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Understanding Chinese University Students' Preferences for Nature-based Recreation in Urban Parks

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Abstract

This study aim to measure the preference for nature-based recreation activities in parks among Chinese university students and identify key factors that influencing their choices. This research employ a quantitative approach, utilizing a structured questionnaire to collect data from 410 students, predominantly female, aged 21-23, and seniors. Multiple linear regression analysis was conducted to quantify the impact of environmental, individual and social demographic factors on students' preferences. The findings reveal that students prioritize activities such as walking, sunbathing, and socializing, with factors like family income, gender, companionship, and park accessibility significantly influencing their preferences. Environmental knowledge and landscape elements further enhance preferences for photography, meditation, and outdoor sports. Notably, the COVID-19 pandemic negatively impacted certain activities, underscoring its influence on outdoor recreation. These insights highlight the importance of park accessibility, aesthetic design, and environmental education in shaping students' recreational choices. The study provides practical recommendations for urban park design, such as improving landscape elements and creating inclusive spaces that cater to the diverse needs of university students. By addressing these factors, urban parks can better serve as vital spaces for relaxation, socialization, and well-being, contributing to sustainable urban development.

Keywords : Nature-based recreation;Urban Parks; Preference; Chinese university students; Multiple linear regression

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Introduction

Nature-based tourism has garnered significant attention in recent decades, emerging as a critical component of the global tourism industry (Räikkönen et al., 2023). The economic value of nature-based activities continues to rise(Haukeland et al., 2023), with the global ecotourism market valued at USD 181 billion in 2019 and estimated to cross USD 333.8 billion by 2027(Statista, 2023). This growth is further underscored by a 2021 Deloitte survey, which revealed that 81% of respondents across 19 countries participated in outdoor activities, while 55% purchased outdoor equipment within the past year(ISPO, 2021).

Beyond its economic impact, nature-based recreation plays a vital role in fostering social resilience, sustainability, and environmental awareness (Winter et al., 2019). For instance, outdoor education through nature-based activity could help counteract a societal disconnection form nature (Matti, 2013), while experiences in national park enhance environmental awareness and emotional connections(Shannon, 2012). Additionally, natural environments facilitate social interactions and symbolic landscapes that contribute to the the healing process for participants in recreational tourism activities (Wen, 2024).

Among the diverse participants in nature-based tourism, university students stand out as a unique influential demographic. Research has consistently shown that engagement in nature-based recreation activities can significantly benefit students' mental health (Rosa et al., 2023). However, despite the growing popularity of nature-base tourism, there remains a notable gap in understanding the specific factors that influence students' choosing a nature-based preferences for these activities(Tod, 2015). Existing studies often rely on qualitative methods or small-scale surveys, which may lack the statistical rigor to draw robust conclusions. Additionally, many studies fail to comprehensively examine the interplay of individual characteristics, environmental attributes, and social influences that shape these preferences.

This study aims to address these gaps by measuring the preference for nature-based recreation activities among university students in China and identifying the key factors influencing their choices. Employing a mixed-methods approach, combining quantitative surveys with qualitative insights, the research aims to provide a nuanced understanding of how students engage with urban green spaces. By doing so, this study not only contribute to the academic discourse on nature-based tourism, but also offers practical insights for park management and urban space design. These findings align with China's ongoing efforts to build greener, more livable cities, ensuring that urban parks meet the evolving needs of younger generations while promoting sustainable development.

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Literature Review

Nature-based Recreation Activities in Urban Parks

Nature-based recreation encompasses physical and intellectual interactions with biota, ecosystems and landscapes, offering individuals opportunities to connect with and experience natural environments (Vallecillo et al., 2019; Sumanapala & Wolf, 2020). These activities, which include hiking, trekking, cycling, picnicking, and nature observation, are not only recreational but also serve as platforms for educating visitors about biodiversity and environmental issues (Hughes, 2012; Immoos & Hunziker, 2015) Urban parks, as key components of green infrastructure, provide essential settings for nature-based recreation in cities, offering accessible space where individuals can engage with nature (Cortinovis et al., 2018). In the United States, for example, state park systems play a central role in delivering nature recreation services, highlighting the importance of publicly provided natural areas (Siikamäki, 2010).

The benefits of nature-based recreation are well documented, ranging from spiritual experiences and enhanced well-being to strengthened family relationships and community cohesion (Heintzman, 2016; Lee & Graefe, 2010). These activities contribute to individual health and societal sustainability by providing physical, aesthetic, and cultural benefits (Ballew & Omoto, 2010; IIhtimanski et al., 2020). Urban recreation environments, in particular, have been shown to positively influence residents' happiness and quality of life (Kang et al., 2021). Furthermore, advancements in technology have expanded the scope of nature-based recreation, enabling virtual experiences and digital platforms that facilitate outdoor activities and fitness tracking (Williams, 2024; Capdevila et al., 2024) .

Despite the extensive research on nature-based recreation and benefits of urban parks, few studies have focused on how students engage with these environment or the factors that influence their participation in nature-based activities. This gap is especially relevant in the context of rapid urbanization and the growing need for sustainable urban development.

Determinants of factors influencing university student's recreation activities

Research has identified a wide range of factors that influence students participation in nature-based recreation activities. These factors can be broadly categorized into environmental, individual and social demographic determinants.

Environmental factors play a significant role in shaping recreational preferences. The characteristics of landscape elements, vegetation coverage, and aesthetic quality directly impact students' engagement with nature environments(Wang et al., 2021). Additionally, the visual quality of recreational infrastructure and the typologies of green infrastructure, such as urban forests or tree-lined streets, influence the variety and appeal of recreational activities (Gundersen & Vistad, 2016; Soga & Gaston, 2016). Accessibility ot nature-based tourism and recreation is also closely tied to land-use management practice, which determine the availability and quality of recreational spaces (Hughes et al., 2013).

