Evaluating Public Perceptions of Urban Green Spaces in Indian Cities: A Survey Study

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Abstract:
This study evaluates public perceptions and usage patterns of Urban Green Spaces (UGSs) across three diverse Indian cities—Delhi, Bengaluru, and Nagpur—amidst the growing challenges of urbanization and environmental inequity. Addressing a critical literature gap in India-specific, multi-city quantitative analyses, the research integrates socio-demographic profiles, perceived benefits, environmental awareness, accessibility, and satisfaction into a unified framework. Using a cross-sectional survey method, data were collected from 828 respondents through a structured, paper-based questionnaire administered in parks and green areas. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to explore latent relationships between awareness, usage, accessibility, and well-being outcomes. Findings reveal that environmental awareness positively correlates with higher UGS usage, while perceived accessibility significantly influences overall satisfaction. Bengaluru emerged as the most engaged city in terms of frequency and satisfaction, whereas Nagpur lagged across key indicators. Physical health was the most commonly reported benefit, followed by mental well-being, with social cohesion rated lowest. The study emphasizes the need for equitable urban green infrastructure planning, context-sensitive park programming, and environmental education initiatives to enhance public engagement and maximize ecosystem service awareness. Methodologically, the study contributes a replicable structural model for UGS perception research in developing urban contexts. Policy implications advocate for integrating urban design, participatory governance, and environmental literacy to foster more inclusive and sustainable public green spaces in rapidly urbanizing Indian cities.

Keywords: Urban Green Spaces, Public Perception, Environmental Awareness, Accessibility, PLS-SEM, Indian Cities.

1. INTRODUCTION

The rapid urbanization in India, projected to have nearly 600 million urban dwellers by 2031 (Government of India, 2018), poses significant challenges to sustainable urban planning and public health. Among various interventions, urban green spaces (UGSs) have emerged as vital elements contributing to environmental sustainability, biodiversity conservation, mental well-being, and community cohesion (Anand & Bhattacharya, 2023). These spaces—comprising public parks, gardens, and green corridors—not only serve ecological functions such as air purification and temperature regulation but also offer recreational, aesthetic, and psychological benefits to city residents (Basu & Nagendra, 2021). Despite this growing recognition, the distribution and accessibility of UGSs remain uneven across Indian cities. Metropolitan centers like Delhi and Bengaluru have pockets of well-maintained green spaces, yet many neighborhoods—especially low-income and high-density areas—face limited access (Paul & Nagendra, 2017). Urban planning frameworks in India have often marginalized community participation, resulting in green space policies that are misaligned with local needs and cultural preferences (Swamy & Devy, 2010).

Further, urban dwellers' engagement with UGSs is shaped by complex socio-economic variables. Aesthetic preferences, safety perceptions, and environmental awareness significantly influence how these spaces are

perceived and used (Dinda & Ghosh, 2021). For example, Dinda and Ghosh (2021) found that over 62% of visitors in Kolkata were willing to pay for access to cleaner, more aesthetic parks, highlighting a public demand for improved green infrastructure.

A growing body of literature explores ecosystem services and psychological benefits provided by UGSs, but significant gaps remain in India-specific studies on public perception and usage patterns. While researchers like Lahoti et al. (2023) examined user preferences in rapidly urbanizing areas, these studies often focus on spatial metrics (e.g., green cover ratios, accessibility scores) rather than socio-cognitive perceptions. Similarly, Basu and Nagendra (2021) provided valuable insights into the socio-ecological benefits of parks in Hyderabad but lacked granularity in measuring psychological and health-related benefits linked to frequency and types of use. Moreover, while international studies have deployed sophisticated analytical tools to examine correlations between park features and health outcomes (e.g., walking frequency, stress reduction), Indian studies often rely on descriptive statistics with minimal modeling of user motivations and satisfaction levels (Subramanian & Jana, 2021). This methodological gap limits policymakers' ability to design user-centric urban planning models that optimize health and equity outcomes.

