–4 hours," and "more than 4 hours") may not reflect uniform transitions in user behavior. Short, medium, and long visits can represent qualitatively different patterns of park use rather than successive levels along a single underlying scale. The MLR category distributions are provided in Table A2. Therefore, a MLR model was employed instead of an ordinal approach. Although ordinal logistic regression was statistically permissible, MLR allows category-specific estimation by treating the outcome categories as nominal, thereby capturing distinct behavioral patterns without assuming that predictor effects are constant across thresholds. The highest category ("stayed more than four hours") was selected as the reference group, representing the desired behavioral outcome of prolonged park engagement. This specification enables clearer interpretation of factors that increase or decrease the likelihood of shorter stays relative to longer ones, aligning with the study's objective of examining determinants of park use behavior.

4. RESULTS

4.1 Citywide spatial accessibility and equality of UGPS

Figure 3 shows the spatial distribution of the six accessibility index levels (Ei), which highlights the imbalance between population demand and UGPS supply. Among 7164 grid cells analyzed, 95.7% were categorized as No Access indicating that the vast majority of the city lacks UGPS provision relative to population demand. Only a small share of grid cells fell under Very Poor Access (0.06%), Poor Access (0.06%), or Moderate Access (0.04%), further reinforcing the severity of undersupply. Notably, only 2 cells (0.03%) achieved Adequate Access, suggesting that spatial equity in UGPS provision is almost absent. Meanwhile, 289 grid cells (4.03%) were classified as Overserved, pointing to a localized overconcentration of UGPS.

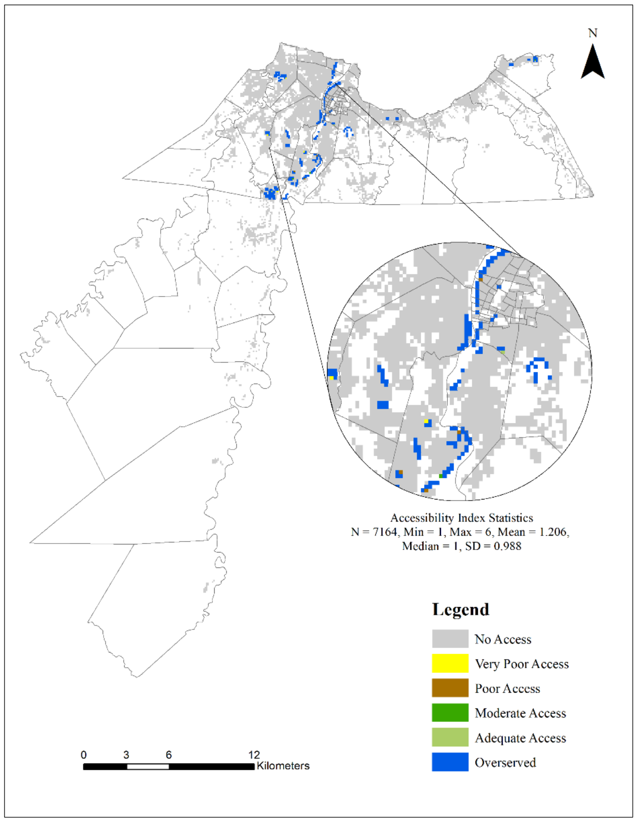


Figure 3. Spatial distribution of four levels of Accessibility Index (Ei) across the study area

Source: Shapefile obtained from City Planning Development Office, 2023. Population data obtained from Philippine Statistics Office, 2020. Processed using 2SFCA method in ArcMap 10.7.

The descriptive statistics supports this imbalance, with a mean accessibility level of 1.21 and median of 1.00, both corresponding to the No Access category. The high skewness (4.623) and coefficient of variation (CV = 81.99%) further underscore the high variability and concentration of accessibility in only a few grid cells. This pattern is also consistent with the high Gini coefficient (0.988) confirming the prevalence of distributional inequality in UGPS accessibility across the study area. These findings highlight a significant spatial disparity in UGPS provision, calling attention to the urgent need for redistributive planning strategies to improve access equity.

4.2 Park user's profile, use patterns, and perceived quality

The characteristics of park users are described through their demographic profiles, visit frequency and duration, motivations for park use, and perceptions of park quality. Understanding these baseline patterns clarifies how different user groups interact with the surveyed UGPS and supports the interpretation of behavioral determinants.

4.2.1 Socio-demographic characteristics

The survey sample comprised predominantly female respondents (59.3%) with males representing 40.7%. Age distribution was concentrated among young adults, with 42.5% aged 18–25 years old group (42.5%), followed by 26–44 years (23.8%) and those 18 years or younger (20.9%), indicating that UGPS primarily serve as recreational and social spaces for younger populations. This reflects that most park users are young adults and students, suggesting that UGPS serve as key recreational and social spaces for younger populations.

More than half of the respondents attained college-level or higher education (37.2% college level, 21.8% college graduates, and 1.4% postgraduate), while only a small portion had primary education (5%). This indicates that UGPS users generally have moderate to high educational backgrounds, consistent with their proximity to educational institutions in the study area. Moreover, the largest group of users were students (51.8%), followed by self-employed individuals (17.5%), private company employees (14.4%), and government employees (11.8%). This suggests that UGPS are frequented primarily by young, studying populations, with working adults representing a smaller share of visitors.

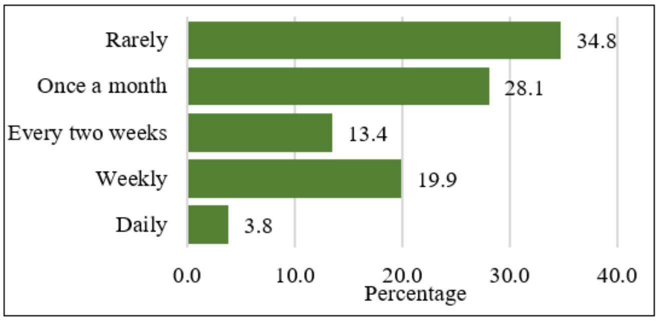
Over half of the respondents (51.9%) belonged to households earning less than 10,957 PHP per month, followed by 10,957 – 21,914 PHP (25.5%). Only a few respondents reported incomes above 76,699 PHP. This shows that a majority of UGPS users come from low- to lower-middle-income groups, emphasizing the importance of public open spaces as affordable leisure environments. Most respondents (72.3%) had lived in their community for more than 10 years, indicating that long-term residents are the primary UGPS users. This reflects the strong neighborhood connection and local familiarity with nearby parks.

The highest number of respondents was recorded at Rio de Oro Boulevard (28%), followed closely by Vicente de Lara Park (27%). These two parks attract a wide range of users due to their large spatial coverage, scenic setting, and availability of amenities for both recreation and relaxation. Plaza Divisoria accounted for 25% of respondents, reflecting its accessibility and popularity as a mixed-use open space surrounded by schools and commercial establishments. Meanwhile, Gaston Park represented 21% of the total sample, serving primarily as a cultural and historical gathering space in the city's downtown area. The relatively balanced distribution of respondents across the four parks suggests that the survey successfully captured diverse user groups and park contexts within the city.

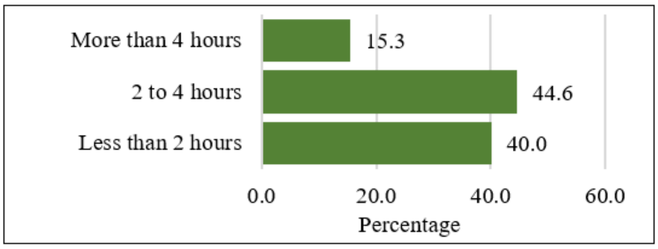
Overall, the survey results indicate that UGPS users are predominantly female, young adults, students, and long-term residents with low to moderate income levels. The largest number of respondents came from Rio de Oro Boulevard and Vicente de Lara Park, followed by Plaza Divisoria and Gaston Park, reflecting the balanced representation of both central and peripheral green spaces in the city. This overall profile underscores the role of UGPS as accessible venues for younger and less affluent populations, providing essential social, recreational, and environmental benefits within their communities.

4.2.2 User behaviour and purpose of visit

The result showed that most of the respondents used parks rarely (Figure 4(a)). About 28% of visit parks only once a month, whereas about 20% of respondents come weekly when time permits. Daily visits were uncommon, with only 3.8% come for a morning or afternoon walk. These patterns suggest that park facilities remain underutilized for much of the week, reflecting a predominantly leisure-oriented rather than routine use of the space.



(a)



(b)

Figure 4. Distribution of respondents' park visitation frequency (a) and duration of stay (b)

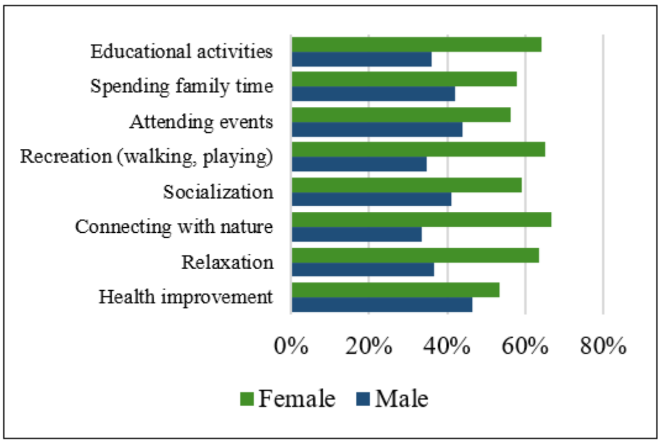
Source: Field survey of UGPS users in Cagayan de Oro City (n = 417), July – September 2023.