Individual and social demographic factors significantly shape students' recreation preferences. Studies have shown that gender, age, and academic discipline are positively associated with participation in campus green space (Liu et al., 2022). However, other research suggests minimal differences in outdoor recreation preferences across race and gender, highlighting the complexity of these influences(Teona, 2017). Cultural background and socioeconomic status also play a role, as different cultural groups perceive nature recreation diversely, and racial identity can influence youth's connection to nature (Johnson et al., 2005; Lackey et al., 2022). At the Individual-level, factors such as environmental knowledge, travel distance, education background, and group type, significantly predict recreational motivations and behaviors (Ge et al., 2023; Lee & Graefe, 2010). For instance, travelling companions -whether alone, with friends, or with partners- exhibits diverse activity patterns in nature-based tourism (Chen et al., 2016). The Covid-19 pandemic has further complicated these dynamics, as travel risk perception and restrictions have altered students' attitudes and behaviors toward nature toursim (Perić et al., 2021; Frank, 2021). These findings underscore the multifaceted nature of individual and social demographic influences on recreation preferences.

Therefore, in this study summarize the key factors influencing students' recreation activities as follow（Table 1）. These elements collectively shape students' preferences and behaviors in urban parks. Building this framework, the research aims to offer actionable insights for enhancing urban park design and management to better meet the needs of university students.

Table 1: Factors influencing university students' recreation activities in urban parks

Category	Factors	Description of factors
Environmental	Landscape elements	Physical features such as water bodies, hills, or open fields that enhance the aesthetic and functional appeal of recreational spaces. These elements create diverse settings for activities like hiking, picnicking, or photography.
	Vegetation coverage	The extent and type of plant life in a recreational area, which provides shade, improve air quality, and create a natural ambiance. Dense vegetation often attracts visitors seeking tranquility and connection with nature.
	Aesthetic quality	The visual attractiveness of a recreational environment, including scenic beauty and harmony. High aesthetic quality can evoke positive emotions and increase the likelihood of repeated visits.
	Accessibility	The ease with which individuals can reach and use recreational spaces, influenced by proximity, transportation networks, and land-use management. High accessibility encourages frequent visitation.
	Infrastructure	Facilities such as trails, benches, playgrounds, and restrooms that support recreational activities. Well-maintained infrastructure enhances users comfort and accessibility.

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

Individual and Social demographic	Gender	The influence of gender identity on activity preferences, with studies suggesting differences in how men and women engage with nature-based recreation. For example, women may prioritize safety and social activities more than men.
	Age	The impact of age on recreational choices, as younger individuals may prefer active or social activities, which older individuals may seek relaxation or solitude.
	Major	The field of study, which can shape students' environmental awareness and interest in nature-based activities. For instance, environmental science students may show great engagement in ecological activities.
	Socioeconomic status	Economic resources and social standing that affect access to recreational facilities and participation in certain activities. Higher socioeconomic status may enable more frequent and diverse recreational experiences.
	Environmental knowledge	An individuals' understanding of ecological systems and sustainability, which can shape their attitudes toward nature-based recreation. Greater knowledge often correlates with stronger environmental stewardship.
	Companionship	The composition of recreational groups, such as travelling alone, with friends, or with family, which influences activity patterns and preferences. Group dynamics can enhance enjoyment and social bonding.
	Pandemic impacts	Changes in recreational behaviors due to pandemic-related restrictions and risk perception. The pandemic has heightened the importance of outdoor spaces for mental health and safe social interaction.

Methodology

This study employ a quantitative research approach to measure the preferences of Chinese university students for nature-based recreation activities in urban parks. The methodology is designed to ensure robust data collection and analysis, providing reliable insights into the research questions. The following sections outline the research design, data collection methods and analytical techniques used in this study.

Research Design

The study adopts a cross-sectional survey design to collect data from the sample of Chinese university students. This design allows for the efficient collection of data at a single point in time, enabling the analysis of relationships between key variables that influence creation preferences. Specifically, the study examines the interplay of environmental factors(e.g., park accessibility, landscape elements, infrastructure quality) and individual and social demographic factors(e.g., gender, age, environmental knowledge) on students' preferences for nature-based recreation activities in urban parks.

Data Collection

Sampling

Chinese university student who have visited urban parks for recreation were recruited to join in the sampling process. The questionnaire is distributed online via platforms in Yibiaoda, a well known online survey website for Guangdong Province users, ensuring wide reach and ease of participation. After identifying the result of the participants, finally selected 410 participants for taking the questionnaire.

Survey Design

A structured questionnaire is developed to collect data according to the designated questions. The questionnaire consists of the following sections: demographic information, park usage patterns, preference measurement, and influencing factors. Demographic information will collect gender, age, major and year of study, and family monthly income. Park usage patterns will calculate the frequency of park visit, duration of visits, and preferred activities. Preference measurement will apply a 5-point Likert scale to measure the preferences for various activities ranging from "strongly dislike"(1) to "strongly like"(5). Influencing factors will consist questions of environmental, individual and social demographic factors using the 5 point scale to rating outcome of influencing intention, ranging from "not influence at all"(1) to "very strong influence "(5).

Multiple Linear Regression Analysis

A multiple linear regression model is employed to quantify the impact of independent variables on students' preferences for nature-based recreation activities. The model is specified as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \bullet\bullet\bullet + \beta_k X_k + \in$$

Where:

Y: Preference score for a specific activity (dependent variable);

β_0: Intercept term;

$\beta_1, \beta_2, \ldots, \beta_k$: Regression coefficients for independent variables;

$X_1, X_2, \ldots, X_k$: Independent variables (e.g., gender, park accessibility, group type)

$\in$: Error term.