Additionally, few studies compare perceptions across multiple urban centers, limiting generalizability. The findings from Delhi, for instance, may not apply to Tier-II cities like Nagpur or Coimbatore, which face different demographic and infrastructural contexts (Sen & Guchhait, 2021). Furthermore, studies such as Anand and Bhattacharya (2023) acknowledged that ecosystem service awareness remains low among Indian park users, but they did not explore how this awareness interacts with usage behavior or perceived benefits. Given this context, there remains a crucial gap in understanding how urban residents across diverse Indian cities perceive, engage with, and evaluate UGSs. While prior research has highlighted the ecological and social importance of UGSs, there is a lack of integrated, user-oriented, multi-city studies that examine how public perceptions are shaped by accessibility, awareness, and socio-demographic factors—and how these in turn influence health, social, and environmental well-being outcomes. This research aims to address this lacuna by systematically evaluating public perceptions of UGSs in Indian cities using quantitative survey tools and advanced statistical modeling.

The overarching aim of this study is to assess the public perceptions of UGSs in selected Indian cities, particularly focusing on usage frequency, perceived benefits, and the influence of socio-demographic and environmental factors. Specifically, the research objectives are:

1. To analyze the frequency and type of UGS usage across different urban socio-demographic groups.
2. To assess the perceived physical, psychological, and social benefits derived from using UGSs.
3. To examine the relationship between environmental awareness and frequency of UGS use.
4. To evaluate the role of accessibility and perceived quality in shaping public satisfaction.

This study contributes to the interdisciplinary field of urban ecology and public health by offering empirical insights into how UGSs are perceived and utilized by diverse urban populations in India. The findings are expected to inform urban planners and policymakers about the latent demand for green infrastructure and the factors that mediate its optimal use. By identifying disparities in access and perception, the study could support more equitable allocation of urban greenery and foster inclusive urban development. Furthermore, the use of Partial Least Squares Structural Equation Modeling (PLS-SEM) enables a nuanced understanding of causal relationships, offering a methodological advancement in Indian UGS research.

2. LITERATURE REVIEW

This section organizes and critically analyzes prior studies on public perceptions of urban green spaces (UGSs) in India, structured thematically to align with our research objectives: perceptions and usage of green spaces, accessibility and infrastructure quality, ecosystem services and psychological well-being, and green infrastructure innovations. This thematic approach highlights the breadth of research, yet reveals where our study fills important empirical gaps.

Theme 1: Perceptions and Usage of Urban Green Spaces

Several studies have explored how urban residents in India perceive and utilize UGSs, emphasizing variability across socio-economic groups and regions. **Anand and Bhattacharya (2023)** conducted a comprehensive

survey of Delhi park users and found that perceptions of cleanliness and safety were the primary factors influencing park visitation. Their research revealed that about 54% of respondents visited UGSs weekly, and perceived access to ecosystem services—like air purification and thermal comfort—significantly correlated with frequent usage.

In Hyderabad, **Basu and Nagendra (2021)** interviewed visitors across four parks and observed that affordability (entry fees) and proximity significantly influenced visitor profiles. Parks without fees attracted more low-income users, while wealthier citizens preferred fenced, aesthetically curated spaces. These findings align with those of **Paul and Nagendra (2017)** in Delhi, who noted a sharp difference in usage across gender and age lines, with older adults more likely to perceive psychological benefits.

Sen and Guchhait (2021) focused on the psychological experience of "situatedness and connectedness" in Kolkata's green spaces. They argued that emotional well-being derived from these spaces plays a pivotal role in urban stress mitigation. Their qualitative interviews with park users demonstrated a growing demand for peaceful, biodiverse environments as a counterbalance to urban chaos.

Theme 2: Accessibility and Quality of Green Infrastructure

A recurring concern across studies is the uneven accessibility and maintenance of green infrastructure. **Lahoti et al. (2023)** examined neighborhood green spaces in a fast-growing Indian city and discovered that while residents valued these spaces highly, inadequate maintenance and poor sanitation discouraged frequent use. Similarly, **Chaudhry et al. (2011)** highlighted disparities in UGS planning across Indian cities, noting that Tier-I cities like Delhi or Mumbai are better endowed than smaller ones like Bhopal or Agra.

The perception of infrastructure quality also varies based on socio-demographic status. **Khan and Munawer (2025)**, surveying urban planners in Delhi, found a divergence in perceptions about the sufficiency of current greenery infrastructure. Planners were more likely to emphasize aesthetic integration, whereas citizens highlighted safety and accessibility.

Further, **Thapa et al. (2023)** addressed a rarely explored gradient—urban to rural. Their photo-elicitation study in Bengaluru found that users associated UGSs in rural peripheries with biodiversity and open space, while urban parks were seen as sites of recreation but not nature immersion. This underscores a divergence in expectations that must be accommodated in policy frameworks.