In terms of duration (Figure 4(b)), 44.6% of the respondents typically spent 2 to 4 hours per visit, representing the most duration category among park users. Meanwhile, 40% stayed for less than 2 hours, and only 15.3% remained for more than 4 hours. Together, these findings show that although visits are infrequent for many users, a considerable portion invest substantial time when they do visit, highlighting the park's role as a leisure and recreation setting.

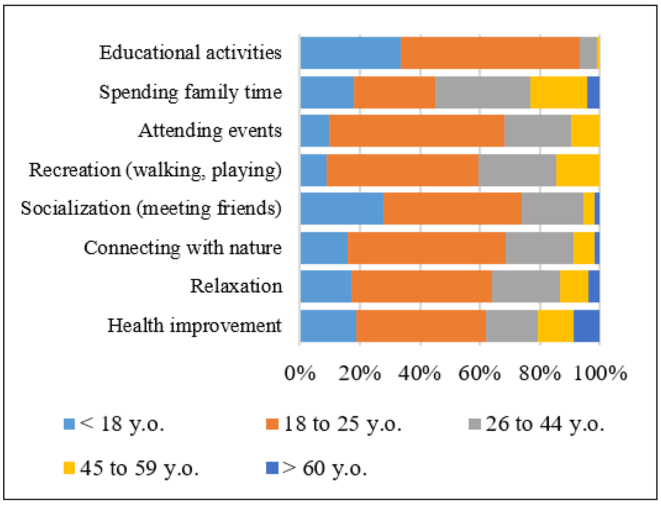
The gender-based comparison in Figure 4(a) shows that women consistently reported higher participation across most purposes of park use, particularly in connecting with nature

(66.7%), recreation (65.2%), relaxation (63.3%), and educational activities (64%). Male respondents also participated in wide range of activities, though at lower proportions, with their highest shares in spending family time (42.1%), attending events (43.9%), and health improvement (46.6%). The results point that women are more likely to express broader range of motivations for visiting the park than to men.

Across age groups, clear life-stage patterns emerge. Youth (<18 years) mainly visit for educational activities (33.7%) and socialization (27%), while young adults (18–25) visit for educational activities (59.6%) and attending events (58.5%). Adults aged 26–44 most often reported spending family time (31.6%) and recreation (26.1%), whereas mid-aged and older adults (45+) were more oriented toward relaxation and wellness-related purposes (Figure 5). These patterns suggest that park use reflects shifting needs across the life course, from learning and social interaction among younger users to family-oriented and wellness-focused activities among older groups.



(a)



(b)

Figure 5. Differences in park visitation purposes across gender (a) and age group (b)

Note: This graph represents a multiple-response question.
Source: Survey interview conducted to actual UGPS users on July-September 2023.

4.2.3 User perception on quality of UGPS

Understanding how users perceive the quality of UGPS is essential, as perceptions of safety, cleanliness, accessibility, and maintenance strongly shape user satisfaction and overall engagement. These perceptions can also vary across socio-demographic groups, influencing how different users experience and evaluate the parks. The perception items demonstrated strong internal reliability. Sociability items showed good internal consistency (α = 0.87), as did the accessibility and linkages (α = 0.88), and uses and activities (α = 0.87) dimensions. Comfort and Image exhibited excellent internal consistency (α = 0.93). These reliability values indicate that the perception checklist items were cohesive and measured their intended constructs effectively.

The analysis of perceived quality performance across the four UGPS reveals consistently low ratings across all dimensions of sociability, access and linkages, uses and activities, and comfort and image (Table 3). Among the parks, Vicente Lara Park (Park A) and Plaza Divisoria (Park B) obtained relatively better evaluations, with most factors classified as Low rather than Very Low. In contrast, Gaston Park (Park C) and Rio de Oro Boulevard (Park D) performed worst, with sociability assessed as Very Low ($\bar{x} = 1.72 - 1.76$). In terms of specific quality dimensions, Comfort and Image was rated consistently Low across all parks ($\bar{x} = 2.03 - 2.26$). Similarly, Access and Linkages and Uses and Activities also fell under the Low category in all sites ($\bar{x} = 1.85 - 1.98$). Overall, the findings underscore that the city's UGPS portfolio is underperforming in its ability to deliver high-quality experiences to residents.

Table 3. Overall perceived quality scores of the four urban green public spaces (UGPS)

UGPS Quality	Park A	Park B	Park C	Park D
Sociability (S)	1.84	1.80	1.76	1.72
Access and Linkages (AL)	1.98	1.98	1.85	1.98
Uses and Activities (UA)	1.91	1.94	1.88	1.96
Comfort and Image (CI)	2.18	2.03	2.26	2.12

Note: Park A = Vicente Lara Park; Park B = Plaza Divisoria; C = Gaston Park; D = Rio de Oro Boulevard.

4.3 Evaluation of perceived urban green public space quality

The CFA results indicated acceptable measurement model, with fit indices meeting recommended thresholds (χ^2 (242) = 812.269, $p < 0.001$; CFI = 0.916; TLI = 0.904; RMSEA = 0.075; SRMR = 0.0465). Of the 31 items initially tested, seven were removed due to low or unreliable loadings, resulting in a final set of 24 items, all with standardized loadings above 0.60 (Table 4). All four constructs demonstrated strong reliability (Cronbach's alpha = 0.830-0.918) and satisfying convergent validity, with average variance extracted (AVE) exceeding the 0.50 criterion. The discriminant validity was also supported, as Heterotrait-Monotrait (HTMT) ratios ranged from 0.719 to 0.792, below the conservative 0.85 cutoff. Overall, the measurement model showed good internal consistency, convergent validity, and discriminant validity, confirming that the perceived quality constructs were statistically sound and appropriate for subsequent regression analyses.

4.3.1 Spatial accessibility effects

After the confirmed validity and reliability of the constructs, a four linear regression analyses were conducted to assess whether the UGPS accessibility influenced each of the four perceived park-quality factors which are Sociability, Access and Linkages, Uses and Activities, and Comfort and Image. In mediation analysis, these regressions tested the "Path A" relationships from the independent variable (UGPS accessibility) to each mediator (the perception factors), while controlling for demographic covariates (e.g. income, education, and gender).

Table 4. Validity and reliability assessment of perceived UGPS quality constructs

Constructs	Variables	Estimates	t-value	C.R.	AVE	Cronbach's Alpha	Discriminant Validity			
							S	AL	UA	C
Sociability (S)	S 1	0.641	**	0.90	0.53	0.854	0.792	0.781	0.754	0.775
	S 2	0.669	15.578							
	S 3	0.678	11.762							
	S 5	0.813	13.502							
	S 6	0.809	13.449							
Access and Linkages (AL)	AL 1	0.737	**	0.93	0.55	0.882		0.770	0.744	0.764
	AL 2	0.705	17.303							
	AL 3	0.761	15.271							
	AL 4	0.798	16.034							
	AL 5	0.736	14.729							
	AL 6	0.712	14.23							
Uses and Activities (UA)	UA 1	0.727	**	0.92	0.58	0.879			0.719	0.738
	UA 2	0.741	20.31							
	UA 3	0.764	15.215							
	UA 4	0.792	15.789							
	UA 5	0.78	15.549							
Comfort and Image (CI)	CI 9	0.659	12.761	0.95	0.57	0.911				0.759
	CI 5	0.769	14.801							
	CI 4	0.745	14.359							
	CI 1	0.702	**							
	CI 3	0.789	15.178							
	CI 12	0.793	15.227							
	CI 11	0.762	14.684							
	CI 13	0.788	15.134							

Note: Model Fit Statistics (x^2 = 812.269, p < 0.001, df = 242; CFI = 0.916, TLI = 0.904, RMSEA = 0.075, SRMR = 0.0465).
** = items constrained for identification purposes.
C.R = Composite Reliability, AVE = Average Variance Extracted
Source: Field survey of UGPS users in Cagayan de Oro City (n = 417), July–September 2023

Table 5. Effects of urban green public space (UGPS) accessibility on perceived quality dimensions (Path A using linear regression)

Predictors	Sociability		Access and Linkages		Uses and Activities		Comfort and Image	
	B	SE	B	SE	B	SE	B	SE
Park Accessibility Index	0.001	0.001	0.001	0.001	0.000	0.001	-0.001	0.001
Age Group	0.005	0.027	-0.001	0.034	-0.026	0.034	-0.011	0.035
Gender	-0.066	0.048	-0.071	0.061	-0.101*	0.060	-0.128**	0.063
Education	-0.038	0.026	-0.045	0.034	-0.060*	0.033	-0.073**	0.035
Family Income	0.057**	0.028	0.086**	0.035	0.042	0.035	0.016	0.037
Occupation	-0.012	0.025	-0.017	0.031	-0.038	0.031	-0.018	0.032
R^2	0.020		0.025		0.022		0.024	
Adjusted R^2	0.005		0.011		0.008		0.009	
F (6,410)	1.368		1.788		1.528		1.649	
p-value	0.226		0.100		0.168		0.132	

Note: N = 417. All coefficients are unstandardized. The symbols ***, **, and * represent 0.001, 0.05, and 0.10 levels of significance, respectively.
Source: Survey responses from UGPS users, July–September 2023; analysis conducted in SPSS AMOS 30.