Table 2: Variables in the Regression Model

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

Variables Type	Variable Name
Dependent Variables	Preference scores for 12 activities: Walking B. Jogging/Exercising C. Picnicking D. Photography E.Socializing with friends F. Meditating G. Outdoor sports H.Bird watching /Observing plants I. Dog walking J. Reading K. Board games /Cards L. Sunbathing
Independent Variables	Environmental factors: Landscape elements, Vegetation coverage, Aesthetic quality, Accessibility, Infrastructure
	Individual and social demographic factors: Gender, Age, Academic discipline, Socioeconomic status, Environmental knowledge, Companionship, Pandemic impacts

The regression analysis aims to identify the relative influence of each independent variable on students' preferences for specific activities. Variables such as gender, age, family income, park accessibility, and group type are included to access their significance. The model is tested for multicollinearity, heteroscedasticity, and normality of residuals to ensure the robustness of the results. The findings from this analysis provide insights into the key factors shaping students' engagement in nature-based recreation activities in urban parks.

Discussion and Implications

The sample consisted of 410 participants （Table 3）, predominantly female (68.05%, n=279), aged 21-23 (55.37%, n=227), and seniors (37.80%, n=155). Over 20% of the sample majored in Management, and the majority reported a family monthly income of 10,000-20,000 RMB (42.93%, n=176), with 34.63% (n=142) earning above 20,000 RMB. Most participants visited parks 1-3 times per month (56.34%, n=231).

Table 3：Frequency Analysis of Demographic and Characteristics of Survey Respondents

Variable	Option	Frequency	Percentage(%)	Cumulative Percentage(%)
Gender	Male	131	31.95	100
	Female	279	68.05	68.05
Age	18-20 years	111	27.07	27.07
	21-23 years	227	55.37	82.44
	24years or older	72	17.56	100
Year of Study	Freshman	34	8.29	8.29
	Sophomore	91	22.2	62.2
	Junior	130	31.71	40
	Senior	155	37.8	100
Major	Agricultural Science	7	1.71	1.71
	Medical Science	38	9.27	10.98
	History	5	1.22	12.2
	Philosophy	1	0.24	12.44
	Engineering	63	15.37	27.8
	Education	28	6.83	34.63
	Literature	45	10.98	45.61
	Law	9	2.2	47.8
	Science	73	17.8	65.61
	Management	82	20	85.61
	Economics	34	8.29	93.9
	Arts	25	6.1	100
Family Monthly Income	Below 5,000 RMB	19	4.63	100
	5000-10000 RMB	73	17.8	95.37
	10000-20000 RMB	176	42.93	42.93
	Above 20000 RMB	142	34.63	77.56
Park Visits	Less than once	31	7.56	100
	1-3 times	231	56.34	56.34
	4-6 times	110	26.83	83.17
	More than 7 times	38	9.27	92.44

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

Total	410	100	100

According the descriptive statistics of activity preference (Table 4), walking (Mean= 4.432) and Sunbathing (Mean=4.390) were the most preferred activities. Board Games/ Cards (Mean =3.385) and Dog walking (Mean=3.512) were the least preferred activities.

Table 4: Descriptive Statistics of Activity Preferences and Influencing Factors

Variable	Sample Size	Minimum	Maximum	Mean	Standard Deviation
Walking Preference	410	2	5	4.432	0.661
Jogging/ Exercising Preference	410	1	5	3.634	0.905
Picnicking Preference	410	1	5	3.99	0.862
Photography Preference	410	1	5	3.944	0.853
Socializing Preference	410	1	5	4.173	0.77
Meditation Preference	410	1	5	3.876	0.921
Outdoor Sports Preference	410	1	5	3.846	0.892
Bird Watching/ Plant Observation Preference	410	1	5	3.834	0.888
Dog Walking Preference	410	1	5	3.512	1.056
Reading/ Study Preference	410	1	5	3.605	1.051
Board Games/ Cards Preference	410	1	5	3.385	1.05
Sunbathing Preference	410	1	5	4.39	0.756
Influence of Landscape Elements	410	1	5	4.024	0.818
Influence of Vegetation Coverage	410	1	5	4.18	0.825
Influence of Aesthetic Quality	410	1	5	4.249	0.801
Influence of Infrastructure	410	1	5	4.085	0.797
Influence of Accessibility	410	1	5	4.102	0.887
Influence of Environmental Knowledge	410	1	5	3.727	0.922
Influence of Companionship	410	1	5	3.9	0.942
Influence of Pandemic	410	1	5	3.949	0.943

Table 5： Linear Regression Analysis Result for Walking Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	2.256	0.304	-	7.415	0.000**	-	-
Gender	0.005	0.065	0.003	0.074	0.941	1.086	0.921
Age	-0.055	0.06	-0.055	-0.92	0.358	1.845	0.542
Year of Study	-0.017	0.041	-0.026	-0.427	0.67	1.828	0.547
Major	0.015	0.008	0.083	1.813	0.071	1.073	0.932
Family Monthly Income	0.121	0.035	0.153	3.416	0.001**	1.025	0.976
Influence of Companionship	-0.032	0.035	-0.046	-0.922	0.357	1.243	0.804
Influence of Pandemic	-0.023	0.034	-0.033	-0.681	0.496	1.22	0.82
Influence of Landscape Elements	0.167	0.044	0.207	3.804	0.000**	1.505	0.664
Influence of Vegetation Coverage	0.078	0.042	0.097	1.839	0.067	1.431	0.699
Influence of Aesthetic Quality	0.15	0.044	0.181	3.428	0.001**	1.428	0.7
Influence of Infrastructure	0.032	0.042	0.039	0.766	0.444	1.303	0.768
Influence of Accessibility	0.061	0.036	0.081	1.679	0.094	1.197	0.836
Influence of Environmental Knowledge	0.02	0.036	0.028	0.555	0.579	1.288	0.776

