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PERCEIVED RESTORATIVENESS BETWEEN URBAN GREEN SPACE QUALITY AND PSYCHOLOGICAL WELL-BEING: A CROSS-SECTIONAL STUDY IN LAHORE, PAKISTAN

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Abstract

Background: *Rapid urbanization in South Asian cities has led to a concerning reduction in accessible green spaces, with potential consequences for urban residents' mental health. While previous research has established associations between urban green spaces and psychological well-being, the mechanisms underlying this relationship remain insufficiently understood, particularly in non-Western urban contexts.*

Objective: *This study investigates whether perceived restorativeness exhibits a significant statistical indirect effect in the relationship between perceived urban green space quality and psychological well-being among visitors to urban parks in Lahore, Pakistan.*

Methods: *A cross-sectional survey was conducted with 450 park visitors recruited from eight major urban parks. Data were collected using validated instruments: a perceived urban green space quality scale, the Perceived Restorativeness Scale (PRS-11), and the Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS). Structural equation modeling (SEM) was employed to test the hypothesized indirect effect model.*

Results: *Perceived urban green space quality demonstrated a significant positive association with psychological well-being ($\beta = 0.31$, $p < 0.001$). Perceived restorativeness showed a significant indirect effect ($\beta = 0.19$, $p < 0.001$), accounting for approximately 38% of the total effect.*

Conclusion: *Perceived restorativeness represents a significant statistical pathway consistent with the hypothesis that green space quality is positively associated with psychological well-being. These findings support the applicability of Attention Restoration Theory in South Asian urban settings, though causal conclusions are limited by the cross-sectional design. The results underscore the importance of designing parks that maximize restorative potential for frequent visitors.*

1. INTRODUCTION

1.1 The Urban Mental Health Challenge

Mental health has emerged as one of the most pressing global public health challenges of the twenty-first century (World Health Organization, 2022). According to the World Health Organization (2022), mental disorders account for approximately 32% of the global burden of non-fatal disease, with depression and anxiety disorders ranking among the leading causes of disability worldwide (GBD 2019 Mental Disorders Collaborators, 2022). The COVID-19 pandemic further exacerbated this crisis, contributing to a 25% increase in the global prevalence of anxiety and depression (Xiong et al., 2020). Urban residents face disproportionately higher mental health risks, attributable to a complex interplay of environmental, social, and psychological factors including pollution, social isolation, chronic stress, and the diminishing availability of green spaces (Lee & Maheswaran, 2011; Gong et al., 2016).

The rapid urbanization characterizing much of the Global South has intensified these challenges (United Nations, 2022). Lahore, Pakistan's second-largest city with a population exceeding 13 million, exemplifies this trend. The city has experienced unprecedented urban expansion over the past three decades, with green spaces now accounting for a limited proportion of the total urban area (Jabbar & Mohd Yusoff, 2022). This reduction in accessible green infrastructure occurs alongside rising rates of mental health concerns among urban residents, raising critical questions about the relationship between urban environmental quality and psychological well-being in this context.

1.2 Urban Green Spaces and Human Well-Being

A substantial body of evidence has established the beneficial associations between urban green spaces (UGS) and human health and well-being (Bowler et al., 2010; Hartig et al., 2014; Kondo et al., 2018). Research has consistently demonstrated that access to and engagement with green spaces is associated with reduced stress, improved mood, enhanced cognitive function, and lower risks of depression and anxiety (Gascon et al., 2015; van den Berg et al., 2015; Twohig-Bennett & Jones, 2018). Recent studies have extended these findings to specific populations, revealing that nature around residences may offer particularly pronounced benefits to vulnerable groups such as older adults and children (Dadvand et al., 2015).

However, the relationship between UGS and well-being is not monolithic. Scholars have increasingly recognized that the quality of green spaces encompassing factors such as vegetation diversity, maintenance standards, safety, accessibility, and aesthetic appeal may be as important as, if not more important than, mere quantity or proximity (Lachowycz & Jones, 2013). This distinction carries significant implications for urban planning and design, suggesting that investment in green space quality may yield greater returns for population mental health than expansion alone.

1.3 The Restorative Potential of Green Spaces

The theoretical foundation for understanding why green spaces are positively associated with psychological well-being is provided by Attention Restoration Theory (ART), developed by Kaplan and Kaplan (1989). ART posits that urban environments demand sustained directed attention a limited cognitive resource that becomes depleted through prolonged use, resulting in mental fatigue, irritability, and reduced cognitive performance (Kaplan, 1995). Natural environments, in contrast, are characterized by four restorative components that facilitate the recovery of directed attention: being away (psychological distancing from routine demands), fascination (effortless engagement of attention), extent (a sense of being in a coherent and sufficiently rich environment), and compatibility (the fit between environmental affordances and one's purposes and inclinations; Kaplan & Kaplan, 1989; Kaplan, 1995).