Theme 3: Ecosystem Services and Psychological Well-being

Research has increasingly explored the non-material benefits of UGSs, particularly their role in mental health, cultural identity, and environmental literacy. In their **2024** study, **Anand and Bhattacharya** assessed residents' awareness of ecosystem services in Delhi and found that only 37% could name three or more such services unprompted. However, those with higher awareness scores reported significantly greater satisfaction with park use.

Similarly, **Sen and Guchhait (2021)** emphasized how cultural and spiritual values were embedded in green space use, particularly among senior citizens. They observed that users often attributed healing and meditative qualities to their environment, reinforcing the importance of emotional engagement in park planning.

Lahoti et al. (2023) also connected perceived green space quality with health outcomes. Their regression analysis showed that perceived air quality in neighborhood parks was a strong predictor of visit frequency and length of stay, especially for individuals above 50.

Theme 4: Innovations in Green Infrastructure Perception

Innovative approaches to UGS development and evaluation are emerging in Indian cities. **Khan and Munawer (2024)** explored vertical greenery systems in Delhi, revealing divergent perceptions between built environment professionals and lay users. Professionals emphasized environmental performance (e.g., heat insulation), whereas the public prioritized visibility and aesthetics. Their work calls for more participatory design in urban greening.

Subramanian and Jana (2021) proposed digital tools for integrating user feedback into UGS design, demonstrating that real-time sentiment tracking could guide more responsive park management. Their pilot in Nirvana Park, Mumbai, showed that digitally captured feedback could increase responsiveness to maintenance issues by 40%. These studies collectively suggest that while empirical interest in UGS perception is growing, it remains fragmented and often lacks integration across spatial scales and demographic groups.

Although existing literature offers substantial insights into the social, ecological, and psychological roles of UGSs in India, there remains a significant gap in quantitative, multi-city studies that integrate user perceptions, environmental awareness, and perceived health and social benefits into a single analytic

framework. Most studies are geographically localized and methodologically limited to descriptive or qualitative analyses. This study addresses that gap by employing standardized survey tools and statistical modeling (PLS-SEM) across three diverse Indian cities. The significance lies in its potential to inform equitable and effective green space planning that reflects the lived experiences and needs of a rapidly urbanizing population.

3. RESEARCH METHODOLOGY

This study adopted a **quantitative, cross-sectional survey design** to systematically evaluate public perceptions of Urban Green Spaces (UGSs) across three major Indian cities—Delhi, Bengaluru, and Nagpur. The research framework was constructed to align precisely with the four stated objectives: (1) to analyze UGS usage frequency and types across socio-demographic groups, (2) to assess the perceived physical, psychological, and social benefits derived from UGSs, (3) to examine the relationship between environmental awareness and usage frequency, and (4) to evaluate accessibility and satisfaction. The study restricted its primary data collection to **one core source—structured, self-administered questionnaires**—designed using both closed-ended and Likert-type items.

3.1 Survey Design and Structure

A structured questionnaire was developed after reviewing validated instruments from previous UGS studies (e.g., Basu & Nagendra, 2021; Lahoti et al., 2023). It was organized into five thematic sections:

1. **Demographic Profile** (e.g., age, gender, income group, education, occupation)
2. **UGS Usage Patterns** (frequency of visits, duration, types of activities)
3. **Perceived Benefits** (physical health, mental well-being, social interaction)
4. **Accessibility and Satisfaction** (distance to nearest UGS, safety, cleanliness)
5. **Environmental Awareness** (knowledge of ecosystem services, pro-environmental attitudes)

Responses were captured on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) where applicable.

3.2 Sampling Strategy

A multi-stage purposive sampling technique was adopted to ensure representation across city zones (central, peri-urban, and residential). A total of **850 valid responses** were collected across the three cities between January and March 2024. Field investigators distributed physical copies of the survey in parks, green belts, and public gardens. Participants were selected on-site during morning and evening hours to capture peak usage periods.

Inclusion criteria required that respondents be (a) aged 18 years or above, and (b) frequent users or passersby of UGSs. Written informed consent was obtained prior to survey administration.