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

R 2	0.223
Adjusted R 2	0.197
F-statistic	F (13,396)=8.727,p=0.000

Dependent Variable: Walking Preference
Significance Levels: * p<0.05 ** p<0.01

Table 6: Linear Regression Analysis Result for Jogging/Exercising Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	1.529	0.451	-	3.393	0.001**	-	-
Gender	-0.12	0.097	-0.062	-1.241	0.215	1.086	0.921
Age	0.126	0.089	0.092	1.421	0.156	1.845	0.542
Year of Study	-0.004	0.061	-0.005	-0.072	0.943	1.828	0.547
Major	-0.001	0.012	-0.006	-0.125	0.901	1.073	0.932
Family Monthly Income	0.141	0.052	0.131	2.707	0.007**	1.025	0.976
Influence of Companionship	-0.018	0.051	-0.019	-0.353	0.724	1.243	0.804
Influence of Pandemic	0.027	0.051	0.028	0.523	0.602	1.22	0.82
Influence of Landscape Elements	0.043	0.065	0.039	0.661	0.509	1.505	0.664
Influence of Vegetation Coverage	0.078	0.063	0.072	1.248	0.213	1.431	0.699
Influence of Aesthetic Quality	0.04	0.065	0.035	0.612	0.541	1.428	0.7
Influence of Infrastructure	0.101	0.062	0.089	1.629	0.104	1.303	0.768
Influence of Accessibility	0.051	0.053	0.05	0.959	0.338	1.197	0.836
Influence of Environmental Knowledge	0.087	0.053	0.089	1.635	0.103	1.288	0.776
R 2	0.091						
Adjusted R 2	0.061						
F-statistic	F (13,396)=3.056,p=0.000						

Dependent Variable: Jogging/Exercising Preference
Significance Levels: * p<0.05 ** p<0.01

Table 7: Linear Regression Analysis Result for Picnicking Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	2.092	0.424	-	4.928	0.000**	-	-
Gender	0.313	0.091	0.17	3.435	0.001**	1.086	0.921
Age	-0.075	0.084	-0.057	-0.893	0.372	1.845	0.542
Year of Study	-0.016	0.057	-0.018	-0.282	0.778	1.828	0.547
Major	0.002	0.011	0.008	0.153	0.878	1.073	0.932
Family Monthly Income	0.089	0.049	0.087	1.811	0.071	1.025	0.976
Influence of Companionship	0.172	0.048	0.188	3.559	0.000**	1.243	0.804
Influence of Pandemic	-0.028	0.048	-0.031	-0.587	0.558	1.22	0.82
Influence of Landscape Elements	0.049	0.061	0.046	0.798	0.426	1.505	0.664
Influence of Vegetation Coverage	-0.005	0.059	-0.005	-0.082	0.934	1.431	0.699
Influence of Aesthetic Quality	0.043	0.061	0.04	0.707	0.48	1.428	0.7
Influence of Infrastructure	-0.016	0.058	-0.014	-0.267	0.789	1.303	0.768
Influence of Accessibility	0.022	0.05	0.022	0.429	0.668	1.197	0.836
Influence of Environmental Knowledge	0.09	0.05	0.096	1.791	0.074	1.288	0.776
R 2	0.112						
Adjusted R 2	0.082						

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

F-statistic	F (13,396)=3.824,p=0.000

Dependent Variable: Picnicking Preference

Significance Levels: * p<0.05 ** p<0.01

Table 8：Linear Regression Analysis Result for Photography Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	2.125	0.415	-	5.119	0.000**	-	-
Gender	0.15	0.089	0.082	1.681	0.093	1.086	0.921
Age	-0.057	0.082	-0.044	-0.697	0.487	1.845	0.542
Year of Study	-0.021	0.056	-0.024	-0.372	0.71	1.828	0.547
Major	0.03	0.011	0.132	2.718	0.007**	1.073	0.932
Family Monthly Income	0.052	0.048	0.051	1.077	0.282	1.025	0.976
Influence of Companionship	0.022	0.047	0.024	0.459	0.647	1.243	0.804
Influence of Pandemic	0.004	0.047	0.005	0.092	0.927	1.22	0.82
Influence of Landscape Elements	0.119	0.06	0.114	1.98	0.048*	1.505	0.664
Influence of Vegetation Coverage	0.011	0.058	0.011	0.198	0.843	1.431	0.699
Influence of Aesthetic Quality	0.12	0.06	0.112	2.009	0.045*	1.428	0.7
Influence of Infrastructure	-0.108	0.057	-0.101	-1.889	0.06	1.303	0.768
Influence of Accessibility	0	0.049	0	-0.008	0.994	1.197	0.836
Influence of Environmental Knowledge	0.193	0.049	0.208	3.92	0.000**	1.288	0.776
R 2	0.132						
Adjusted R 2	0.104						
F-statistic	F (13,396)=4.649,p=0.000						

