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Urban Green Space Engagement and Mental Well-Being: The Role of Accessibility, Activity, and Social Interaction among University Students in Kobe, Japan

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Abstract

Urban green spaces are increasingly recognized as important infrastructures for supporting mental well-being and social cohesion in cities. However, their benefits depend not only on accessibility but also on how they are used and experienced. This pilot study examines the relationships between green space accessibility, usage patterns, activity types, and perceived psychosocial outcomes among university students in Kobe City, Japan. A cross-sectional survey was conducted with 128 students at Kobe City University of Foreign Studies. The questionnaire captured data on accessibility, visit frequency, activity types, and perceived mental health and social interaction. Descriptive statistics and chi-square tests were used to assess associations between variables. Results indicate that perceived accessibility was significantly associated with visit frequency ($p = 0.022$) and inclusivity ($p < 0.001$). However, visit frequency alone was not significantly related to mental health outcomes ($p = 0.654$). Instead, activity type showed a stronger association with perceived mental health outcomes ($p = 0.007$): passive activities such as relaxing were linked to calmness and reduced anxiety, while active activities such as walking were associated with increased energy and stress reduction. Parks, visited by 68% of respondents, showed strong associations with positive emotional outcomes, including happiness (100%) and stress reduction (81%). Frequent users also reported higher levels of social interaction ($p < 0.001$). These findings suggest that ac-

cessibility was associated with more frequent use, but the psychosocial benefits of green spaces are shaped by activity, quality, and inclusivity. Urban planning should therefore move beyond proximity-based approaches toward designing multifunctional and user-oriented green environments that support both mental health and social interaction.

Keywords

Urban Green Space, Mental Well-Being, Social Interaction, Accessibility, Activity Patterns, University Students, Kobe City

1. Introduction

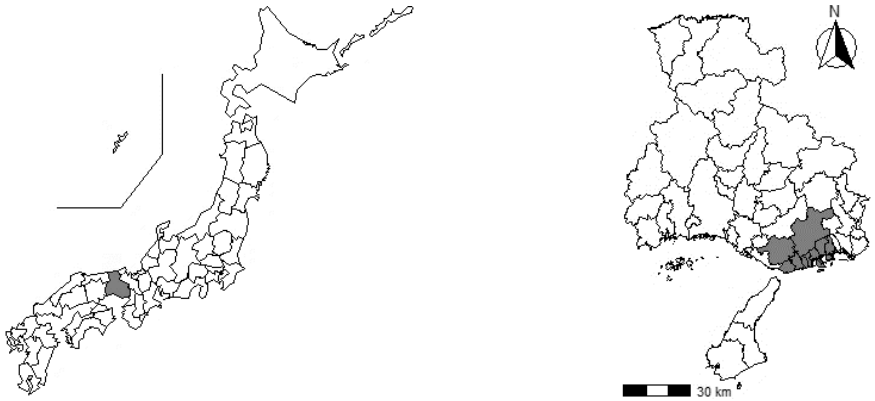
Urban green spaces such as parks, gardens, green corridors, and recreational landscapes are increasingly framed as core infrastructures for sustainable and health-supportive cities (Addas, 2023; Aram, 2024; Liu & Russo, 2021). Beyond ecosystem services, they are associated with improved population health, urban livability, and environmental resilience (World Health Organization, 2016, 2022; Kabisch et al., 2017; James et al., 2015; Liu & Russo, 2021). In dense urban contexts, exposure to green environments can mitigate stressors related to congestion, noise, and social isolation, while enabling physical activity and social interaction (Gascon et al., 2015; Twohig-Bennett & Jones, 2018; Nutsford et al., 2013).

Several studies have highlighted the positive associations between exposure to urban greenery and improved mental health outcomes, including reductions in anxiety, depression, and psychological distress (Hartig et al., 2014; van den Bosch & Ode Sang, 2017; Bressane et al., 2024a, 2024b; Twohig-Bennett & Jones, 2018; Maller et al., 2006). These effects are typically explained through stress-reduction and attention-restoration pathways (Ulrich et al., 1991; Kaplan & Kaplan, 1989; Hartig et al., 2014; van den Bosch & Ode Sang, 2017; Willis et al., 2024). In addition, green spaces also operate as social infrastructures that support informal encounters, belonging, and civic participation, contributing to social cohesion (Peters et al., 2010; Jennings & Bamkole, 2019; Maas et al., 2009).