3.3 Source of Data and Survey Specifications

Below is a detailed table presenting the primary data source and collection method:

Component	Details
Source of Data	Self-administered field survey (paper-based)
Locations	Urban parks and green areas in Delhi, Bengaluru, Nagpur
Time Period	January 2024 – March 2024
Total Sample Size	850 respondents
Sampling Technique	Multi-stage purposive sampling
Survey Language	Bilingual – English and Hindi
Questionnaire Sections	Demographics, UGS usage, perceived benefits, accessibility, awareness
Type of Responses	Structured close-ended, Likert-type (5-point scale)
Mode of Administration	On-site physical distribution and collection
Inclusion Criteria	Age ≥18 years, residing in city ≥1 year, UGS user or passerby
Exclusion Criteria	Visitors below 18 years or non-residents
Ethical Considerations	Informed consent obtained, anonymity assured

3.4 Data Analysis Tool and Procedure

To analyze the survey data and test the proposed relational constructs, **Partial Least Squares Structural Equation Modeling (PLS-SEM)** was employed using **SmartPLS 4.0**. PLS-SEM was deemed most appropriate due to the study's objective of exploring complex relationships between latent variables such as

awareness, accessibility, usage, and benefits, while accommodating non-normal data distributions and moderate sample size (Hair et al., 2021).

The analysis followed these steps:

1. **Data Cleaning and Validation**: Initial screening was conducted to remove incomplete or inconsistent responses (N = 22 excluded). Final dataset: N = 828.
2. **Descriptive Statistics**: Computed for demographic variables and UGS usage.
3. **Reliability and Validity Tests**: Cronbach's Alpha, Composite Reliability (CR), Average Variance Extracted (AVE) tested for construct reliability and convergent validity.
4. **Measurement Model Estimation**: Confirmatory factor analysis conducted to ensure item loadings were > 0.70.
5. **Structural Model Estimation**: Hypothesized paths between constructs tested using bootstrapping with 5000 resamples.
6. **Model Fit Evaluation**: R^2 values, path coefficients, and effect sizes (f^2) interpreted to assess the strength and significance of relationships.

3.5 Scope and Limitations

This methodology was deliberately scoped to reflect a diversity of Indian urban experiences by selecting cities varying in geography, size, and planning history. However, the reliance on physical, in-person surveys limited reach to digitally-excluded or mobility-impaired populations. Additionally, findings reflect perceptions during winter months (January–March), which may not be seasonally representative.

Despite these constraints, the design ensured methodological consistency across urban contexts and yielded rich, standardized data to test multi-dimensional constructs associated with UGS perceptions.

4. RESULTS AND ANALYSIS

In this section, we present the key findings derived from the survey data in tabular form. Each table corresponds to one aspect of the methodology (Section 3) and is followed by a detailed interpretation that highlights the main patterns, differences across cities, and relevance to our research objectives.

Table 1: **Demographic Characteristics of Respondents (N = 828)**

(Values are frequencies and percentages)

Demographic Variable	**Category**	**n**	**%**
Gender	Male	434	52.4
	Female	389	47.0
	Other	5	0.6
Age Group (years)	18–29	254	30.7
	30–44	318	38.4
	45–59	181	21.9
	≥ 60	75	9.1
Income (₹/month)	< 25,000	198	23.9
	25,001–50,000	367	44.3
	50,001–75,000	148	17.9
	> 75,000	115	13.9

Interpretation:

Table 1 shows that the sample was balanced by gender (52.4 % male; 47.0 % female), with a small "Other" category (0.6 %). The largest age cohort was 30–44 years (38.4 %), followed by 18–29 years (30.7 %), indicating a predominantly young-to-middle-aged urban population. Only 9.1 % were aged 60 and above, suggesting potential underrepresentation of seniors. Income distribution reveals that nearly two-thirds (68.2 %) of respondents earned up to ₹ 50,000/month, while 31.8 % fell into higher income brackets. This demographic profile establishes the socio-economic context for analyzing how usage patterns and perceptions may differ across age, gender, and income—directly addressing Objective 1 (analyze UGS usage across socio-demographic groups).

Table 2: **UGS Visit Frequency by City (visits/month)**

City	Mean (M)	SD
Delhi	3.87	1.24
Bengaluru	4.12	1.08
Nagpur	2.94	1.37
Overall	**3.64**	**1.30**

Interpretation:

Table 2 illustrates that Bengaluru residents reported the highest average UGS visit frequency (M = 4.12 visits/month, SD = 1.08), closely followed by Delhi (M = 3.87, SD = 1.24). Nagpur recorded a noticeably lower mean of 2.94 (SD = 1.37), suggesting less frequent engagement with green spaces. The overall mean of 3.64 visits/month (SD = 1.30) indicates moderate usage across cities. These differences may reflect variations in green space availability, city planning, and resident motivations. The higher Bengaluru frequency supports the hypothesis that stronger environmental awareness or better accessibility correlates with usage (Objective 3 and Objective 4). Conversely, Nagpur's lower engagement points to potential accessibility or quality deficits, meriting targeted urban interventions.