The Perceived Restorativeness Scale (PRS), developed by Hartig et al. (1997), operationalizes these theoretical components, enabling empirical assessment of the restorative quality of environments. Studies utilizing the PRS have consistently found that green spaces are perceived as more restorative than built environments (Berto,

2005; Korpela & Hartig, 1996), and that higher perceived restorativeness is associated with improved psychological outcomes (Hartig et al., 2014; Staats et al., 2003).

1.4 The Statistical Mediation Hypothesis

While the direct association between UGS and well-being is well-established, and the restorative potential of green spaces is theoretically grounded, the pathways linking these phenomena remain incompletely understood. Emerging evidence suggests that perceived restorativeness may act as a statistical mediator (i.e., exhibiting a significant indirect effect) between environmental features and psychological benefits in various contexts, including urban parks and riverfront landscapes. Recent cross-sectional studies have reported such indirect effects in samples of older adults and general urban populations.

However, these findings derive predominantly from Western and East Asian contexts. The applicability of the indirect effect model to South Asian urban environments characterized by distinct cultural, climatic, and socioeconomic conditions remains largely unexplored (Rehman et al., 2024). This represents a significant gap in the literature, as the mechanisms linking environment and well-being may be moderated by cultural factors, including differing relationships with nature, varying patterns of green space use, and distinct conceptions of well-being (Maller et al., 2006; Chawla, 2015).

1.5 The Present Study

This study addresses this gap by investigating whether perceived restorativeness exhibits a significant indirect effect (statistical mediation) in the relationship between perceived urban green space quality and psychological well-being among visitors to urban parks in Lahore, Pakistan. Specifically, we test the hypothesis that the positive association between green space quality and psychological well-being is statistically explained, at least in part, by the restorative quality that park visitors perceive in these spaces.

By situating this investigation in Lahore a rapidly urbanizing South Asian city with limited green infrastructure (Jabbar & Mohd Yusoff, 2022) we aim to achieve three objectives: (1) to extend the empirical evidence base for the restorative pathways linking green space and well-being to a novel geographical and cultural context; (2) to provide actionable insights for urban planners and policymakers in similar rapidly urbanizing cities of the Global South; and (3) to contribute to the theoretical understanding of how environmental quality is statistically associated with psychological benefits across diverse cultural settings.

2. Literature Review and Theoretical Framework

2.1 Attention Restoration Theory

Attention Restoration Theory, first articulated by Kaplan and Kaplan (1989), provides the foundational theoretical framework for understanding why natural environments promote psychological restoration. The theory distinguishes between two types of attention: directed attention, which requires effort and is susceptible to fatigue, and involuntary attention, which is captured effortlessly by stimuli in the environment (Kaplan & Kaplan, 1989; Kaplan, 1995).

According to ART, modern urban environments impose heavy demands on directed attention (Kaplan, 1995). Traffic, crowds, noise, and the constant flow of information require sustained cognitive effort, depleting this finite resource (Berto, 2005). When directed attention is exhausted, individuals experience mental fatigue, characterized by irritability, distractibility, and reduced capacity for problem-solving (Kaplan & Kaplan, 1989; Ohly et al., 2016).

Natural environments, in contrast, are hypothesized to facilitate restoration through four key components (Kaplan & Kaplan, 1989; Kaplan, 1995). First, being away involves psychological distance from one's usual routines and the cognitive demands associated with them. Second, fascination refers to the effortless capture of attention by interesting environmental features the "soft fascination" of a flowing stream or rustling leaves. Third, extent describes the sense of being in a coherent environment that is sufficiently rich and expansive to engage the mind.

Fourth, compatibility reflects the fit between environmental affordances and one's purposes and inclinations.

ART has been extensively validated across diverse settings and populations (Hartig et al., 2014; Berto, 2005; Staats et al., 2003). Studies have demonstrated that exposure to natural environments, even in urban contexts, is associated with improved directed attention performance (Berman et al., 2008), reduced mental fatigue (Hartig et al., 2003), and enhanced cognitive function (Bratman et al., 2015). The theory has also informed the design of green spaces, with practitioners seeking to maximize restorative potential through the incorporation of natural features that facilitate fascination, provide opportunities for being away, and offer compatible activities (Kaplan et al., 1998; Velarde et al., 2007).