In Japan, research on forest bathing (Shinrin-yoku) demonstrates measurable physiological and psychological benefits, including reduced cortisol and improved affect (Tsunetsugu et al., 2011; Song et al., 2016). Urban studies further suggest that even small-scale green spaces in high-density cities can support everyday mental restoration (Lu et al., 2022; Dadvand et al., 2015). Emerging evidence also links green environments to broader public health outcomes, including reduced psychological distress and suicide risk (Jiang et al., 2021; Xian et al., 2024). Despite these advances, two gaps remain. First, most Japanese studies focus on general populations or ecological associations, with limited attention to university students, a group facing heightened mental health risks due to academic pressure and life transitions (Tsunetsugu et al., 2011; Lu et al., 2022; Xian et al., 2024; Jiang et

al., 2021; Beiter et al., 2015). Second, prior work emphasizes availability and proximity, while comparatively less is known about how green spaces are used and experienced including activity types, frequency, perceived quality, and inclusivity factors increasingly recognized as central to health outcomes (Kabisch et al., 2017; Bratman et al., 2019).

Responding to these gaps, this study examines how green space accessibility, usage patterns, and activity types relate to perceived mental well-being and social interaction among students at Kobe City University of Foreign Studies (KCUFS) in Kobe City, Japan. Kobe offers a pertinent case due to its mountainous terrain and uneven green space distribution, which shape accessibility and patterns of use (Uchiyama et al., 2024). Accessibility encompasses not only spatial proximity but also perceived safety, walkability, connectivity, and the extent to which users feel comfortable using green spaces (Gibson, 2018). Beyond accessibility, recent studies emphasize that the health benefits of urban green spaces also depend on their inclusivity, namely whether people perceive these environments as welcoming, safe, equitable, and suitable for users with different social, cultural, and physical backgrounds (Jennings & Bamkole, 2019; Kabisch et al., 2017). By focusing on a student population within this complex urban setting, the study contributes micro-level behavior-based insights into how green spaces function as everyday environments for psychological restoration and social interaction. Against this backdrop, the present study aims to contribute to the growing body of literature on green space, well-being, and urban sustainability by providing empirical evidence from a complex urban context. **Figure 1** illustrates the geographical location of Japan, highlighting Hyogo Prefecture and Kobe City.



(a) (b)

Figure 1. (a) Map of Japan highlighting Hyogo prefecture; (b) Map of Hyogo prefecture with Kobe City. Map generated by R.

2. Methodology

2.1. Study Design and Participants

This study employed a cross-sectional pilot survey design to examine associations between green space accessibility, usage patterns, activity types, and perceived

mental health and social outcomes among university students in Kobe City, Japan. Cross-sectional designs are widely used in environmental health research to explore relationships between exposures and outcomes at a specific point in time, particularly in exploratory and hypothesis-generating studies (Levin, 2006; Setia, 2016). Kobe City, located in Hyogo Prefecture, provides a distinctive urban context characterized by a narrow coastal plain bordered by mountainous terrain, resulting in uneven spatial distribution and accessibility of green spaces. Such geographic heterogeneity offers a valuable setting to investigate how environmental accessibility and urban form shape green space use and well-being (Kabisch et al., 2017).

The target population comprised undergraduate and graduate students (aged ≥ 18 years) enrolled at KCUFS. University students were selected as a focal group due to their heightened vulnerability to mental health challenges linked to academic stress, social transitions, and urban living (Beiter et al., 2015; Stallman, 2010). A non-probability convenience sampling approach was adopted, with participants recruited from classes taught by the lead author. Data collection was conducted in July 2024, yielding 128 valid responses. The sample size is appropriate for a pilot study aimed at testing survey instruments and identifying preliminary associations. Prior methodological guidance suggests that samples of 100 - 150 are sufficient for pilot studies assessing feasibility and instrument reliability (Bujang et al., 2016; Hertzog, 2008). Additionally, for chi-square analyses, a sample size exceeding 100 is generally adequate to detect medium effect sizes (Cohen, 1988).