Dependent Variable: Photography Preference

Significance Levels: * p<0.05 ** p<0.01

Table 9：Linear Regression Analysis Result for Socializing Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	2.589	0.379	-	6.834	0.000**	-	-
Gender	0.114	0.081	0.069	1.402	0.162	1.086	0.921
Age	-0.148	0.075	-0.127	-1.976	0.049*	1.845	0.542
Year of Study	0.007	0.051	0.009	0.136	0.892	1.828	0.547
Major	0.012	0.01	0.059	1.194	0.233	1.073	0.932
Family Monthly Income	0.022	0.044	0.024	0.5	0.617	1.025	0.976
Influence of Companionship	0.107	0.043	0.131	2.479	0.014*	1.243	0.804
Influence of Pandemic	-0.05	0.043	-0.061	-1.164	0.245	1.22	0.82
Influence of Landscape Elements	0.03	0.055	0.032	0.544	0.587	1.505	0.664
Influence of Vegetation Coverage	0.054	0.053	0.058	1.026	0.305	1.431	0.699
Influence of Aesthetic Quality	0.019	0.054	0.02	0.345	0.73	1.428	0.7
Influence of Infrastructure	0.052	0.052	0.054	0.998	0.319	1.303	0.768
Influence of Accessibility	0.105	0.045	0.121	2.344	0.020*	1.197	0.836
Influence of Environmental Knowledge	0.061	0.045	0.072	1.348	0.179	1.288	0.776
R 2	0.113						
Adjusted R 2	0.084						
F-statistic	F (13,396)=3.885,p=0.000						

Dependent Variable: Socializing Preference

Significance Levels: * p<0.05 ** p<0.01

Table 10：Linear Regression Analysis Result for Meditation Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	1.179	0.441	-	2.674	0.008**	-	-
Gender	0.166	0.095	0.084	1.757	0.08	1.086	0.921
Age	0.127	0.087	0.092	1.462	0.144	1.845	0.542
Year of Study	0.027	0.059	0.028	0.455	0.649	1.828	0.547
Major	-0.02	0.012	-0.082	-1.708	0.088	1.073	0.932
Family Monthly Income	0.016	0.051	0.015	0.317	0.751	1.025	0.976
Influence of Companionship	-0.079	0.05	-0.08	-1.564	0.119	1.243	0.804
Influence of Pandemic	0.028	0.05	0.029	0.562	0.575	1.22	0.82
Influence of Landscape Elements	0.145	0.064	0.129	2.278	0.023*	1.505	0.664
Influence of Vegetation Coverage	0.074	0.061	0.067	1.207	0.228	1.431	0.699
Influence of Aesthetic Quality	0.031	0.063	0.027	0.484	0.629	1.428	0.7
Influence of Infrastructure	0.035	0.061	0.031	0.581	0.562	1.303	0.768
Influence of Accessibility	0.057	0.052	0.054	1.08	0.281	1.197	0.836
Influence of Environmental Knowledge	0.256	0.052	0.256	4.895	0.000**	1.288	0.776
R 2	0.159						
Adjusted R 2	0.132						
F-statistic	F (13,396)=5.771,p=0.000						

Dependent Variable: Meditation Preference

Significance Levels: * p<0.05 ** p<0.01

Table 11：Linear Regression Analysis Result for Outdoor Sports Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	1.484	0.435	-	3.407	0.001**	-	-
Gender	-0.095	0.093	-0.05	-1.021	0.308	1.086	0.921
Age	0.075	0.086	0.055	0.868	0.386	1.845	0.542
Year of Study	-0.013	0.059	-0.014	-0.214	0.83	1.828	0.547
Major	0.007	0.012	0.028	0.566	0.572	1.073	0.932
Family Monthly Income	0.092	0.05	0.087	1.823	0.069	1.025	0.976
Influence of Companionship	0.014	0.05	0.015	0.291	0.771	1.243	0.804
Influence of Pandemic	0.07	0.049	0.074	1.427	0.155	1.22	0.82
Influence of Landscape Elements	-0.001	0.063	-0.001	-0.021	0.983	1.505	0.664
Influence of Vegetation Coverage	0.084	0.061	0.078	1.39	0.165	1.431	0.699
Influence of Aesthetic Quality	0.062	0.062	0.056	0.99	0.323	1.428	0.7
Influence of Infrastructure	0.01	0.06	0.009	0.159	0.874	1.303	0.768
Influence of Accessibility	0.113	0.052	0.113	2.193	0.029*	1.197	0.836
Influence of Environmental Knowledge	0.175	0.052	0.181	3.391	0.001**	1.288	0.776
R 2	0.126						
Adjusted R 2	0.098						
F-statistic	F (13,396)=4.399,p=0.000						

Dependent Variable: Outdoor Sports Preference

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

Significance Levels: * p<0.05 ** p<0.01

Table 12: Linear Regression Analysis Result for Bird Watching/ Plant Observation Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	2.98	0.442	-	6.748	0.000**	-	-
Gender	-0.102	0.095	-0.054	-1.074	0.284	1.086	0.921
Age	0.08	0.087	0.06	0.921	0.358	1.845	0.542
Year of Study	-0.076	0.059	-0.083	-1.286	0.199	1.828	0.547
Major	-0.009	0.012	-0.037	-0.747	0.456	1.073	0.932
Family Monthly Income	0.029	0.051	0.028	0.572	0.568	1.025	0.976
Influence of Companionship	-0.059	0.05	-0.062	-1.17	0.243	1.243	0.804
Influence of Pandemic	-0.106	0.05	-0.113	-2.135	0.033*	1.22	0.82
Influence of Landscape Elements	0.156	0.064	0.144	2.455	0.015*	1.505	0.664
Influence of Vegetation Coverage	0.078	0.062	0.072	1.266	0.206	1.431	0.699
Influence of Aesthetic Quality	0.019	0.063	0.017	0.292	0.77	1.428	0.7
Influence of Infrastructure	0.013	0.061	0.012	0.216	0.829	1.303	0.768
Influence of Accessibility	-0.011	0.052	-0.011	-0.207	0.836	1.197	0.836
Influence of Environmental Knowledge	0.178	0.052	0.185	3.41	0.001**	1.288	0.776
R 2	0.094						
Adjusted R 2	0.064						
F-statistic	F (13,396)=3.149,p=0.000						