Table 5 shows the regression results for path A. The results provided no evidence that UGPS accessibility affects people's perceptions of quality. In all four models, UGPS accessibility's coefficient was not statistically significant for predicting any of the perception factors. In other words, higher UGPS accessibility index did not lead to higher perceived sociability, access and linkages, comfort and image, or uses and activities. Each model explained only a very small portion of variance in the perception outcomes (R^2 = 0.02 – 0.03), and none of the overall regression models was significant.

Although the independent variable (UGPS accessibility index) showed no effect, some demographic control variables had minor relationships with the perception outcomes. Some covariates related to perceptions such as family income positively predicted to Sociability with a very small model fit (R^2 = 0.020, F (6,410) = 1.368, p = 0.226) and Access and Linkages (R^2 = 0.025, F (6,410) = 1.788, p = 0.100). Meanwhile, while education and gender negatively predicted both Comfort & Image and Uses & Activities. Given the null Path A, indirect effects via perceptions are unlikely.

4.3.2 Predictors of park use behavior

The multinomial logistic regression model for time spent in the park showed a strong overall fit (χ^2 (38) = 151.106, p < 0.001) and explained 35% of the variation in visit duration (Nagelkerke R^2 = 0.350). With "> hours" as the reference category, the model reliably distinguished between short (<2 hours), medium (2–4 hours), and long visits (>4 hours) (Table

6 and Tables A2 and A3).

Comfort and Image were a significant predictor of visit duration. A one standard deviation (SD) increase in this perception was associated with a 92% decrease in the odds of a short stay (<2h) compared to a long visit (>4h) (OR = 0.079, CI [0.025–0.250], p = 0.007). A substantial effect was also observed for medium-length stays, with the odds of a 2–4-hour visit versus a > 4h visit decreasing by 74% (OR = 0.262, CI [0.094–0.734], p = 0.011). This indicates that visitors stay longer when the park is perceived as safe, comfortable, and visually appealing.

Meanwhile, Uses and Activities dimension exhibited the largest association with visit duration. Respondents reporting higher perceptions of available amenities, recreational opportunities, and activities were more likely to be classified into the shorter-visit categories than the longest-duration category (>4 hours). The odds of staying < 2 hours versus > 4 hours were substantially higher among respondents with higher Uses and Activities scores (OR = 579.841, 95% CI: [91.666–3667.821], p < 0.001), while the odds of a 2–4 hour stay versus > 4 hours were also elevated (OR = 22.968, 95% CI: [4.723–111.687], p < 0.001).

Table 6. Factors associated with time spent in urban green public space (UGPS)

Predictors	< 2 Hours VS > 4 Hours		2 to 4 Hours VS > 4 Hours	
	O.R. (95% C.I.)	***P*-Value**	**O.R. (95% C.I.)**	***P*-Value**
Perception:				
Comfort and image	0.079 (0.025 - 0.250)	0.000***	0.262 (0.094 - 0.734)	0.011**
Uses and activities	579.841 (91.666 - 3667.821)	0.000***	22.968 (4.723 - 111.687)	0.000***
Access and linkages	0.044 (0.008 - 0.247)	0.000**	0.173 (0.035 - 0.840)	0.031**
Sociability	0.278 (0.067 - 1.150)	0.077*	0.889 (0.246 - 3.211)	0.857
Accessibility:				
Park-level accessibility index	0.985 (0.974 - 0.996)	0.007**	0.982 (0.972 - 0.993)	0.001**
Age group:				
18 and below	7.012 (0.631- 77.876)	0.113	2.109 (0.297 - 12.004)	0.456
18 to 25 years old	4.165 (0.410 - 42.303)	0.228	2.084 (0.319 - 13.620)	0.443
26 to 44 years old	5.359 (0.577 - 49.763)	0.140	1.658 (0.276 - 9.978)	0.581
45 to 59 years old	2.972 (0.301 - 29.353)	0.351	1.013 (0.160 - 6.422)	0.989
60 and above (ref.)				
Occupation:				
Government employee	0.382 (0.051 - 2.874)	0.350	0.217 (0.034 - 1.395)	0.107
Private company employee	1.417 (0.182 - 11.037)	0.739	1.03 (0.158 - 6.731)	0.975
Self-employed	0.457 (0.069 - 3.036)	0.418	0.384 (0.068 - 2.172)	0.279
Student	0.277 (0.039 - 1.967)	0.199	0.253 (0.042 - 1.515)	0.132
Others (ref.)				
Gender:				
Male	0.653 (0.325 - 1.312)	0.231	0.74 (0.390 - 1.406)	0.358
Female (ref.)				
Education:				
Basic education	0.492 (0.195 - 1.242)	0.133	0.582 (0.258 - 1.313)	0.192
Technical-Vocational educ.	0.172 (0.023 - 1.316)	0.090*	0.187 (0.030 - 1.166)	0.073*
Higher education (ref.)				
Income Class:				
Poor-income class	7.107 (1.012 - 49.896)	0.049**	1.045 (0.239 - 4.574)	0.953
Low-income class	6.673 (0.886 - 50.239)	0.065*	0.92 (0.193 - 4.401)	0.917
Middle-income class	1.522 (0.200 - 11.612)	0.685	0.466 (0.099 - 2.198)	0.335
Upper-income class (ref.)				

Note: The symbols ***, **, and * represent 0.001, 0.05, and 0.10 levels of significance, respectively.
Reference Category: >4 hours
Ref.: Reference category; O.R.: Odds Ratio; -2LL: -2Log Likelihood
Source: Survey responses from UGPS users, July-September 2023; analysis conducted in SPSS 23.

However, additional diagnostic analyses revealed substantial multicollinearity among the perceived park-quality dimensions (VIF = 9.61 – 20.20) (Table A4). Consequently, the magnitude of the coefficient should be interpreted cautiously, as multicollinearity may have inflated the estimated odds ratio. Greater emphasis should therefore be placed on the direction and statistical significance of the relationship, which indicates that perceptions of available activities and recreational opportunities were closely associated with differences in visit duration.

Access and linkages appear to be a powerful determinant of how long visitors stay in the park (p = 0.001). Specifically, Higher perceived accessibility reduced the odds of a short stay by 96% (OR = 0.044, 95% CI: [0.008, 0.247], p < 0.001) and decreased the odds of a 2–4 hour stays by 83%. This suggests that users who found the park easy to reach and navigate tended to stay significantly longer.

Perceived sociability had a modest but meaningful effect (p = 0.041). Higher sociability scores reduced the odds of very short visits by 72% (OR = 0.278, 95% CI: [0.067–1.150], p = 0.077), though it did not significantly distinguish medium from long stays. Socially vibrant environments appear to encourage lingering but not necessarily multi-hour stays.

Importantly, result shows that the park-level accessibility index also significantly predicted visit frequency. Each one-unit increase in the accessibility index decreased the odds of a short visit by approximately 1.5% (OR = 0.985, 95% CI [0.974–0.996], p = 0.007) and the odds of a 2–4 hour stay by 1.8% (OR = 0.982, p = 0.001). More accessible parks therefore supported longer visits across all categories (OR = 0.982, 95% CI [0.972–0.993], p = 0.001).

The findings from the time-spent model demonstrate how differences in spatial accessibility and perceived park qualities are associated with the depth of on-site engagement. However, duration alone does not fully capture patterns of park use. To provide a more complete picture of user behavior, a second multinomial logistic regression model was fitted to examine the predictors of visit frequency.

The multinomial logistic regression model for visit frequency was statistically significant (χ^2 (38) = 92.167, p < 0.001), indicating that the predictors, as a set, reliably distinguish between light, moderate, and heavy park user. The model explained a moderate portion of the variance in visit frequency (Nagelkerke R^2 = 0.225). Three variables significantly predicted the frequency of park visits: perceived access and linkages, perceived sociability, and the spatial accessibility index (Table 7 and Table A5).