2.2. Data Collection Instrument

Data were collected using structured, self-administered online questionnaire developed using Google Forms. To ensure inclusivity and reduce language bias, the survey was administered in both English and Japanese, reflecting the diverse student population at KCUFS. In this study, perceived inclusivity refers to participants' perception that urban green spaces are welcoming, accessible, comfortable, and usable by people from diverse backgrounds, regardless of age, gender, nationality, cultural background, or physical ability. It also reflects whether respondents perceived green spaces as places where everyone feels safe, accepted, and able to participate in recreational or social activities. Inclusivity was assessed using participants' self-reported perceptions collected through the questionnaire. The questionnaire was initially developed in English and subsequently translated into Japanese by bilingual researchers. The translated version was reviewed by bilingual researchers to ensure conceptual equivalence, consistency of meaning, and cultural appropriateness across both language versions before survey administration.

The questionnaire was designed based on established frameworks in environmental psychology and public health research (Hartig et al., 2014; Bratman et al., 2019) and comprised six sections:

- Demographics: age, gender, nationality, and duration of residence in Kobe.
- Green space use and perception: frequency of visits, accessibility, and perceived quality.

- Mental health and well-being: emotional responses, stress reduction, and perceived benefits.
- Social interaction: frequency and types of social engagement in green spaces.
- Green space management and policy: perceptions of safety, inclusivity, and adequacy.
- SDG relevance: perceived contributions to sustainability and well-being.

The principal study constructs were operationalized using self-reported survey measures. Perceived accessibility was assessed through a single-item question asking respondents to rate how accessible urban green spaces were to them, with response categories ranging from "Not accessible" to "Very accessible." Inclusivity was measured by participants' agreement with the statement that green spaces in Kobe City were inclusive and welcoming to diverse users, using a five-point Likert scale from "Strongly disagree" to "Strongly agree." Perceived mental health benefits were assessed through respondents' agreement with the statement that access to green spaces positively contributed to their mental well-being, also using a five-point Likert scale. Social interaction was evaluated through questions regarding the frequency of interactions occurring in green spaces and the primary groups with whom respondents interacted (e.g., friends, family, neighbors, or strangers).

The survey included Likert-scale items, binary responses, and multiple-choice questions, along with one open-ended question to capture qualitative insights. Since the principal outcome measures in this exploratory pilot study were assessed using single-item indicators rather than multi-item scales, internal consistency reliability measures such as Cronbach's alpha were not applicable. The pilot phase enabled refinement of question clarity, structure, and respondent engagement.

2.3. Statistical Analysis

Data were analyzed using IBM SPSS Statistics (version 28). Descriptive statistics (means, standard deviations, frequencies, and percentages) were used to summarize participant characteristics and usage patterns. To examine relationships between categorical variables, Pearson's chi-square (χ^2) test of independence was applied. This method is commonly used in public health and social science research to assess associations between categorical variables (McHugh, 2013). Key variables examined included green space accessibility, visit frequency, activity type, perceived mental health outcomes, and social interaction. Statistical significance was set at $p < 0.05$. Given the exploratory nature and limited sample size of the pilot study, multivariate analyses (e.g., regression or structural equation modeling) were not conducted. However, the findings identify key variables such as activity type, inclusivity, and emotional responses that warrant inclusion in future multivariate analyses in larger, more representative samples (Bratman et al., 2019).

2.4. Ethical Considerations

The study adhered to established ethical standards for social science research (Israel & Hay, 2006). Participation was voluntary, and informed consent was ob-

tained digitally prior to survey completion. Participants were informed of the study's purpose, their right to withdraw at any time, and the confidentiality of their responses. All data were anonymized, with no personally identifiable information collected. Data were securely stored and accessible only to the research team, ensuring compliance with data protection and ethical research practices.

3. Results

3.1. Participant Characteristics and Green Space Use

A total of 128 students from KCUFS participated in the survey. The mean age of respondents was 19.60 years (SD ± 1.47), reflecting a young adult population typical of undergraduate students. Notably, 50% of participants had resided in Kobe City for less than one year, indicating a high proportion of newcomers to the city, likely due to their recent enrollment. This demographic feature is particularly relevant, as prior studies suggest that newcomers often rely on public spaces as avenues for social integration and place attachment (Scannell & Gifford, 2010). **Table 1** shows the general characteristics of the participants in the survey.

Table 1. General characteristics of the study subjects (N = 128).