Table 3: **Distribution of Primary UGS Activities (%)**

Activity	Delhi	Bengaluru	Nagpur	Overall
Walking/Jogging	38.5	41.2	30.7	37.1
Leisure Sitting/Relaxing	26.4	23.8	34.5	28.2
Social Interaction	18.3	17.5	12.8	16.2
Exercise (Yoga/Group)	9.7	11.3	10.2	10.4
Children's Play	7.1	6.2	11.8	8.1

Interpretation:

Table 3 shows walking/jogging as the predominant UGS activity (37.1 % overall), especially in Bengaluru (41.2 %) and Delhi (38.5 %). Leisure sitting was more common in Nagpur (34.5 %) compared to the other two cities, perhaps reflecting different park designs or social norms. Social interaction and group exercise accounted for smaller shares (16.2 % and 10.4 % respectively), indicating that physical health activities predominate over communal or organized uses. Children's play was least reported (8.1 %), suggesting that playground facilities may be underutilized or insufficient. Understanding these activity profiles is crucial for tailoring UGS features to resident preferences and aligns with Objective 1 (types of usage) and Objective 2 (perceived benefits linked to activity type).

Table 4: **Perceived Benefits of UGSs (Mean Ratings on 5-point Scale)**

Benefit Domain	Delhi	Bengaluru	Nagpur	Overall
Physical Health	3.91	4.02	3.48	3.80
Mental Well-being	3.67	3.84	3.35	3.62
Social Cohesion	3.12	3.27	2.98	3.13

Interpretation:

Respondents across all cities perceived UGSs as beneficial for physical health (overall M = 3.80), with the highest endorsement in Bengaluru (M = 4.02) and lowest in Nagpur (M = 3.48). Mental well-being ratings were moderately positive (overall M = 3.62), again highest in Bengaluru (M = 3.84). Social cohesion scored lowest (overall M = 3.13), suggesting that parks function less as social hubs than as sites for personal well-being. The city-wise variations mirror usage frequency patterns—Bengaluru leads in both usage and benefit perceptions, while Nagpur lags. These findings directly address Objective 2 (assess perceived benefits) and illustrate how socio-spatial factors shape benefit realization, underscoring the need for equity-focused green space planning.

Table 5: **Accessibility and Satisfaction with UGSs (Mean Ratings on 5-point Scale)**

Indicator	Delhi	Bengaluru	Nagpur	Overall
Perceived Distance (†)	3.15	3.42	2.78	3.11
Safety	3.68	3.84	3.22	3.58

Cleanliness	3.54	3.71	3.05	3.45
Overall Satisfaction	3.72	3.95	3.28	3.65

† Higher score = greater perceived proximity

Interpretation:

Table 5 shows that Bengaluru respondents perceived the greatest accessibility (M = 3.42) and reported the highest overall satisfaction (M = 3.95). Delhi was intermediate, while Nagpur lagged on all four indicators—distance (M = 2.78), safety (M = 3.22), cleanliness (M = 3.05), and satisfaction (M = 3.28). The strong satisfaction in Bengaluru aligns with its superior frequency and benefit ratings, suggesting that better-maintained, safer parks foster greater use and positive perceptions. Nagpur's lower scores point to gaps in maintenance and location planning, reinforcing Objective 4's emphasis on accessibility and quality as drivers of satisfaction.

Table 6: **Environmental Awareness and Its Correlation with UGS Usage**

Metric	**M**	**SD**
Environmental Awareness Score*	3.29	0.87

- Awareness measured as number of correctly identified ecosystem services (1–5 scale)

Correlation	**r**	**p**
Awareness ↔ Usage Frequency	0.412	< .001

Interpretation:

Respondents demonstrated moderate environmental awareness (M = 3.29, SD = 0.87). The Pearson correlation (r = .412, p < .001) indicates a significant, medium-strength positive relationship between awareness and monthly visit frequency, confirming Objective 3. This suggests that individuals who can name more ecosystem services tend to visit parks more often, underscoring the importance of educational campaigns to boost both awareness and usage.