Table 7. Factors associated with the frequency of visits of urban green public space (UGPS) visits

Categories	Light User VS Heavy User		Moderate User VS Heavy User	
	O.R. (95% C.I.)	***P*-Value**	**O.R. (95% C.I.)**	***P*-Value**
Perception:				
Comfort and image	0.999 (0.432 - 2.313)	0.999	1.348 (0.583 - 3.118)	0.485
Uses and activities	1.090 (0.315 - 3.770)	0.892	1.788 (0.517 - 6.183)	0.359
Access and linkages	0.196 (0.055 - 0.700)	0.011**	0.64 (0.177 - 2.316)	0.496
Sociability	3.478 (1.148 - 10.533)	0.027**	0.752 (0.240 - 2.358)	0.625
Age group:				
18 and below	0.131 (0.017 - 0.998)	0.050**	0.401 (0.056 - 2.884)	0.364
18 to 25 years old	0.266 (0.037 - 1.902)	0.187	0.485 (0.073 - 3.247)	0.456
26 to 44 years old	0.563 (0.081 - 3.889)	0.560	1.344 (0.206 - 8.783)	0.757
45 to 59 years old	0.436 (0.057 - 3.317)	0.423	1.093 (0.158 - 7.549)	0.928
60 and above (ref.)				
Occupation:				
Government employee	0.299 (0.043 - 2.078)	0.222	0.133 (0.023 - 0.782)	0.026**
Private company employee	0.698 (0.107 - 4.534)	0.706	0.217 (0.038 - 1.233)	0.085*
Self-employed	0.333 (0.052 - 2.155)	0.249	0.21 (0.039 - 1.134)	0.070*
Student	2.2 (0.346 - 13.995)	0.404	0.505 (0.091 - 2.801)	0.434
Others (ref.)				
Gender:				
Male	0.827 (0.469 - 1.456)	0.510	1.01 (0.592 - 1.726)	0.970
Female (ref.)				
Education:				
Basic education	0.909 (0.416 - 1.987)	0.811	1.172 (0.562 - 2.444)	0.672
Technical-Vocational educ.	1.619 (0.362 - 7.252)	0.529	0.674 (0.132 - 3.441)	0.635
Higher education (ref.)				
Income Class:				
Poor-income class	1.626 (0.370 - 7.152)	0.520	0.709 (0.208 - 2.412)	0.582
Low-income class	2.528 (0.539 - 11.843)	0.239	1.232 (0.341 - 4.453)	0.751
Middle-income class	1.849 (0.391 - 8.750)	0.439	0.53 (0.142 - 1.972)	0.343
Upper-income class (ref.)				
Accessibility:				
Park-level accessibility index	1.005 (0.995 - 1.015)	0.302	1.015 (1.006 - 1.024)	0.001***

Notes: The symbols ***, **, and * represent 0.001, 0.05, and 0.10 levels of significance, respectively.
Reference category = Heavy User (daily-to-weekly visits)
Ref.: Reference category; O.R.: Odds Ratio; -2LL: -2Log Likelihood
Source: Survey responses from UGPS users, July-September 2023; analysis conducted in SPSS 23.

Higher perceived access and linkages substantially reduced the likelihood of being a light rather than a heavy user (OR = 0.196, 95% CI [0.055–0.700], p = 0.011), although it did not differentiate moderate from heavy users. The sociability factor also showed a significant overall effect (p = 0.004) but in the opposite direction: users who perceived the park as more sociable were more likely to be light users than heavy users (OR = 3.478, 95% CI [1.148–10.533], p = 0.027), suggesting that sociability attracts selective or occasional users rather than habitual visitors.

The sociability factor also showed a significant overall effect (p = 0.004) but in the opposite direction: users who perceived the park as more sociable were more likely to be light users than heavy users (OR = 3.478, 95% CI [1.148–10.533], p = 0.027), suggesting that sociability attracts selective or occasional users rather than habitual visitors. Unlike in the time-spent model, the Comfort & Image and Uses & Activities factors did not significantly predict visit frequency (p = 0.689 and p = 0.568), indicating that perceived aesthetic quality or amenity variety did not shape how often users visited the park.

The park-level accessibility index had a significant overall effect on visit frequency (p = 0.001). Interestingly, higher accessibility was associated with being a moderate user rather than a heavy user. Each unit increase in the accessibility index raised the odds of a respondent being a moderate user (once or twice a month visit) versus a heavy user by about 1.5% (OR = 1.015, CI [1.006–1.024], p = 0.001). The accessibility index did not significantly distinguish light users from heavy users (OR = 1.005, p = 0.302 for Light vs Heavy).

4.3.3 Socio-economic predictors of UGPS use

Household income emerged as the only demographic factor significantly associated with time spent in the park (p = 0.006). Poor-income users were substantially more likely to have short visits (<2 hours) compared to long ones (>4 hours), with odds more than seven times higher (OR = 7.107, 95% CI [1.012–49.896], p = 0.049). A similar trend was observed for low-income respondents (OR = 6.673), although this effect did not reach statistical significance (p = 0.065). These patterns suggest that socio-economic constraints may limit the ability of lower-income visitors to remain in parks for extended periods.

Occupation significantly predicted visit frequency (p = 0.002). Government employees were more likely to be heavy users than moderate users (OR = 0.133, CI [0.023–0.782], p = 0.026), and similar heavy-use tendencies were observed among private company workers and self-employed individuals (OR ≈ 0.21, p = 0.07 – 0.09). Students did not differ significantly from the reference group. These findings indicate that structured work schedules and proximity to the city's parks may support more regular use among employed respondents.

In contrast, most demographic variables, including age, gender, and education, were not significant predictors of either visit duration or visit frequency once other factors were controlled. Overall, the results show limited demographic disparities in visitation patterns, aside from income-related differences in stay duration and occupation-related differences in frequency.

5. DISCUSSIONS

5.1 Spatial and perceptual determinants of park use

Both stages of the factor score regression analysis (Paths B and C) showed consistent associations between spatial accessibility and pattern of park use, supporting previous studies that identify accessibility as a key determinant of visitation behavior [45, 46]. Interpreted as a contextual characteristic of the study parks, accessibility appeared to be associated with distinct behavioral mechanisms. Parks with higher accessibility were generally linked to more frequent visitation and longer engagement, suggesting that reduced travel effort, time, and cost may facilitate the integration of park use into everyday routines. This interpretation is consistent with the principles of the 15-minute city, which emphasize proximity to everyday destinations as a means of promoting active mobility, health, and well-being [47-50].

However, the results also indicate that accessibility alone does not fully explain patterns of park use. Although higher accessibility generally increased the likelihood of longer stays and more frequent visits, the heaviest users were not always those with the highest levels of accessibility. This finding suggests that habitual park use may be influenced by factors beyond physical proximity, including personal motivations, recreational preferences, and subjective well-being. While accessibility has consistently been identified as an important predictor of visitation behavior, previous studies have also shown that park use is shaped by psychological and experiential factors that may override spatial constraints among highly motivated users [51]. In contrast, accessibility may be particularly important for moderate users, whose visitation behavior appears more sensitive to reductions in travel barriers. These findings reinforce the notion that accessibility functions as an enabling condition for park use, while the intensity of engagement is ultimately shaped by a broader set of individual and contextual factors.

Taken together, these findings suggest that accessibility functions as an important enabling condition for park use, even though it does not solely determine patterns of engagement. This interpretation is particularly relevant in the context of the citywide accessibility assessment, which revealed substantial inequalities in the distribution of UGPS opportunities. From a spatial justice perspective, the significant influence of accessibility on visitation behavior indicates that unequal access to green spaces may translate into unequal opportunities to experience their recreational, social, and health benefits. Consequently, improving the equitable distribution of accessible UGPS remains a critical component of fostering inclusive and sustainable urban environments.

The perceived comfort and image, which includes safety, cleanliness, and aesthetic appeal, emerged as one of the strongest predictors of time spent in the park. This underscores that if people feel safe, comfortable, and pleased with the environment, they tend to linger and truly utilize the space, confirming that subjective experiences shape engagement [52, 53]. Users are more likely to relax, explore, and prolong their stay in a well-maintained and visually inviting park, underscoring that perceived quality and safety foster sustained use and strengthen the social and health benefits of UGPS [54].

The perceived variety of uses and activities within a park, encompassing recreational facilities, events, or amenities, showed a differentiated effect on user behavior. In the time spent model, a higher "uses & activities" score corresponded to significantly longer visits, aligning with the placemaking concept which suggests that diverse amenities can capture visitor interest and extend engagement period [24, 55, 56]. This finding indicates that visitors are likely to remain in parks longer when they perceive a broader range of recreational opportunities and supporting facilities. While longer visit duration should not automatically be interpreted as a positive outcome, the visitor-purpose analysis indicated that respondents primarily used the parks for recreation, relaxation, educational activities, attending event, and health-related purposes. This suggests that extended stays in the surveyed parks are more likely to reflect continued participation in park-related activities and engagement with the park environment. Nevertheless, the specific activities undertaken during extended visits were not directly examined.

However, this factor did not significantly influence visitation frequency, revealing an important distinction between attracting longer engagement and encouraging repeated use. The absence of a significant relationship with frequency suggests that diverse amenities alone may not be sufficient to establish habitual visitation. While facilities and activities may enhance the quality of the visitor experience and extend the duration of individual visits, regular park use may depend more heavily on factors such as accessibility, convenience, daily routines, and personal motivations. From a planning perspective, this finding implies that investments in recreational facilities and programming may improve visitor experience and prolong engagement, but may not necessarily increase visitation frequency unless complemented by broader improvements in accessibility, connectivity, and park management.

Meanwhile, perceived access and linkages also emerged as a consistent and powerful predictor of both the frequency and duration of park use. The findings indicate that when parks are perceived as easy to reach and navigate, through well-placed facilities, clear pathways, and strong connectivity, they not only attract more frequent visits but also sustain longer stays. This finding aligns with the prior studies emphasizing the role of accessibility in shaping both visitation and engagement [51, 57]. This dual influence underscores accessibility as a cornerstone of placemaking: well-connected parks foster habitual visitation patterns and prolonged engagement, thereby enhancing opportunities for social interaction, recreation, and restorative experiences [24, 55, 56]. Conversely, inadequate access or poor internal linkages may truncate both the regularity and depth of use, limiting the social and health benefits UGPS are intended to deliver.

Park quality has been identified as one of the most significant predictors of social interaction [54]. In this study, perceived sociability demonstrated a nuanced role in shaping park use, influencing visit duration and frequency in different ways. Users who viewed parks as lively, interactive, and socially engaging tended to report longer visit durations, suggesting that vibrant environments may contribute to more sustained use of park spaces [58-60]. However, higher sociability scores were also associated with greater odds of being a light rather than a heavy user, indicating that sociability does not necessarily translate into more frequent visitation.