Characteristics	*N*	%
Age, years (mean ± SD)	19.60 ± 1.47	
Duration of Residency		
Less than 1 year	64	50.0
1 to 3 years	40	31.3
4 to 6 years	2	1.6
More than 6 years	22	17.2
Frequency of Green Space Visit		
Never	7	5.5
Rarely	51	39.8
Monthly	24	18.8
Weekly	17	13.3
Daily	29	22.7
Preferred Types of Green Space		
No response	3	2.3
Parks	87	68.0
Community gardens	7	5.5
Nature reserves	8	6.3

Continued

Urban forests	19	14.8
Others	4	3.1
Green Space Activities		
No response	3	2.3
Walking	58	45.3
Jogging	6	4.7
Socializing	6	4.7
Relaxing	38	29.7
Meditating	6	4.7
Participating in community events	11	8.6
Green Space Accessibility		
No response	1	0.8
Not accessible	9	7.0
Somewhat accessible	35	27.3
Accessible	47	36.7
Very accessible	36	28.1
Emotional Impact of Green Space Visit		
No change	2	1.6
Less tressed	21	16.4
Happy	8	6.3
Energized	8	6.3
Relaxed	89	69.5
Perceived Mental Health Benefits from Green Space Access		
Strongly disagree	-	-
Disagree	2	1.6
Neutral	10	7.8
Agree	61	47.7
Strongly agree	55	43.0
Use of Green Spaces for Mental Health Activities		
Yes	39	30.5
No	89	69.5

Continued

Role of Green Spaces in Community Interaction and Social Cohesion		
Strongly disagree	1	0.8
Disagree	17	13.3
Neutral	42	32.8
Agree	49	38.3
Strongly agree	19	14.8
Types of Community Interactions in Green Spaces		
No response	16	12.5
Social gathering	20	15.6
Cultural events	22	17.2
Environmental activities	22	17.2
Sports and recreation	48	37.5
Others	-	-
Community Event Participation in Green Spaces		
Never	38	29.7
Rarely	62	48.4
Occasionally	26	20.3
Frequently	2	1.6
Perception of Green Space Inclusivity		
Strongly disagree	-	-
Disagree	7	5.5
Neutral	16	12.5
Agree	78	60.9
Strongly agree	27	21.1
Frequency of Social Interaction in Green Spaces		
Never	26	20.3
Rarely	64	50.0
Monthly	19	14.8
Weekly	15	11.7
Daily	4	3.1

Continued

Social Interaction Demographics in Green Spaces		
No interaction	19	14.8
Family	12	9.4
Friends	80	62.5
Neighbors	9	7.0
Strangers	6	4.7
Others	2	1.6
Rating of Green Space Management		
Poor	6	4.7
Good	36	28.1
Fair	68	53.1
Excellent	18	14.1
Perceived Need for Green Space Development		
No response	1	0.8
Strongly disagree	1	0.8
Disagree	5	3.9
Neutral	20	15.6
Agree	66	51.6
Strongly agree	35	27.3
Suggestions for Green Space Management Improvement		
No response	3	2.3
Increased maintenance	33	25.8
Better facilities (e.g., benches, restrooms)	63	49.2
More community events	27	21.1
Enhanced safety measures	21	16.4
More green spaces	39	30.5
Contribution of Green Spaces to SDGs		
No response	3	2.3
Good Health and Well-Being (SDG 3)	69	53.9
Sustainable Cities and Communities (SDG 11)	72	56.3
Climate Action (SDG 13)	22	17.2
Life on Land (SDG 15)	30	23.4

Note: The categories "Suggestions for Green Space Management Improvement" and "Contribution of Green Spaces to Sustainable Development Goals (SDGs)" were multiple-response questions. Respondents were permitted to select more than one option; therefore, total responses exceed the sample size (N = 128), and percentages do not sum to 100%.

Regarding usage, the majority of respondents (39.8%) reported visiting green spaces rarely, while only a small segment reported frequent use. Parks emerged as the most preferred type of green space (68.0%), followed by smaller green patches and community gardens. The most common activities were walking (45.3%) and relaxing (29.7%), while jogging, photography, and socializing were less frequent but notable. This aligns with global findings that walking and passive relaxation are dominant activities in urban greenery (Peters et al., 2010). Importantly, perceptions of green spaces were largely positive: 47.7% agreed and 42.9% strongly agreed that these spaces contribute to mental health benefits. Suggestions for improvement centered on infrastructure enhancements, such as benches, shaded areas, and restrooms (49.2%). This demand mirrors prior evidence that supportive amenities significantly influence both usage patterns and perceived quality of urban parks (Kaźmierczak, 2013).