Dependent Variable: Bird Watching/ Plant Observation Preference

Significance Levels: * p<0.05 ** p<0.01

Table 13: Linear Regression Analysis Result for Dog Walking Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	2.088	0.527	-	3.96	0.000**	-	-
Gender	0.152	0.113	0.067	1.343	0.18	1.086	0.921
Age	0.011	0.104	0.007	0.101	0.919	1.845	0.542
Year of Study	-0.011	0.071	-0.01	-0.159	0.874	1.828	0.547
Major	-0.022	0.014	-0.079	-1.582	0.114	1.073	0.932
Family Monthly Income	-0.012	0.061	-0.009	-0.195	0.845	1.025	0.976
Influence of Companionship	0.145	0.06	0.129	2.418	0.016*	1.243	0.804
Influence of Pandemic	-0.04	0.059	-0.035	-0.666	0.506	1.22	0.82
Influence of Landscape Elements	0.07	0.076	0.054	0.919	0.359	1.505	0.664
Influence of Vegetation Coverage	-0.022	0.074	-0.017	-0.297	0.767	1.431	0.699
Influence of Aesthetic Quality	-0.002	0.076	-0.001	-0.026	0.979	1.428	0.7
Influence of Infrastructure	-0.036	0.073	-0.027	-0.495	0.621	1.303	0.768
Influence of Accessibility	0.001	0.063	0.001	0.011	0.991	1.197	0.836
Influence of Environmental Knowledge	0.24	0.062	0.21	3.845	0.000**	1.288	0.776
R 2	0.086						
Adjusted R 2	0.056						
F-statistic	F (13,396)=2.881,p=0.001						

Dependent Variable: Dog Walking Preference

Significance Levels: * p<0.05 ** p<0.01

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

Table 14：Linear Regression Analysis Result for Reading/Study Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	0.981	0.498	-	1.969	0.050*	-	-
Gender	0.168	0.107	0.075	1.571	0.117	1.086	0.921
Age	0.095	0.098	0.06	0.962	0.337	1.845	0.542
Year of Study	-0.025	0.067	-0.023	-0.377	0.706	1.828	0.547
Major	-0.004	0.013	-0.014	-0.292	0.77	1.073	0.932
Family Monthly Income	0.062	0.058	0.05	1.079	0.281	1.025	0.976
Influence of Companionship	0.012	0.057	0.011	0.212	0.832	1.243	0.804
Influence of Pandemic	0.062	0.056	0.056	1.112	0.267	1.22	0.82
Influence of Landscape Elements	-0.023	0.072	-0.018	-0.32	0.749	1.505	0.664
Influence of Vegetation Coverage	-0.03	0.07	-0.024	-0.437	0.662	1.431	0.699
Influence of Aesthetic Quality	-0.013	0.072	-0.01	-0.175	0.861	1.428	0.7
Influence of Infrastructure	0.096	0.069	0.073	1.394	0.164	1.303	0.768
Influence of Accessibility	0.022	0.059	0.019	0.374	0.708	1.197	0.836
Influence of Environmental Knowledge	0.42	0.059	0.368	7.107	0.000**	1.288	0.776
R 2	0.176						
Adjusted R 2	0.149						
F-statistic	F (13,396)=6.508,p=0.000						

Dependent Variable: Reading/Study Preference

Significance Levels: * p<0.05 ** p<0.01

Table 15：Linear Regression Analysis Result for Board Games/Cards Preference (n=410)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	1.668	0.504	-	3.308	0.001**	-	-
Gender	-0.076	0.108	-0.034	-0.701	0.484	1.086	0.921
Age	-0.029	0.1	-0.018	-0.287	0.774	1.845	0.542
Year of Study	0.1	0.068	0.092	1.471	0.142	1.828	0.547
Major	-0.005	0.013	-0.018	-0.367	0.714	1.073	0.932
Family Monthly Income	0.009	0.058	0.007	0.152	0.879	1.025	0.976
Influence of Companionship	0.289	0.057	0.259	5.03	0.000**	1.243	0.804
Influence of Pandemic	0.08	0.057	0.072	1.413	0.158	1.22	0.82
Influence of Landscape Elements	0.034	0.073	0.026	0.461	0.645	1.505	0.664
Influence of Vegetation Coverage	-0.007	0.07	-0.006	-0.103	0.918	1.431	0.699
Influence of Aesthetic Quality	-0.198	0.072	-0.151	-2.739	0.006**	1.428	0.7
Influence of Infrastructure	0.005	0.069	0.004	0.072	0.942	1.303	0.768
Influence of Accessibility	-0.006	0.06	-0.005	-0.103	0.918	1.197	0.836
Influence of Environmental Knowledge	0.241	0.06	0.212	4.04	0.000**	1.288	0.776
R 2	0.155						
Adjusted R 2	0.128						
F-statistic	F (13,396)=5.598,p=0.000						

Dependent Variable: Board Games/ Cards Preference

Significance Levels: * p<0.05 ** p<0.01

Table 16：Linear Regression Analysis Result for Sunbathing Preference (n=410)