This contrasting influence highlights an important distinction between engagement and habitual use. Higher perceived sociability was associated with longer visits, suggesting that opportunities for interaction, community participation, and social support may contribute to more engaging park experience. However, sociability was not associated with more frequent visitation, indicating that socially vibrant environments do not necessarily appeal equally to all users for routine park use. Some visitors may prefer quieter settings for relaxation, restoration, or solitary recreation, making highly social environments less attractive for routine use. Similar observations have been reported in previous studies suggesting that social interactions often cluster within specific areas and are context-dependent, suggesting that social interactions are often context-dependent and concentrated in specific settings, allowing sociability to deepen engagement without necessarily increasing visitation frequency [54, 61].

From a placemaking perspective, sociability transforms parks into meaningful places that foster deeper engagement during visits [11]. However, Social Exchange Theory reminds us that engagement is contingent on perceived costs and rewards [62, 63]. For some users, lively social settings provide strong incentives to interact, while for others they may feel overwhelming or situational. Consequently, sociability emerges as a paradoxical dimension of placemaking, enhancing the quality and depth of individual visits but not always translating into regular or routine use across groups.

5.2 Demographic patterns and inclusive engagement

Perceptions and use pattern varied significantly across socio-demographic groups. The finding revealed significant relationship between visitor income and time spent in parks where lower-income visitors experienced substantially shorter visits compared to higher-income groups. This pattern reflects previous findings linking economic disparities to uneven park use and engagement [64-66]. Interestingly, other study observed that higher levels of comfort with park environments among lower-income respondents, suggesting that positive perceptions of park quality do not necessarily translate into longer durations of use [67]. The findings highlight that urban parks are not equally accessible or utilized across income groups. While physical access may exist, effective participation remains hindered by social and economic barriers. From a spatial justice perspective, this finding highlights that equitable access extends beyond physical proximity. Although parks may be geographically accessible, lower-income individuals may face constraints related to work schedules, transportation costs, caregiving responsibilities, or limited leisure time that reduce their ability to fully benefit from these spaces. Consequently, equal spatial provision does not automatically ensure equal opportunities for use and enjoyment, underscoring the importance of considering socio-economic barriers alongside physical accessibility in UGPS planning.

Meanwhile, the significant effect of occupation on visitation frequency suggests that work-life factors strongly shape park use. Government employees and other full-time workers reported a greater tendency to use the park frequently. Similar patterns have been reported that individuals working standard hours (8–10 hours per day) were more inclined toward frequent visits [68]. Contrary to expectations, retirees or individuals with greater discretionary time did not exhibit higher visitation frequencies. This finding suggests that the availability of free time alone may not be sufficient to encourage park use. Factors such as health status, mobility limitations, social networks, and the availability of age-appropriate activities may play a more important role in determining whether individuals regularly engage with UGPS [69]. The results therefore indicate that park use is influenced not only by temporal availability but also by how well parks align with the needs and lifestyles of different user groups.

Gender was not a significant factor in park use, echoing studies that also found minimal gender variation in visitation frequency population [70]. Although research from China identified contextual gender gaps in duration and activity type [71, 72], the balanced pattern observed in this study suggests that the parks effectively support both male- and female-oriented activities. The capacity of the parks to host activities ranging from social and educational programs for youth to restorative and health-related uses for adults and seniors demonstrates a multigenerational and multifunctional character. Such adaptability enables the coexistence of distinct user needs within shared space, strengthening social inclusion and community resilience [73].

Although previous research reported a significant positive correlation between age and frequency of use, no comparable pattern was observed in the present study, as usage intensity did not differ significantly across age groups [53]. This disparity could be due to differences in the study population, geographic location, or specific definitions of usage intensity and frequency of use. The observed lack of age disparity in park usage can be a significant finding, as previous studies has documented barrier older people often face in accessing public spaces [4, 74, 75] and youths tend to underutilize parks due to perceived lack of interest [51], which suggests that equity is not given. The findings tentatively suggest that the park's design and activities positively create an inclusive and welcoming atmosphere for a broad demographic, from youths to seniors.

Education level was also not a significant predictor of park use, contrasting with evidence linking higher education to more frequent visitation [76]. While some studies suggest that education may influence how people perceive a park's attractiveness [70], the findings of this study indicate that such perceptual differences do not necessarily translate into measurable differences in actual use. Individuals from diverse educational backgrounds were equally represented among frequent and long-stay visitors, underscoring the park's role in fostering social cohesion and inclusivity. This pattern suggests that, regardless of educational attainment, users experience comparable opportunities for recreation and interaction, an encouraging sign of socially sustainable public space where socio-economic differences do not limit engagement.

Longer visits were strongly associated with higher accessibility and more positive perceptions of park quality. Although most socio-demographic variables were not significant, household income consistently shaped patterns of use, with lower-income groups experiencing shorter stays. This finding is consistent with previous studies showing adequate access and connectivity enhance sociability, comfort, and activities, while park attributes influence visit duration across types [77, 78]. Together, these insights reinforce the idea that both spatial and perceptual dimensions are critical in understanding how parks function as everyday public spaces.

Overall, accessibility and perception jointly shape how people engage with parks, influencing not only to equitable spatial distribution but also to the social and economic contexts that shape participation. While accessibility determines whether people can conveniently reach parks, perceptions of comfort, sociability, activities, and connectivity influence the quality and depth of engagement once users arrive. The generally balanced patterns of use across gender and age groups suggests progress toward inclusivity. However, the shorter visits observed among lower-income users indicate that equitable physical provision does not necessarily translate into equitable benefits. These findings reinforce the principles of spatial justice by highlighting that UGPS equity extends beyond proximity and availability to include the capacity of diverse user groups to meaningfully access and benefit from these spaces. Addressing such disparities through improved walkability, inclusive programming, and culturally responsive park management can strengthen engagement and support the goal of universal access to safe, inclusive, and accessible green spaces envisioned under SDG 11.7.

6. CONCLUSIONS

The findings reveal clear patterns in how spatial accessibility perceived park quality shape UGPS use, reinforcing their importance for sustainable and inclusive urban development. The results further indicate that access to UGPS remains unevenly distributed across the city, highlighting persistent spatial inequalities in opportunities for park use and engagement. Users' experiences and perceptions are strongly associated with both visit frequency and length of stay, highlighting the role of perceived quality in fostering meaningful engagement. The results further show, that spatial accessibility, perception, and socio-economic characteristics jointly shape how residents interact with UGPS, reflecting underlying spatial inequalities in use. Although accessibility was associated with both visit frequency and duration, it alone does not ensure equitable or inclusive engagement across all parks.

Among the perceptual dimensions, access and linkages and comfort and image emerged as the strongest predictors of behavioral engagement, with sociability further enriching the depth of user interaction. Users are more likely to visit and stay longer in parks that are visually appealing, comfortable, and well-connected to surrounding areas. Demographic results indicate that income and occupation significantly influence park use, whereas age and gender differences are minimal reflecting a generally inclusive environment. However, shorter visits among lower-income users reveal that socio-economic barriers continue to constrain engagement despite positive perceptions of quality. Overall, inclusivity arises from the interplay between spatial equality and experiential quality, not from either dimension alone.

This study contributes to urban planning scholarship by demonstrating that spatial equity must be understood alongside users' lived experiences and perceptions to fully explain public space engagement. The findings highlight the value of integrating spatial analytics with user-centered evaluation in assessing UGPS performance. From a practical perspective, urban planners and policymakers should adopt an integrated approach that combines spatial analytics with user-centered design. This includes (1) prioritizing underserved areas for investment, (2) enhancing connectivity through walkable and bikeable linkages, (3) embedding social and cultural programming to strengthen sociability, and (4) establishing monitoring systems that regularly evaluate park accessibility and quality. Future public space developments should align with SDG 11.7, ensuring universal access to safe, inclusive, and accessible green spaces, particularly for low-income and vulnerable groups.

This study's scope is limited by its cross-sectional design and reliance on 2023 data, which restricts temporal analysis. The behavioral survey was conducted in four UGPS and the accessibility analysis relied on a fixed 300-meter threshold, which may not fully capture real-time mobility barriers. In addition, the perceived park-quality dimensions exhibited substantial overlap when entered simultaneously into the regression models, which may have affected the stability of individual coefficient estimates and contributed to inflated odds rations. Future research should apply longitudinal or mixed-method designs, integrate mobility tracking and temporal analyses, and expand to multiple cities to strengthen generalizability. Incorporating qualitative insights on governance, participation, and lived experiences will further clarify how spatial and social processes sustain inclusive and resilient UGPS.

AUTHOR CONTRIBUTION

Vida Fe K. Lagumbay: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft. Vilas Nitivattananon: Conceptualization, Supervision, Visualization, Writing – review & editing. Harshit Sosan Lakra: Conceptualization, Supervision, Visualization, Writing – review & editing.