3.2. Accessibility and Frequency of Visits

Pearson's chi-square test revealed a statistically significant association between perceived accessibility and frequency of visits ($\chi^2 = 29.290$, df = 16, $p = 0.022$) as shown in Table 2. Students who rated green spaces as "very accessible" were more likely to visit them regularly. This finding is consistent with established evidence that accessibility is one of the most critical determinants of green space utilization (Mitchell & Popham, 2008; Kabisch et al., 2017). For students who often balance academic schedules with limited free time, ease of access appears to be a crucial facilitator of engagement with green spaces.

Table 2. Relationship between perceived green space accessibility and frequency of visit.

Statistic	Value
Pearson Chi-square (χ^2)	29.290
Degrees of Freedom (*df*)	16
p-value	0.022*

Note: *$p < 0.05$; Several cells had expected frequencies below five; therefore, results should be interpreted with caution.

3.3. Accessibility and Inclusivity of Green Spaces

A statistically significant association was observed between perceived accessibility and inclusivity of green spaces, indicating that respondents who considered green spaces easier to access also tended to perceive them as more welcoming and suitable for people from diverse backgrounds. ($\chi^2 = 33.936$, df = 12, $p < 0.001$) as shown in Table 3. Students who rated green spaces as "accessible" or "very accessible" tended to perceive them as more inclusive, whereas those who viewed them as "not accessible" or "somewhat accessible" reported lower levels of inclusivity. This finding suggests that higher perceived accessibility was associated with greater perceptions of inclusivity and belonging within green spaces.

Table 3. Relationship between accessibility and inclusivity of green spaces.

Statistic	Value
Pearson Chi-square (χ^2)	33.936
Degrees of Freedom (*df*)	12
p-value	0.001*

Note: *$p < 0.05$; Several cells had expected frequencies below five; therefore, results should be interpreted with caution.

3.4. Activity Type and Mental Health Outcomes

The type of activity performed in green spaces was significantly associated with mental health outcomes ($\chi^2 = 35.867$, df = 18, $p = 0.007$) as shown in Table 4. Passive activities such as relaxing and meditating were more commonly associated with reports of calmness and reduced anxiety, whereas active engagements such as jogging and walking were more commonly associated with increased energy and reduced stress. This dual effect reflects the restorative and activating pathways of nature engagement discussed in environmental psychology literature (Korpela et al., 2008; Marselle et al., 2020). Furthermore, the type of green space visited was significantly associated with emotional responses ($\chi^2 = 36.983$, df = 20, $p = 0.012$) as shown in Table 5. Parks, the most frequently visited spaces, were strongly associated with relaxation (62.9%), stress reduction (81.0%), and happiness (100%). In contrast, community gardens and smaller patches elicited weaker impacts, potentially due to limited size, facilities, or maintenance. This emphasizes the role of design and quality in shaping psychosocial benefits, echoing Tanaka et al. (2020) on green space quality in urban Japan.

Table 4. Relationship between green space activities and perceived mental health benefits.

Statistic	Value
Pearson Chi-square (χ^2)	35.867
Degrees of Freedom (*df*)	18
p-value	0.007*

Note: *$p < 0.05$; Several cells had expected frequencies below five; therefore, results should be interpreted with caution.

Table 5. Relationship between type of green space visited and emotional impact.

Statistic	Value
Pearson Chi-square (χ^2)	36.983
Degrees of Freedom (*df*)	20
p-value	0.012*

Note: *$p < 0.05$; Several cells had expected frequencies below five; therefore, results should be interpreted with caution.

3.5. Frequency of Visits and Perceived Mental Benefits

Interestingly, no significant association was found between visit frequency and mental health benefits ($\chi^2 = 9.564$, df = 12, $p = 0.654$) as shown in Table 6. These findings indicate that visit frequency was not significantly associated with perceived mental health benefits in this sample. This contrasts with assumptions that more frequent exposure necessarily leads to greater benefits. Instead, quality and type of interaction appear more influential, a finding consistent with Hartig et al. (2014) and Cox et al. (2017). For urban planning, this indicates that simply increasing visitation may not be sufficient; enhancing the experiential quality of green spaces is equally critical. Similarly, accessibility was not significantly related to perceptions of community cohesion ($\chi^2 = 15.322$, df = 16, $p = 0.501$) as shown in Table 7. Although accessible spaces encourage visits, their social role may depend more on intentional design features (e.g., gathering spaces, programming) rather than accessibility alone.

Table 6. Relationship between green space visit and perceived mental health benefits.