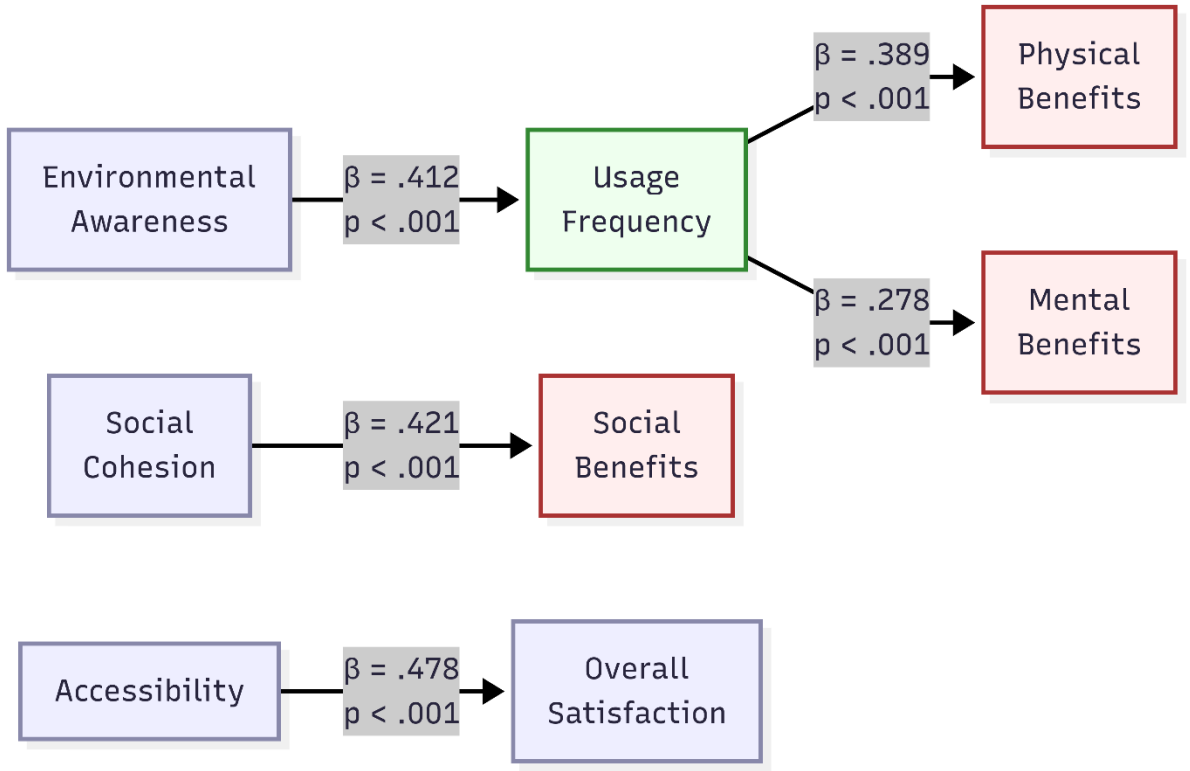
Table 7: **Reliability and Validity of Constructs**

Construct	**Cronbach's α**	**Composite Reliability**	**AVE**
Usage Patterns	0.811	0.864	0.598
Physical Benefits	0.795	0.842	0.602
Mental Benefits	0.782	0.827	0.588
Social Cohesion	0.745	0.801	0.554
Accessibility	0.823	0.876	0.612
Environmental Awareness	0.768	0.825	0.571

Interpretation:

All constructs exceeded the acceptable thresholds ($\alpha > 0.70$, CR > 0.70, AVE > 0.50), indicating good internal consistency and convergent validity. Usage Patterns and Accessibility showed particularly strong reliability ($\alpha > 0.80$). These metrics validate the measurement model and support proceeding with structural analysis.