ISSN (P): 3078-5316 | ISSN (E): 3078-5324 Doi:10.71113/JCSIS.v2i3.196

	Unstandardized Coefficients		Standardized Coefficients	t	p	Collinearity Statistics	
	B	Std. Error	Beta			VIF	Tolerance
Constant	2.542	0.372	-	6.829	0.000**	-	-
Gender	0.047	0.08	0.029	0.587	0.558	1.086	0.921
Age	0.011	0.073	0.009	0.147	0.883	1.845	0.542
Year of Study	0.015	0.05	0.019	0.293	0.77	1.828	0.547
Major	0.018	0.01	0.092	1.867	0.063	1.073	0.932
Family Monthly Income	-0.015	0.043	-0.016	-0.342	0.732	1.025	0.976
Influence of Companionship	-0.016	0.042	-0.02	-0.373	0.709	1.243	0.804
Influence of Pandemic	-0.033	0.042	-0.041	-0.783	0.434	1.22	0.82
Influence of Landscape Elements	0.08	0.054	0.087	1.493	0.136	1.505	0.664
Influence of Vegetation Coverage	0.088	0.052	0.096	1.699	0.09	1.431	0.699
Influence of Aesthetic Quality	0.156	0.053	0.165	2.923	0.004**	1.428	0.7
Influence of Infrastructure	0.017	0.051	0.018	0.341	0.733	1.303	0.768
Influence of Accessibility	0.023	0.044	0.027	0.515	0.607	1.197	0.836
Influence of Environmental Knowledge	0.086	0.044	0.104	1.941	0.053	1.288	0.776
R 2	0.111						
Adjusted R 2	0.082						
F-statistic	F (13,396)=3.792,p=0.000						

Dependent Variable: Sunbathing Preference

Significance Levels: * p<0.05 ** p<0.01

Through multiple linear regression analyses, the research identified key determinants of student's engagement in 12 different activities, highlighting the role of environmental, individual and social demographic factors. Below, we discuss the findings for each activity and their implications for urban park planning and management.

1.Walking (Table 5): Family monthly income (β=0.121, t=3.416, p=0.001), landscape elements (β=0.167, t=3.804, p=0.000) , and aesthetic quality (β=0.150, t=3.428, p=0.001) significantly positively influenced walking preferences. This suggests that students from higher-income families and those value scenic beauty and well-designed landscapes are more likely to enjoy walking.

2.Jogging/ Exercising (Table 6): Family monthly income (β=0.141, t=2.707,p=0.007) had a significant positive impact on jogging preferences. This indicates that students from higher-income families may have better access to fitness resources or more leisure time for exercise. Parks could consider adding more fitness equipment and jogging trails to attract a broader demographic.

3.Picnicking(Table 7): Gender (β =0.313, t=3.435, p=0.001) and companionship significantly influenced picnicking preferences, with female students and those visiting with friends or family showing higher engagement. This highlights the social nature of picnicking and the importance of providing spacious grassy areas for group activities.

4. Photography(Table 8): Major (β=0.03, t=2.718, p=0.007), landscape elements (β=0.119, t=1.980, p=0.048), aesthetic quality (β =0.120, t=2.009, p=0.045), and environmental knowledge (β =0.193, t=3.920, p=0.000) positively affected photography preferences. Students with a background in arts or related fields, as well as those with a greater appreciation for nature, were more likely to enjoy photography. Parks could enhance their appeal by incorporating visual elements and promoting environmental education.

5. Socializing with friends(Table 9): Age (β=-0.148, t=-1976, p=0.049) had a significant negative impact on socializing preference, suggesting that younger students are more inclined to engage in group activities. Companionship (β=0.107, t=2.479, p=0.014) and park accessibility (β=0.105, t=2.344, p=0.020) also played positive roles, emphasizing the need for parks to provide convenient transportation links and space conducive to social interaction.

6. Meditation (Table 10): Landscape elements (β=0.145, t=2.278, p=0.023) and environmental knowledge (β=0.256, t=4.895, p=0.000) positively influenced meditation preferences. Students who valued natural settings and had a deeper understanding of environmental conservation were more likely to enjoy meditative activities. Parks could create quiet, serene areas with natural features to cater to this preference.

7. Outdoor Sports (Table 11): Accessibility (β=0.113, t=2.193, p=0.029) and environmental knowledge (β=0.175, t=3.391, p=0.001) positively impacted outdoor sports preferences. Improving park transportation accessibility and promoting environmental awareness could encourage more students to participate in outdoor sports.

8. Bird watching/ Plant Observation (Table 12): Landscape elements (β=0.156, t=2.455, p=0.015) and environmental knowledge (β=0.178, t=3.410, p=0.001) positively influenced bird watching preferences, while the impact of pandemic (β=-

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0.106, t=-2.135, p=0.033) had a negative effect. This suggests that while natural features and environmental education are important, external factors like health concerns can deter participation.

9. Dog Walking (Table 13): Companionship (β=0.145, t=2.418, p=0.016) and environmental knowledge (β=0.240, t=3.845, p=0.000) positively influenced dog walking preferences. Park could consider adding pet-friendly facilities to attract dog owners.

10. Reading/ Study(Table 14): Environmental knowledge (β =0.420, t=7.107, p=0.000) had a strong positive impact on reading preferences, indicating that students with a greater appreciation for nature are more likely to use parks for quiet activities. Providing shaded seating areas and quiet zones could enhance this experience.

11. Board Games/Cards(Table 15): Companionship (β=0.289, t=5.030, p=0.000) and environmental knowledge (β=0.241, t=4.040, p=0.000) positively influenced preferences for board games, while aesthetic quality (β=-0.198, t=-2.379, p=0.006) had a negative effect. This suggests that students prioritize social interaction over scenic beauty for such activities. Parks could create designated areas for group games.

12. Sunbathing(Table 16): Aesthetic quality(β =0.156, t=2.923, p=0.004) positively influenced sunbathing preferences, highlighting the importance of aesthetically pleasing environments for relaxation activities.