Statistic	Value
Pearson Chi-square (χ^2)	9.564
Degrees of Freedom (*df*)	12
p-value	0.654

Table 7. Relationship between accessibility of green spaces and perceived role in promoting community interaction.

Statistic	Value
Pearson Chi-square (χ^2)	15.322
Degrees of Freedom (*df*)	16
p-value	0.501

3.6. Cluster Analysis of User Profiles

The cluster analysis was conducted as an exploratory technique to investigate whether distinct patterns of green space engagement could be identified among participants. Although the resulting three-cluster solution demonstrated poor silhouette quality and should therefore be interpreted cautiously, the analysis was retained to provide preliminary insights into potential behavioral groupings that may warrant further investigation in larger samples. A two-step cluster analysis was conducted using visit frequency, type of activity, community interaction, and emotional responses as shown in Figure 2. While a three-cluster solution was generated, the silhouette coefficient indicated poor model fit, suggesting overlapping patterns of behavior and weak subgroup differentiation. This limitation reflects the complexity of human-nature interactions, where individuals often engage in

multiple overlapping ways (e.g., using parks both for relaxation and socializing). Larger and more diverse samples are needed to detect meaningful user typologies.

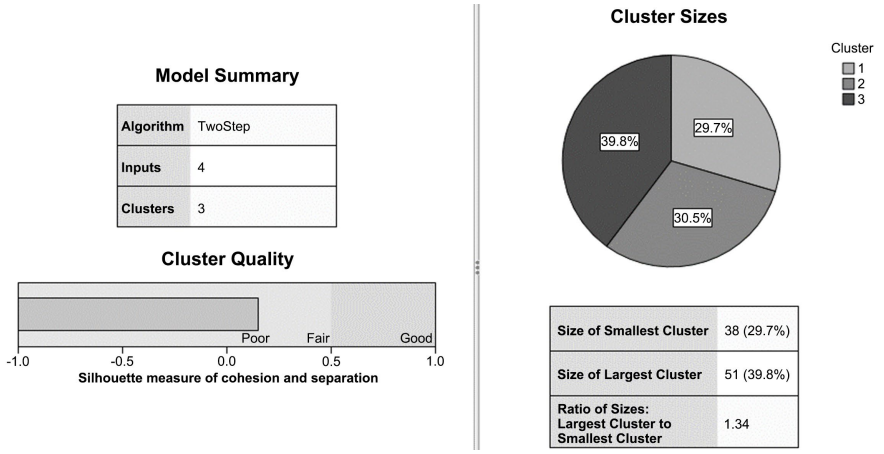


Figure 2. Distribution of participants across user profile clusters.

3.7. Residency Duration and Perceived Mental Health Benefits

A chi-square test found no significant association between residency duration and perceived mental health benefits of green space access ($\chi^2 = 5.61$, df = 9, $p = 0.778$) as shown in Table 8. Students reported similarly positive perceptions of mental health benefits regardless of how long they had lived in Kobe City. More than 90% of respondents across residency-duration categories either agreed or strongly agreed that green space access contributes positively to mental well-being. These findings suggest that the psychological benefits of urban green spaces are shared by both newcomers and long-term residents.

Table 8. Relationship between perceived mental health benefits and residency duration.

Statistic	Value
Pearson Chi-square (χ^2)	5.610
Degrees of Freedom (*df*)	9
P-value	0.778

4. Discussion

This study provides empirical insights into how urban green spaces contribute to mental well-being and social interaction among university students in Kobe City. KCUFS has a relatively large proportion of students who recently relocated to Kobe. Consequently, patterns of green space use may differ from universities with predominantly local commuter students or suburban campuses. Nevertheless, academic stress and transitional life stages are common across university populations, suggesting that many findings may be transferable while requiring confirmation in broader samples.

Consistent with existing literature, perceived accessibility was significantly associated with green space use, reinforcing evidence that proximity and ease of access are important correlates of utilization, with significant associations observed between perceived accessibility and visit frequency. This finding reinforces well-established evidence that proximity and ease of access are among the most consistent predictors of green space utilization (Mitchell & Popham, 2008; Kabisch et al., 2017; World Health Organization, 2016). For university students with constrained schedules, accessible green spaces appear to function as low-barrier environments for everyday engagement. However, the absence of a significant relationship between visit frequency and perceived mental health benefits challenges the assumption that increased exposure alone leads to improved outcomes. Instead, the findings suggest that the quality and nature of interaction with green spaces may be more closely associated with perceived mental health benefits than visit frequency alone. This aligns with theoretical frameworks such as Attention Restoration Theory and Stress Reduction Theory, which emphasize the importance of experiential qualities of environments rather than mere exposure (Kaplan & Kaplan, 1989; Ulrich et al., 1991). The observed associations between activity types and emotional outcomes further support this interpretation: passive activities were linked to relaxation and reduced anxiety, while active engagements were associated with increased energy and stress relief. Similar patterns have been reported in prior studies highlighting the context-dependent nature of green space benefits (Hartig et al., 2014; Cox et al., 2017; Marselle et al., 2020).