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REFERENCES

[1] Hamstead, Z.A., Fisher, D., Ilieva, R.T., Wood, S.A., McPhearson, T., Kremer, P. (2018). Geolocated social media as a rapid indicator of park visitation and equitable park access. Computers, Environment and Urban Systems, 72: 38-50. https://doi.org/10.1016/j.compenvurbsys.2018.01.007

[2] Vargas-Hernández, J.G., Pallagst, K., Zdunek-Wielgołaska, J. (2018). Urban green spaces as a component of an ecosystem. In Handbook of Engaged Sustainability, S. Dhiman and J. Marques, Eds., Cham, Switzerland: Springer International Publishing AG, pp. 885-916. https://doi.org/10.1007/978-3-319-53121-2_49-1

[3] Mabon, L. (2020). Environmental justice in urban greening for subtropical Asian cities: The view from Taipei. Singapore Journal of Tropical Geography, 41(3): 432-449. https://doi.org/10.1111/sjtg.12341

[4] Nguyen, N.T., Nguyen, L. (2023). Disentangling environmental justice dimensions of urban green spaces in cities of the Global South. Bridging Peace and Sustainability Amidst Global Transformations, pp. 149-178. https://doi.org/10.1007/978-981-99-7572-3_9

[5] Teimouri, R., Yigitcanlar, T. (2018). An approach towards effective ecological planning: Quantitative analysis of urban green space characteristics. Global Journal of Environmental Science and Management, 4(2): 195-206. https://doi.org/10.22034/gjesm.2018.04.02.007

[6] Wolff, M., Haase, D. (2019). Mediating sustainability and liveability-turning points of green space supply in European cities. Frontiers in Environmental Science, 7: 61. https://doi.org/10.3389/fenvs.2019.00061

[7] Shackleton, C.M. (2023). Urban green infrastructure, biodiversity, poverty, and equity. In Routledge Handbook of Urban Biodiversity, pp. 307-319. https://doi.org/10.4324/9781003016120-25

[8] Carmona, M. (2021). Public Places Urban Spaces: The Dimensions of Urban Design. Routledge, Taylor & Francis Group.

[9] Markusen, A., Nicodemus, A.G. (2014). Creative placemaking: How to do it well. In Community Development Investment Review, pp. 35-42.

[10] Bush, J., Hernandez-Santin, C., Hes, D. (2019). Nature in place: Placemaking in the biosphere. Placemaking Fundamentals for the Built Environment, pp. 39-61. https://doi.org/10.1007/978-981-32-9624-4_3

[11] Project for Public Spaces. (2020). What makes a successful place? https://www.pps.org/article/grplacefeat.

[12] Dash, S.P., Thilagam, N.L. (2023). 'Creative placemaking': A conceptual model fostering social cohesion in community spaces within residential environments. Creativity Studies, 16(2): 541-564. https://doi.org/10.3846/cs.2023.16497

[13] Lew, A.A. (2017). Tourism planning and place making: Place-making or placemaking? Tourism Geographies, 19(3): 448-466. https://doi.org/10.1080/14616688.2017.1282007

[14] Choe, K., Laquian, A. (2008). City Cluster Development: Toward an Urban-led Development Strategy for Asia. https://www.adb.org/publications/city-cluster-development-toward-urban-led-development-strategy-asia.

[15] Rizvi, S.H., Fatima, H., Iqbal, M.J., Alam, K. (2020). The effect of urbanization on the intensification of SUHIs: Analysis by LULC on Karachi. Journal of Atmospheric and Solar-Terrestrial Physics, 207: 105374. https://doi.org/10.1016/J.JASTP.2020.105374

[16] Afriyanie, D., Julian, M.M., Riqqi, A., Akbar, R., Suroso, D.S.A., Kustiwan, I. (2020). Re-framing urban green spaces planning for flood protection through socio-ecological resilience in Bandung City, Indonesia. Cities, 101: 102710. https://doi.org/10.1016/j.cities.2020.102710

[17] Bret, B., Moreau, S. (2022). Spatial and environmental justice. Where Has Social Justice Gone? pp. 145-158. https://doi.org/10.1007/978-3-030-93123-0_9

[18] de Oliveira, A.M., Gouvêa, J.B., Barbado, N. (2024). Approaching the concepts of environmental justice and spatiality to environmental health. Revista de Gestao Social e Ambiental, 18(4): e04997. https://doi.org/10.24857/rgsa.v18n4-083

[19] Hipparkar, D., Keskar, Y., Waghmare, S. (2024). Revitalizing urban landscapes: A case study of urban green spaces and urban greenways in Pune, India. Evergreen, 11(3): 1625-1640. https://doi.org/10.5109/7236817

[20] Biernacka, M., Kronenberg, J. (2019). Urban green space availability, accessibility and attractiveness, and the delivery of ecosystem services. Cities and the Environment (CATE), 12(1): 5.

[21] Vukmirovic, M., Gavrilović, S. (2020). Placemaking as an approach of sustainable urban facilities management. Facilities, 38(11-12): 801-818. https://doi.org/10.1108/F-04-2020-0055

[22] White, M.P., Alcock, I., Grellier, J., Wheeler, B.W., et al. (2019). Spending at least 120 minutes a week in nature is associated with good health and wellbeing. Scientific Reports, 9(1): 7730. https://doi.org/10.1038/s41598-019-44097-3

[23] Cohen, M., Maund, K., Gajendran, T., Lloyd, J., Smith, C., Landcom, L. (2018). Valuing Creative Placemaking: Development of a Toolkit for Public and Private Stakeholders. NSW Government, Landcom: Sydney, Australia.

[24] Carmona, M. (2019). Place value: Place quality and its impact on health, social, economic and environmental outcomes. Journal of Urban Design, 24(1): 1-48. https://doi.org/10.1080/13574809.2018.1472523

[25] Hernandez-Santin, C. (2020). Head, heart, and hands model for placemaking learning: The Sandbox studio approach. Placemaking Sandbox: Emergent Approaches, Techniques and Practices to Create More Thriving Places, pp. 15-34. https://doi.org/10.1007/978-981-15-2752-4_2

[26] Sadeghi, A.R., Shahvaran, F., Gholami, A.R., Feyzabi, T. (2022). Toward behavior-based placemaking: The evolution of place concept in urban design knowledge.