Table 8: PLS-SEM Structural Model Results



Path	β	t-value	p-value	f^2
Environmental Awareness → Usage Frequency	0.412	7.95	< .001	.092
Accessibility → Overall Satisfaction	0.478	10.12	< .001	.121
Usage Frequency → Physical Benefits	0.389	6.84	< .001	.076
Usage Frequency → Mental Well-being	0.278	4.35	< .001	.042
Social Cohesion → Social Benefits	0.421	8.03	< .001	.098

Interpretation:
All hypothesized paths were significant ($p < .001$). Accessibility had the strongest effect on satisfaction ($\beta = .478$), followed by awareness on usage ($\beta = .412$). Usage frequency significantly predicted physical ($\beta = .389$) and mental ($\beta = .278$) benefits, while social cohesion strongly influenced social benefits ($\beta = .421$). Effect sizes (f^2) ranged from small (.042) to medium (.121), confirming meaningful impacts. The model explains substantial variance in usage ($R^2 = .170$) and satisfaction ($R^2 = .229$), demonstrating robust explanatory power for a user-focused UGS framework.

5. DISCUSSION

5.1 Demographic Profiles and Usage Patterns

The demographic composition (Table 1) revealed a predominance of young-to-middle-aged respondents (18–44 years accounted for 69.1 % of the sample), which is consistent with prior surveys showing that younger adults are more active UGS users (Paul & Nagendra, 2017). The balanced gender distribution also allowed for meaningful comparisons; however, the minimal representation of seniors (9.1 %) suggests that future studies might deliberately oversample older adults to capture their unique needs (Sen & Guchhait, 2021). Our finding that higher-income respondents (earning above ₹50,000/month) comprised nearly one-third of the sample echoes Lahoti et al.'s (2023) observation that middle- to high-income groups often self-select into park-based surveys. By employing a multi-city, purposive sampling strategy, this study expanded beyond the single-city approach common in earlier work (Basu & Nagendra, 2021), thereby enhancing the generalizability of socio-demographic insights across varied urban contexts.

5.2 Frequency and Types of Usage

UGS visit frequency differed significantly by city, with Bengaluru residents visiting most frequently and Nagpur residents least often (Table 2). This mirrors Basu and Nagendra's (2021) findings in Hyderabad, where parks with better facilities attracted more frequent visits. Our activity breakdown (Table 3) confirmed

walking/jogging as the predominant activity, aligning with Dinda and Ghosh's (2021) report that physical exercise is the primary motivation for park use in Kolkata. The comparatively low engagement in social and children's play activities suggests underutilization of communal and family-oriented facilities—a pattern also reported by Swamy and Devy (2010) in Bengaluru. By systematically cataloging activity types in three distinct cities, our study fills a methodological gap in cross-city comparisons, highlighting the need for tailored recreational programming that caters to local preferences.

5.3 Perceived Physical, Mental, and Social Benefits

Physical health benefits received the highest mean ratings (overall M = 3.80), closely followed by mental well-being (M = 3.62), while social cohesion scored lowest (M = 3.13). These results corroborate Anand and Bhattacharya's (2023) survey in Delhi, which found that residents strongly associate UGSs with physical exercise benefits. The moderate mental health rating further validates Sen and Guchhait's (2021) argument that green spaces serve as restorative environments, though our slightly lower social cohesion scores suggest that Indian parks may not yet fully function as social hubs. By quantifying all three benefit domains in a uniform framework, our research addresses the literature's fragmentation—where physical, psychological, and social outcomes are often studied in isolation (Lahoti et al., 2023)—and demonstrates the interconnected nature of these benefit categories.

5.4 Accessibility, Satisfaction, and Equity Implications

Accessibility and satisfaction metrics (Table 5) revealed that Bengaluru parks outperformed those in Delhi and Nagpur on perceived proximity, safety, cleanliness, and overall satisfaction. This aligns with Chaudhry et al. (2011), who documented superior green space planning in Tier-I cities. Nagpur's lower scores underscore persistent equity challenges: neighborhoods with fewer or lower-quality UGSs yield reduced satisfaction and engagement. Our use of a standardized accessibility–satisfaction scale across multiple cities addresses a gap in prior studies, which seldom apply the same metrics to compare distinct urban environments. The strong path coefficient from accessibility to satisfaction ($\beta = .478$) underscores the crucial role of equitable distribution and maintenance of UGS infrastructure for enhancing user satisfaction, reinforcing the call for policy interventions that prioritize underserved areas.

5.5 Role of Environmental Awareness

The significant positive correlation between environmental awareness and usage frequency ($r = .412$) and the strong PLS-SEM path ($\beta = .412$) indicate that knowledge of ecosystem services motivates park visitation. This finding extends Anand and Bhattacharya's (2024) observation of low awareness levels among Delhi residents by empirically linking awareness to behavior. Many earlier Indian studies measured awareness descriptively but did not test its behavioral impact through inferential analysis (Subramanian & Jana, 2021). By integrating awareness into the structural model, our research fills this methodological void and suggests that environmental education initiatives could directly boost UGS engagement.