Another notable finding is the lack of variation in perceived mental health benefits across residency duration. Both newcomers and long-term residents reported similarly positive perceptions of the mental health benefits associated with green space access. This suggests that green spaces may function as socially inclusive environments that transcend differences in familiarity with place. Such findings support previous work indicating that urban green spaces facilitate social cohesion by providing shared, accessible environments for interaction (Peters et al., 2010; Jennings & Bamkole, 2019; Maas et al., 2009). A more precise comparison with prior studies further clarifies the contribution of the present research. Peters et al. (2010), based on research in urban parks in the Netherlands, found that parks can stimulate social interaction by providing shared public spaces where people from different social and cultural backgrounds can meet. Similarly, Maas et al. (2009), also using evidence from the Netherlands, showed that social contact may partly explain the relationship between green space and health. Jennings and Bamkole (2019), drawing mainly on evidence from the United States, emphasized that urban green spaces can strengthen social cohesion by supporting informal encounters, collective activities, and a sense of belonging. The present study is consistent with these findings in showing that green spaces in Kobe City are perceived as supportive environments for social interaction among university students. However, unlike these earlier studies, which largely focused on neighborhood residents or general urban populations, the present study focuses specifically on uni-

versity students, many of whom had recently relocated to Kobe. This difference is important because students may use green spaces less as long-term neighborhood spaces and more as flexible everyday settings for relaxation, stress relief, and peer interaction. In a city such as Kobe, characterized by demographic diversity, a transient student population, and a history of social resilience, green spaces may therefore play an especially important role in supporting both social integration and psychological well-being.

A further finding of this study is the absence of clearly distinguishable user groups in the cluster analysis. Although a three-cluster solution was generated, the low silhouette coefficient indicated considerable overlap in patterns of green space use. This suggests that students engage with green spaces in diverse and flexible ways rather than following distinct behavioral profiles. Such heterogeneity likely reflects the multifunctional nature of urban green spaces, where individuals shift between activities depending on their needs, available time, and social context. Similar complexities have been highlighted in recent research emphasizing the dynamic and context-dependent nature of human-environment interactions (Bratman et al., 2019). These findings further support the need for future studies employing larger samples and mixed-method approaches to better understand the diverse ways in which university students experience and benefit from urban green spaces.

The findings also have practical implications for the programming and management of urban green spaces. Although the present study did not investigate existing organized activities in Kobe City, previous research suggests that structured community engagement can increase green space use and strengthen social cohesion. In Japan, activities such as Shinrin-yoku (forest bathing) programs, community gardening, park volunteer initiatives, and nature conservation activities have been widely promoted to improve psychological well-being and encourage public engagement with natural environments (Tsunetsugu et al., 2011; Song et al., 2016). Internationally, universities and municipalities have introduced initiatives such as campus walking groups, outdoor yoga sessions, citizen science projects, environmental education programs, and community gardening, all of which have been associated with increased use of green spaces and improved mental and social well-being (Jennings & Bamkole, 2019; Hunter et al., 2019). Although these initiatives were not examined in the present study, they provide practical examples that could be adapted to the Kobe City context.

Limitations and Future Directions

Several limitations should be acknowledged. First, the use of convenience sampling limits the generalizability of the findings, as the sample may not be representative of the broader student population or other urban residents. Second, reliance on self-reported measures introduces potential recall and social desirability biases, which may affect the accuracy of reported behaviors and perceptions. Third, the cross-sectional design restricts causal inference, making it difficult to

determine whether green space use contributes to improved mental health or whether individuals with better mental health are more likely to engage with green spaces (Setia, 2016). Given the exploratory nature of this pilot study, the findings should be interpreted as preliminary evidence of associations rather than confirmation of causal relationships. These limitations point to several directions for future research. Studies with larger and more diverse samples are needed to improve representativeness and allow for subgroup analysis. Longitudinal designs would enable examination of temporal relationships and causal pathways between green space exposure and mental health outcomes. In addition, mixed-method approaches, incorporating qualitative methods such as interviews or participatory mapping, could provide deeper insights into how individuals experience and engage with green spaces in everyday contexts.