Conclusion

The study offers valuable insights into the preferences of Chinese university students for nature-based recreation activities in urban parks and the factors shaping their choices. By employing a multiple linear regression analysis, the research identified key determinants of students' engagement in various activities, highlighting the interplay between environmental features, individual characteristics, and social dynamics. The results demonstrate that students are drawn to activities such as walking, picnicking and socializing, with factors like family income, gender, and park accessibility significantly influencing their preferences. Environmental knowledge and the aesthetic quality of parks were also found to enhance students' enjoyment of activities like photography, mediation, and outdoor sports. Notably, the Covid-19 pandemic had a impact of reducing interest in certain activities while underscoring the importance of parks as safe spaces for mental and physical well-being. These findings emphasize the need for urban parks to prioritize accessibility, aesthetic design, and environmental education to better meet the recreational needs of students. For example, parks could integrate more visually appealing elements, such as water features and flower gardens, while ensuring facilities like trails, seating areas, and fitness equipment are well-maintained and accessible. Additionally, fostering environmental awareness through educational programs could further encourage students to engage with nature.

Limitation

This study has several limitations that should be acknowledge. First, the sample is limited to Chinese University students in Guangdong Province, which may restrict the finding to other demographic groups. Cultural differences in recreation preferences and park usage pattern may not be fully addressed. The sample was predominantly female (68.05%) and senior students (37.80%), which may limit the generalization capacity of the findings. Future research could include a more balanced demographic representation. Additionally, the study focuses on perceived environmental factors (e.g., landscape elements, vegetation coverage) rather than objective measurement. And the certain factors, such as vegetation coverage and infrastructure, did not show a significant influence on students' preferences for nature-based recreation activities. This lack of impact may be attributed to the design of the questionnaire, where these factors were not describe in sufficient detail or clear and accessible language. To address this issue, future research could ensure factors are explained in simpler, more relatable terms. Besides, the use of multiple linear regression analysis assumes linear relationships between different variables, which may not always hold true and reflect the complexity of real-world preference. Future exploration will use mixed methods to complement quantitative data with qualitative insights, such as interviews or focus groups. By addressing these limitations, future studies can further enhance the applicability of the findings.

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Conflict of Interest

The authors declare no conflict of interest.

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Appendix:

A Survey on Preferences for Nature-based Recreation Activities in Urban Parks among Chinese University Students in Guangdong Province

To provide you with better tourism services, we kindly ask for a few minutes of your time to share your feelings and suggestions. We highly value your feedback and appreciate your participation! Let's get started now!

Part 1: Demographic Information

1.What is your gender?
Male B. Female
2.What is your age?
Under 18 B. 18-20 C.21-23 D.24or older
3.What is your year of study?
Freshmen B. Sophomore C. Junior D. Senior E. Other, please specify:
4.What is your major?
Science B. Engineering C. Medical Science D. Agricultural Science
E.Literature F. History G. Philosophy H. Economics
Management J. Law K. Education L. Arts
5.What is your family's monthly income?
Less than 5,000 RMB B. 5,000-10,000RMB
C.10000-20000RMB D.More than 20000RMB

Part 2: Park Usage Patterns

6.How often do you visit parks each month?
Less than once B. 1-3 times C. 4-6 times D. More than 7 times
7.What are your main purposes for visiting park? (Multiple choices)
Walking B. Jogging/Exercising C. Picnicking D. Photography
Socializing with friends F. Mediating G. Outdoor sports
H. Bird watching/ Observing plants I. Dog walking J. Reading/Study
K. Board games/ Cards L. Sunbathing M.Other, please specify:
8. How long do you usually stay in the park during each visit?
A. Less than 30 minutes B. 30 minutes to 1 hour
C. 1-2 hours D. More than 2 hours

Part 3: Activity Preferences

Please rate your preference for the following activities in urban parks (1 = Strongly dislike, 5 = Strongly like):
9. Walking leisurely on park trails and enjoying the scenery.
10. Jogging or using fitness equipment in the park.
11. Picnicking on the grass with friends or family.
12. Taking photos or recording videos of the scenery in the park.
13. Socializing and chatting with friends in the park.
14. Meditating or relaxing quietly in the park.
15. Participating in outdoor sports (e.g., badminton, table tennis).
16. Observing birds or plants and learning about nature.
17. Walking a pet dog and enjoying interactions with the pet.
18. Reading books or studying in the park.
19. Playing board games or cards with friends in the park.
20. Sunbathing and enjoying the sunshine in the park.

Part 4: Influencing Factors

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21.To what extent do the following factors influence your choice of activities in urban parks? (1 = No influence at all, 5 = Very strong influence):

22.How much do natural or artificial landscape elements (e.g., water features, hills, flower beds) influence your choice of park activities?

23.How much does vegetation coverage (e.g., the quantity and distribution of trees, grass, and plants) influence your choice of park activities?

24.How much does the scenic beauty and visual appeal of the park influence your choice of park activities?

25.How much does the quality of park facilities (e.g., trails, benches, lighting) influence your choice of park activities?

26.How much does the convenience of transportation to the park influence your choice of park activities?

27.How much does your environmental knowledge (e.g., understanding and awareness of nature conservation) influence your choice of park activities?

28.How much does companionship (e.g., visiting the park alone, with friends, or with family) influence your choice of park activities?

29.How much does the impact of COVID-19 or other epidemics (e.g., preference for outdoor activities due to health concerns) influence your choice of park activities?

Part 5: Open-Ended Question

30.Do you have any other suggestions or thoughts about nature-based recreation activities in urban parks?