International Journal of Human Capital in Urban Management, 7(3): 357-372. https://doi.org/10.22034/IJHCUM.2022.03.05
[27] Brown, G., Raymond, C. (2007). The relationship between place attachment and landscape values: Toward mapping place attachment. Applied Geography, 27(2): 89-111. https://doi.org/10.1016/j.apgeog.2006.11.002
[28] Alessa, L., Kliskey, A., Brown, G. (2008). Social–ecological hotspots mapping: A spatial approach for identifying coupled social–ecological space. Landscape and Urban Planning, 85(1): 27-39. https://doi.org/10.1016/J.LANDURBPLAN.2007.09.007
[29] Danilina, N., Tsurenkova, K., Berkovich, V. (2021). Evaluating urban green public spaces: The case study of Krasnodar region cities, Russia. Sustainability, 13(24), 14059. https://doi.org/10.3390/su132414059
[30] Haq, S.M.A. (2011). Urban green spaces and an integrative approach to sustainable environment. Journal of Environmental Protection, 2(5): 601-608. https://doi.org/10.4236/jep.2011.25069
[31] Groff, E., McCord, E.S. (2012). The role of neighborhood parks as crime generators. Security Journal, 25(1): 1-24. https://doi.org/10.1057/sj.2011.1
[32] Marquet, O., Ogletree, S. S., Hipp, J.A., Suau, L.J., Horvath, C.B., Sinykin, A., Floyd, M.F. (2020). Effects of crime type and location on park use behavior. Preventing Chronic Disease, 17: 190434. https://doi.org/10.5888/pcd17.190434
[33] Lu, J., Luo, X., Yang, N., Shen, Y. (2021). Multiple pathways: The influence mechanism of greenspace exposure on mental health-a case study of Hangzhou, China. Land, 10(4): 339. https://doi.org/10.3390/land10040339
[34] Yan, J., Wang, J., Su, F., Liu, B. (2024). Morphology changes and the expansion of major port cities in the Philippines from 1990 to 2020. Cities, 147: 104818. https://doi.org/10.1016/j.cities.2024.104818
[35] UN-Habitat. (2020). Public space site-specific assessment: Guidelines to achieve quality public spaces at neighbourhood level. https://unhabitat.org/public-space-site-specific-assessment-guidelines-to-achieve-quality-public-spaces-at-neighbourhood.
[36] Praliya, S., Garg, P. (2019). Public space quality evaluation: Prerequisite for public space management. The Journal of Public Space, 4(1): 98. https://doi.org/10.32891/jps.v4i1.667
[37] Xu, C., Haase, D., Pribadi, D.O., Pauleit, S. (2018). Spatial variation of green space equity and its relation with urban dynamics: A case study in the region of Munich. Ecological Indicators, 93: 512-523. https://doi.org/10.1016/j.ecolind.2018.05.024
[38] Guan, J., Wang, R., Van Berkel, D., Liang, Z. (2023). How spatial patterns affect urban green space equity at different equity levels: A Bayesian quantile regression approach. Landscape and Urban Planning, 233: 104709. https://doi.org/10.1016/j.landurbplan.2023.104709
[39] Dai, W., Yuan, S., Liu, Y., Peng, D., Niu, S. (2022). Measuring equality in access to urban parks: A big data analysis from Chengdu. Frontiers in Public Health, 10: 1022666. https://doi.org/10.3389/fpubh.2022.1022666
[40] Devlieger, I., Rosseel, Y. (2017). Factor score path analysis: An alternative for SEM? Methodology, 13: 31-38. https://doi.org/10.1027/1614-2241/a000130
[41] Hayes, T., Usami, S. (2020). Factor score regression in the presence of correlated unique factors. Educational and Psychological Measurement, 80(1): 5-40. https://doi.org/10.1177/0013164419854492
[42] Anderson, J.C., Gerbing, D.W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. Psychological Bulletin, 103(3): 411-423. https://doi.org/10.1037/0033-2909.103.3.411
[43] Cheung, G.W., Cooper-Thomas, H.D., Lau, R.S., Wang, L.C. (2024). Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-practice recommendations. Asia Pacific Journal of Management, 41(2): 745-783. https://doi.org/10.1007/s10490-023-09871-y
[44] Collier, J.E. (2020). Applied Structural Equation Modeling Using AMOS. Routledge. https://doi.org/10.4324/9781003018414
[45] Lin, C-Y., Lai, T-F., Fang, C-Y., Hsueh, M-C., Liao, Y. (2024). Park proximity and all-day and time-specific physical activity and sedentary behaviour in older adults. BMC Geriatrics, 24(1): 938. https://doi.org/10.1186/s12877-024-05527-8
[46] Wu, H., Gong, C., Wang, R., Niu, X., Cao, Y., Cao, C., Hu, C. (2025). Moderating effects of park accessibility and external environment on park satisfaction in a mountainous city. Land, 14(1): 77. https://doi.org/10.3390/land14010077
[47] Caselli, B., Carra, M., Rossetti, S., Zazzi, M. (2021). From urban planning techniques to 15-minute neighbourhoods. A theoretical framework and GIS-based analysis of pedestrian accessibility to public services. European Transport, 85(10): 1-15. https://doi.org/10.48295/ET.2021.85.10
[48] Alkhafagee, K.H., Basee, D.H. (2023). Urban resilience as a mitigating mechanism of urban change: Insights from two case studies. ISVS e-Journal, 10(8): 162-178. https://doi.org/10.61275/ISVSej-2023-10-08-12
[49] Blaschke, P., Pedersen Zari, M., Chapman, R., Randal, E., Perry, M., Howden-Chapman, P., Gyde, E. (2024). Multiple roles of green space in the resilience, sustainability and equity of Aotearoa New Zealand's cities. Land, 13(7): 1022. https://doi.org/10.3390/land13071022
[50] Vidal, D.G., Fernandes, C.O., Teixeira, C.P., et al. (2022). Behavioural mapping of urban green spaces users: Methodological procedures applied to Corujeira Garden (Porto, Portugal). Sustainable Policies and Practices in Energy, Environment and Health Research: Addressing Cross-cutting Issues, pp. 147-166. https://doi.org/10.1007/978-3-030-86304-3_9
[51] Hong, S.K., Lee, S.W., Jo, H.K., Yoo, M. (2019). Impact of frequency of visits and time spent in urban green space on subjective well-being. Sustainability, 11(15): 4189. https://doi.org/10.3390/su11154189
[52] Zhou, H., Wang, J., Wilson, K. (2022). Impacts of perceived safety and beauty of park environments on time spent in parks: Examining the potential of street view imagery and phone-based GPS data. International Journal of Applied Earth Observation and Geoinformation, 115: 103078. https://doi.org/10.1016/J.JAG.2022.103078
[53] Gong, Y., Mamat, Z., Shi, L., Liu, F. (2023). Restorative effects of park visiting on physiology, psychology, and

society and the factors influencing park visiting. Sustainability, 15(1): 841. https://doi.org/10.3390/su15010841

[54] Chen, S., Sleipness, O., Christensen, K., et al. (2024). Exploring associations between social interaction and urban park attributes: Design guideline for both overall and separate park quality enhancement. Cities, 145: 104714. https://doi.org/10.1016/J.CITIES.2023.104714

[55] Gulsrud, N.M., Hertzog, K., Shears, I. (2018). Innovative urban forestry governance in Melbourne?: Investigating “green placemaking” as a nature-based solution. Environmental Research, 161: 158-167. https://doi.org/10.1016/j.envres.2017.11.005

[56] Costa, C.S., García-Esparza, J.A., Kimic, K. (2024). Participatory budgeting and placemaking: Concepts, methods, and practices. Urban Planning, 9. https://doi.org/10.17645/up.7162

[57] Wright Wendel, H.E., Zarger, R.K., Mihelcic, J.R. (2012). Accessibility and usability: Green space preferences, perceptions, and barriers in a rapidly urbanizing city in Latin America. Landscape and Urban Planning, 107(3): 272-282. https://doi.org/10.1016/j.landurbplan.2012.06.003

[58] Mohamed, A.A., Kronenberg, J. (2025). Users’ experiences of park accessibility and attractiveness based on online review analytics. Scientific Reports, 15(1): 4268. https://doi.org/10.1038/s41598-025-88500-8

[59] Veitch, J., Rivera, E., Loh, V., et al. (2025). Examining park features that encourage physical activity and social interaction among adults. Health Promotion International, 40(3): daaf063. https://doi.org/10.1093/heapro/daaf063

[60] Alshehri, R.M., Alzenifeer, B.M., Alqahtany, A.M., et al. (2025). Impact of urban green spaces on social interaction and sustainability: A case study in Jubail, Saudi Arabia. Sustainability, 17(10): 4467. https://doi.org/10.3390/su17104467

[61] Peters, K., Elands, B., Buijs, A. (2010). Social interactions in urban parks: Stimulating social cohesion? Urban Forestry & Urban Greening, 9(2): 93-100. https://doi.org/10.1016/J.UFUG.2009.11.003

[62] Stafford, L., Kuiper, K. (2021). Social exchange theories: Calculating the rewards and costs of personal relationships. In Engaging Theories in Interpersonal Communication, New York: Routledge, pp. 379-390. https://doi.org/10.4324/9781003195511-33

[63] Homans, G.C. (1958). Social behavior as exchange. American Journal of Sociology, 63(6): 597-606. https://doi.org/10.1086/222355

[64] Cohen, D.A., Han, B., Nagel, C.J., et al. (2016). The first national study of neighborhood parks: Implications for physical activity. American Journal of Preventive Medicine, 51(4): 419-426. https://doi.org/10.1016/j.amepre.2016.03.021

[65] Wu, W., Wang, M., Zhu, N., Zhang, W., Sun, H. (2019). Residential satisfaction about urban greenness: Heterogeneous effects across social and spatial gradients. Urban Forestry & Urban Greening, 38: 133-144. https://doi.org/10.1016/J.UFUG.2018.11.011

[66] You, H. (2016). Characterizing the inequalities in urban public green space provision in Shenzhen, China. Habitat International, 56: 176-180. https://doi.org/10.1016/j.habitatint.2016.05.006

[67] Büyükağaçcı, S.B., Arısoy, N. (2024). Social sustainability in urban parks: Insights from Alaeddin Hill Park, Konya. Sustainability, 16(22): 9697. https://doi.org/10.3390/su16229697

[68] Wang, L., Shen, L., Liu, H. (2024). Working hours influence preferences of residents for micro features of small urban green spaces. Scientific Reports, 14(1): 23948. https://doi.org/10.1038/s41598-024-74607-x

[69] Liu, H., Li, F., Xu, L., Han, B. (2017). The impact of socio-demographic, environmental, and individual factors on urban park visitation in Beijing, China. Journal of Cleaner Production, 163: S181-S188. https://doi.org/10.1016/j.jclepro.2015.09.012

[70] Gu, X., Li, Q., Chand, S. (2020). Factors influencing residents’ access to and use of country parks in Shanghai, China. Cities, 97: 102501. https://doi.org/10.1016/J.CITIES.2019.102501

[71] Huang, X., Yang, Q., Gu, D., et al. (2024). Revealing gender disparities in urban green space utilization using mobile phone data. Ecosystem Health and Sustainability, 10: 0268. https://doi.org/10.34133/ehs.0268

[72] Li, Y., Niu, S., Mou, Y. (2022). Gender difference in the Chinese middle-aged and elderly of pocket park use: A case study of Zongbei Park. Frontiers in Environmental Science, 10: 978935. https://doi.org/10.3389/fenvs.2022.978935

[73] Abdulmunem, S.A., Shok, M.E., Al-Hussaini, Z.I.H., Alkinani, A.S. (2024). Multigenerational urban design: Creating urban spaces that support active aging and intergenerational interaction. International Journal of Sustainable Development and Planning, 19(10): 3737-3747. https://doi.org/10.18280/ijsdp.191004

[74] Artmann, M., Mueller, C., Goetzlich, L., Hof, A. (2019). Supply and demand concerning urban green spaces for recreation by elderlies living in care facilities: The role of accessibility in an explorative case study in Austria. Frontiers in Environmental Science, 7: 136. https://doi.org/10.3389/fenvs.2019.00136

[75] Wen, C., Albert, C., von Haaren, C. (2020). Equality in access to urban green spaces: A case study in Hannover, Germany, with a focus on the elderly population. Urban Forestry & Urban Greening, 55: 126820. https://doi.org/10.1016/j.ufug.2020.126820

[76] Ma, Y., Brindley, P., Lange, E. (2022). The influence of socio-demographic factors on preference and park usage in Guangzhou, China. Land, 11(8): 1219. https://doi.org/10.3390/land11081219