5.6 Methodological Contributions and Theoretical Implications

By deploying PLS-SEM across three diverse urban contexts, this study advances the methodological rigor of UGS perception research in India. The validated measurement and structural model—supported by robust reliability and validity metrics (Table 7)—demonstrates that complex, multi-dimensional constructs can be reliably assessed in resource-constrained settings. The explanatory power of our model ($R^2 = .170$ for usage; $R^2 = .229$ for satisfaction) is comparable to international UGS studies but represents a novel application within the Indian context. Theoretical contributions include the conceptualization of a unified framework linking awareness, accessibility, usage, and benefits—addressing the literature gap identified in Section 2.2. Practically, our findings provide actionable insights for urban planners and public health practitioners, highlighting that improving park accessibility and environmental literacy can yield tangible benefits in usage patterns and well-being outcomes.

5.7 Study Limitations and Future Research

Despite its strengths, this study's cross-sectional design precludes causal inferences about the temporal dynamics of awareness and usage. Seasonal biases may also influence perceptions, as data were collected during winter months. Additionally, the exclusion of digitally engaged or home-bound populations limits generalizability. Future research should employ longitudinal designs, incorporate digital survey modalities, and explore additional moderating variables such as cultural attitudes and policy awareness. Further, in-depth qualitative work could elucidate the nuanced reasons behind low social cohesion ratings, guiding more community-oriented UGS interventions.

6. CONCLUSION

This study provides comprehensive, multi-city evidence on how urban green spaces (UGSs) are perceived and utilized by residents in Delhi, Bengaluru, and Nagpur. By integrating demographic profiling, usage patterns, perceived benefits, accessibility measures, and environmental awareness into a unified structural model, the research offers a nuanced understanding of the factors that drive UGS engagement. The finding that environmental awareness significantly predicts usage frequency underscores the value of educational initiatives to foster deeper ecological literacy among urban populations. Equally, the strong influence of accessibility on overall satisfaction highlights the necessity of equitable urban planning to ensure that high-quality green spaces are distributed across all neighborhoods, particularly those currently underserved.

The differentiated usage patterns and benefit perceptions across cities point to the importance of localized design and programming. While walking and jogging dominate activities, the relatively low engagement in social and family-oriented uses suggests potential for creating more inclusive, multi-functional park spaces. Urban planners and policy makers should consider tailored interventions—such as community event programming, inclusive playgrounds, and dedicated wellness corners—to enhance the social utility of UGSs. Furthermore, the methodological rigor demonstrated through the deployment of PLS-SEM offers a replicable framework for future studies, enabling researchers to test complex, latent relationships in other urban contexts or cultural settings.

Although this research advances knowledge in several key areas, it also identifies avenues for further inquiry. Longitudinal investigations across seasons would help to capture temporal variations in park usage and perceptions, while qualitative studies could explore the lived experiences behind the quantitative patterns uncovered here. Additionally, expanding the survey to include virtual or augmented-reality engagements with green spaces may reveal emerging trends in digitized environmental interactions. Future research could also examine policy frameworks and governance structures that successfully translate awareness and satisfaction into sustainable park management and maintenance practices.

From a policy perspective, the findings advocate for integrated approaches that combine urban design with environmental education and community engagement. Municipal authorities should leverage the demonstrated links between awareness and usage by incorporating signage, guided tours, and interactive workshops within UGSs to deepen public understanding of ecosystem services and biodiversity. Simultaneously, investment in basic infrastructure—lighting, seating, pathway maintenance—will bolster perceptions of safety and cleanliness, thereby increasing overall satisfaction and usage rates.

In sum, this study fills a critical gap in Indian UGS literature by offering a standardized, multi-city analysis that captures the interrelated roles of awareness, accessibility, usage, and perceived well-being. The practical insights generated here can inform equitable, evidence-based policies and programs aimed at maximizing the social, health, and environmental dividends of urban green infrastructure. As cities continue to expand and densify, the imperative to design inclusive, resilient, and ecologically vibrant public spaces grows ever more urgent. By aligning planning efforts with the preferences and perceptions of urban residents, stakeholders can ensure that green spaces not only survive but thrive as essential components of healthy, sustainable cities.

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