An additional limitation relates to the chi-square analyses. Several contingency tables contained cells with expected frequencies below five, indicating partial violation of the assumptions of Pearson's chi-square test. Consequently, some associations should be interpreted with caution. Future studies should employ larger sample sizes and consider collapsing sparse categories or applying exact statistical methods where appropriate.

Future research would also benefit from integrating objective measures of exposure and health outcomes. The use of spatial data, such as GIS-based accessibility and proximity indicators, can provide more precise assessments of environmental exposure, while physiological measures (e.g., cortisol levels, heart rate variability) can complement self-reported well-being and strengthen the robustness of findings (Dadvand et al., 2015; Kondo et al., 2018). Such approaches would enable a more comprehensive understanding of the mechanisms linking urban green spaces, mental health, and social interaction.

5. Conclusion and Recommendations

This exploratory cross-sectional study provides empirical evidence that urban green spaces function as important psychosocial infrastructures for university students in Kobe City. Accessibility was significantly associated with visit frequency ($\chi^2 = 29.290$, df = 16, $p = 0.022$) and perceptions of inclusivity ($\chi^2 = 33.936$, df = 12, $p < 0.001$), suggesting that ease of access remains an important correlate of engagement. However, frequent visits alone did not significantly predict mental health outcomes ($\chi^2 = 9.564$, df = 12, $p = 0.654$). Instead, the type of activity undertaken in green spaces showed a stronger association with perceived well-being outcomes ($\chi^2 = 35.867$, df = 18, $p = 0.007$). Passive activities such as relaxing and meditating were associated with calmness and reduced anxiety, while active behaviors such as walking were linked to increased energy and stress reduction, highlighting the multifunctional role of green spaces. Parks, visited by 68% of respondents, were particularly associated with positive emotional outcomes, including happiness (100%) and stress reduction (81%). Additionally, frequent users reported significantly higher levels of social interaction ($p < 0.001$), reinforcing the

role of green spaces as community-building environments. These findings contribute to ongoing debates in urban health research by demonstrating that proximity alone is insufficient; rather, the experience and use of green spaces are important factors associated with their perceived health value. For cities with complex spatial structures such as Kobe, this underscores the importance of integrating accessibility with design quality and user-oriented functionality. For student populations, green spaces can serve as low-cost, preventive mental health resources embedded within everyday urban life.

Building on these findings, urban planning should move beyond an access-based approach to prioritize the usability, inclusivity, and experiential quality of green spaces. Designing environments that support both restorative and active engagement through features such as quiet areas, walkable paths, seating, and adequate amenities can better address diverse psychological needs. Enhancing safety, accessibility, and user-friendly infrastructure is particularly important for student populations with limited time and mobility. In addition, activating green spaces through organized social programming, including student-led walking groups, community gardening, outdoor wellness activities, environmental education programs, and citizen science initiatives, may strengthen social interaction, encourage regular use, and enhance the mental health benefits of green spaces. Several of these initiatives have already been implemented successfully in Japan and other countries and could be adapted to the Kobe City context. Integrating green infrastructure into public health and campus planning frameworks, supported by evidence from both subjective experiences and objective measures, can enable more targeted and effective interventions. Overall, urban green spaces should be reconceptualized not merely as physical assets, but as dynamic social and health infrastructures that support mental well-being and community cohesion in complex urban environments.

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Author Contributions

R. K. Singh conceived and designed the study, developed the research methodology, supervised the overall research project, conducted the data collection and formal data analysis, interpreted the findings, and prepared the original manuscript draft. R. Singh contributed to the literature review, data analysis, statistical analysis, interpretation of the findings, and played an equal role in drafting the manuscript. N. Nozaki assisted with the interpretation of the results, critically reviewed the manuscript, and contributed to the intellectual content. M. H. F. Yabar

contributed to the study design, provided technical and methodological guidance, and critically reviewed and edited the manuscript. R. Rakwal contributed to the study design, provided technical and methodological guidance, and critically reviewed and edited the manuscript. All authors have read and approved the final version of the manuscript.

Declaration of Interest Statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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