[77] Zhao, R., Song, Y., Guo, S., Guo, Z., Shen, X. (2025). Unraveling the relationships between urban park characteristics and visit durations: A longitudinal smartphone behavior survey in Austin. Urban Forestry & Urban Greening, 105: 128706. https://doi.org/10.1016/j.ufug.2025.128706

[78] Hashim, N.I., Mohd Hashim, N.H., MohdNasir, N.A., Mohd Soliheen, S.S. (2022). Successful park characteristics and users’ behavior: An experience of Perdana Botanical Garden, Kuala Lumpur. IOP Conference Series: Earth and Environmental Science, 1067(1): 012014. https://doi.org/10.1088/1755-1315/1067/1/012014

NOMENCLATURE

Ai	accessibility score

Ei	UGPS accessibility index	d_{kj}	distance from the grid cell to UGPS j
R_j	supply-demand ratio for UGPS j	d_0	catchment threshold
S_j	supply (area of UGPS j)		
P_k	population in residential grid cell k within the buffer		

APPENDIX

Table A1. Profile of respondents

Variables	Sub-Variables	F	%
Gender	Male	169	40.7
	Female	246	59.3
Age group	18 years old and below	87	20.9
	18 to 25 years old	177	42.5
	26 to 44 years old	99	23.8
	45 to 59 years old	42	10.1
	60 years old and above	11	2.6
Education Level	Primary School	21	5.0
	Junior High School	67	16.1
	Senior High School	63	15.1
	Vocational	14	3.4
	College Level	155	37.2
	College Graduate	91	21.8
	Postgraduate	6	1.4
Occupation	Government Employee	49	11.8
	Private Company Employee	60	14.4
	Self-employed	73	17.5
	Student	216	51.8
	Others	19	4.6
Estimated Family Monthly Income	Less than PhP 10,957	216	51.9
	PhP 10,957 - PhP 21,914	106	25.5
	PhP 21,914 – PhP 43,828	63	15.1
	PhP 43,828 – PhP 76,699	13	3.1
	PhP 76,699 – PhP 131,484	9	2.2
	Php 131,484 – PhP 219,140	4	1.0
	At least PhP 219,140	5	1.2
Length of Residency	Less than 1 year	23	5.6
	1 to 5 years	28	6.8
	5 to 10 years	63	15.3
	More than 10 years	298	72.3
Number of Respondents per Park	Gaston Park	87	21
	Plaza Divisoria	103	25
	Vicente de Lara Park	111	27
	Rio de Oro Boulevard	116	28

Source*:* Field survey of UGPS users, 2023.

Table A2. Distribution of visit duration categories used in multinomial logistic regression analysis

Time Spent	f	%
Less than 2 hours	167	40%
2 to 4 hours	186	44.6%
More than 4 hours	64	15.3%
Total	417	100%

Table A3. Detailed result of multinomial logistic regression for respondent's amount of time spent in UGPS

Variables	Categories	Model Fitting	Likelihood Ratio Test			Less than 2 Hours VS > 4 Hours			2 to 4 Hours VS > 4 Hours		
		-2 LL	X^2	*df*	*P-*Value	O.R.	*P-*Value	95% CI	O.R.	*P-*Value	95% CI
Accessibility	Park-Level Accessibility Index	706.146	11.382	2	0.003	0.985	.007	0.974 - 0.996	0.982	.001	0.972 - 0.993
User Perception	Comfort and Image	716.576	21.812	2	0.000	0.079	.000	0.025 - 0.250	0.262	.011	0.094 - 0.734
	Uses and Activities	756.256	61.492	2	0.000	579.841	.000	91.666 - 3667.821	22.968	.000	4.723 - 111.687

Variables	Categories	Model Fitting	Likelihood Ratio Test			Less than 2 Hours VS > 4 Hours			2 to 4 Hours VS > 4 Hours		
		-2 LL	X^2	*df*	*P*-Value	O.R.	*P*-Value	95% CI	O.R.	*P*-Value	95% CI
	Access and Linkages	709.217	14.454	2	0.001	0.044	.000	0.008 - 0.247	0.173	.031	0.035 - 0.840
	Sociability	701.154	6.391	2	0.041	0.278	.077	0.067 - 1.150	0.889	.857	0.246 - 3.211
	18 years old and below					7.012	.113	0.631- 77.876	2.109	.456	0.297 - 12.004
	18 to 25 years old					4.165	.228	0.410 - 42.303	2.084	.443	0.319 - 13.620
Age group	26 to 44 years old	701.368	6.605	8	0.580	5.359	.140	0.577 - 49.763	1.658	.581	0.276 - 9.978
	45 to 59 years old					2.972	.351	0.301 - 29.353	1.013	.989	0.160 - 6.422
	60 years old and above (ref.)										
	Government Employee					0.382	.350	0.051 - 2.874	0.217	.107	0.034 - 1.395
	Private Company Employee					1.417	.739	0.182 - 11.037	1.030	.975	0.158 - 6.731
Occupation	Self-employed	703.380	8.617	8	0.376	0.457	.418	0.069 - 3.036	0.384	.279	0.068 - 2.172
	Student					0.277	.199	0.039 - 1.967	0.253	.132	0.042 - 1.515
	Others (ref.)										
Gender	Male	696.198	1.435	2	0.488	0.653	.231	0.325 - 1.312	0.740	.358	0.390 - 1.406
	Female (ref.)										
	Basic Education					0.492	.133	0.195 - 1.242	0.582	.192	0.258 - 1.313
Level of Education	Technical-Vocational Education	699.851	5.088	4	0.278	0.172	.090	0.023 - 1.316	0.187	.073	0.030 - 1.166
	Higher Education (ref.)										
	Poor Income Class					7.107	.049	1.012 - 49.896	1.045	.953	0.239 - 4.574
Family Income Class	Low Income Class	712.778	18.015	6	0.006	6.673	.065	0.886 - 50.239	0.920	.917	0.193 - 4.401
	Middle Income Class					1.522	.685	0.200 - 11.612	0.466	.335	0.099 - 2.198
	Upper Income Class (ref.)										

Table A4. Multicollinearity diagnostics for factors scores of perceived UGPS quality

Predictor	Tolerance	VIF
Comfort and Image	0.104	9.607
Uses and Activities	0.050	20.198
Access and Linkages	0.050	20.148
Sociability	0.066	15.145

Table A5. Detailed result of multinomial logistic regression for respondent's visit in UGPS

Variables	Categories	Model Fitting	Likelihood Ratio Test			Light User VS Heavy User			Moderate User VS Heavy User		
		-2 LL	X^2	*df*	*P*-Value	O.R.	*P*-Value	95% CI	O.R.	*P*-Value	95% CI
Accessibility	Park-Level Accessibility Index	816.683	13.381	2	0.001	1.005	0.302	0.995 - 1.015	1.015	0.001	1.006 - 1.024
User Perception	Comfort and Image	804.045	0.743	2	0.690	1.000	0.999	0.432 - 2.313	1.348	0.485	0.583 - 3.118
	Uses and Activities	804.434	1.133	2	0.568	1.090	0.892	0.315 - 3.770	1.788	0.359	0.517 - 6.183
	Access and Linkages	811.226	7.925	2	0.019	0.196	0.011	0.055 - 0.700	0.640	0.496	0.177 - 2.316
	Sociability	814.131	10.830	2	0.004	3.478	0.027	1.148 - 10.533	0.752	0.625	0.240 - 2.358
Age group	18 years old and below	814.665	11.364	8	0.182	0.131	0.050	0.017 - 0.998	0.401	0.364	0.056 - 2.884
	18 to 25 years old					0.266	0.187	0.037 - 1.902	0.485	0.456	0.073 - 3.247
	26 to 44 years old					0.563	0.560	0.081 - 3.889	1.344	0.757	0.206 - 8.783
	45 to 59 years old					0.436	0.423	0.057 - 3.317	1.093	0.928	0.158 - 7.549
	60 years old and above (ref.)										
Occupation	Government Employee	827.448	24.146	8	0.002	0.299	0.222	0.043 - 2.078	0.133	0.026	0.023 - 0.782
	Private Company Employee					0.698	0.706	0.107 - 4.534	0.217	0.085	0.038 - 1.233
	Self-employed					0.333	0.249	0.052 - 2.155	0.210	0.070	0.039 - 1.134
	Student					2.200	0.404	0.346 - 13.995	0.505	0.434	0.091 - 2.801
	Others (ref.)										
Gender	Male	804.033	0.731	2	0.694	0.827	0.510	0.469 - 1.456	1.010	0.970	0.592 - 1.726
	Female (ref.)										
Level of Education	Basic Education	805.855	2.553	4	0.635	0.909	0.811	0.416 - 1.987	1.172	0.672	0.562 - 2.444
	Technical-Vocational Education					1.619	0.529	0.362 - 7.252	0.674	0.635	0.132 - 3.441
	Higher Education (ref.)										
Family Income Class	Poor Income Class	810.401	7.100	6	0.312	1.626	0.520	0.370 - 7.152	0.709	0.582	0.208 - 2.412
	Low Income Class					2.528	0.239	0.539 - 11.843	1.232	0.751	0.341 - 4.453
	Middle Income Class					1.849	0.439	0.391 - 8.750	0.530	0.343	0.142 - 1.972
	Upper Income Class (ref.)										