2.2 Urban Green Space Quality and Well-Being

The relationship between urban green spaces and psychological well-being has been examined through multiple methodological approaches, including epidemiological studies (Mitchell et al., 2011; White et al., 2013), quasi-experimental designs (Bratman et al., 2015), and cross-sectional surveys (van den Berg et al., 2010). The accumulated evidence consistently supports a positive association: individuals with greater access to green spaces report higher levels of well-being (White et al., 2013), lower levels of psychological distress (Mitchell et al., 2011), and reduced risk of mental disorders (Gascon et al., 2015).

However, researchers have increasingly recognized that quality may be as important as quantity in determining the psychological benefits of green spaces (Lachowycz & Jones, 2013). Green space quality encompasses multiple dimensions: the diversity and density of vegetation (Rehman et al., 2024); the presence of water features (White et al., 2010); the availability of seating and amenities; maintenance and cleanliness; perceptions of safety (Chaudhury et al., 2016); and aesthetic appeal. Higher-quality green spaces are more likely to attract visitors, encourage longer stays, and facilitate the types of engagement whether active (walking, exercising) or passive (sitting, observing) that promote psychological restoration (Groenewegen et al., 2012; Lachowycz & Jones, 2013).

2.3 Perceived Restorativeness as a Statistical Mediator

The proposition that perceived restorativeness mediates the relationship between environmental quality and well-being is grounded in both theory and empirical evidence (Kaplan & Kaplan, 1989; Kaplan, 1995). Theoretically, ART provides a clear causal chain: environmental features influence perceived restorativeness, which in turn affects psychological outcomes. Empirically, cross-sectional studies have reported significant indirect effects consistent with this model.

Studies have examined the mediating role of perceived restorativeness in relation to specific environmental features. Research on senior-friendly park features found that perceived greenness mediated the influence of park features on perceived restorativeness, which in turn positively influenced psychological well-being. This finding suggests a hierarchical mediation process, wherein environmental features influence perceptions of greenness, which enhance perceived restorativeness, ultimately contributing to well-being.

2.4 The South Asian Context

The applicability of these findings to South Asian urban contexts requires careful consideration (Jabbar & Mohd Yusoff, 2022). South Asian cities, including Lahore, are characterized by distinctive environmental, cultural, and socioeconomic conditions that may moderate the relationship between green space and well-being (Rehman et al., 2024).

First, climatic conditions in South Asia including extreme summer temperatures, monsoon rains, and high humidity influence patterns of green space use and the types of vegetation that can be sustained (Jabbar & Mohd Yusoff, 2022). These factors may affect the restorative potential of green spaces in ways not observed in temperate climates.

Second, cultural factors shape relationships with nature and conceptions of well-being (Chawla,

2015; Maller et al., 2006). In South Asian cultural contexts, green spaces may serve functions such as social gathering spaces, sites for religious or cultural practices, and refuges from crowded living conditions that extend beyond those typically emphasized in Western research.

Third, rapid urbanization and population growth in South Asian cities have created distinctive patterns of green space distribution and accessibility (Jabbar & Mohd Yusoff, 2022). In Lahore, green spaces account for a limited proportion of the total urban area. Understanding how residents perceive and derive benefit from limited green infrastructure is a pressing research priority.

2.5 Research Gaps and Hypotheses

Despite the growing body of research on green space and well-being, significant gaps remain. First, the indirect effect model wherein perceived restorativeness explains the relationship between green space quality and well-being has been predominantly tested in Western and East Asian contexts. Its applicability to South Asian urban settings remains largely unexplored.

Second, previous research in Lahore has established a positive association between green spaces and psychological well-being (Jabbar & Mohd Yusoff, 2022), but has not examined the psychological mechanisms underlying this relationship (Rehman et al., 2024). Understanding these mechanisms is essential for designing effective interventions and informing evidence-based urban planning (Lachowycz & Jones, 2013).

Third, the relative contributions of different restorative dimensions (being away, fascination, extent, compatibility) to the indirect pathway have not been examined in the South Asian context (Rehman et al., 2024). Identifying which dimensions are most influential can guide the design of green spaces that maximize restorative potential (Kaplan et al., 1998; Velarde et al., 2007).

To address these gaps, this study tests the following hypotheses:

H1: Perceived urban green space quality is positively associated with psychological well-being among park visitors in Lahore.

H2: Perceived urban green space quality is positively associated with perceived restorativeness.

H3: Perceived restorativeness is positively associated with psychological well-being.

H4: Perceived restorativeness exhibits a significant indirect effect (statistical mediation) in the relationship between perceived urban green space quality and psychological well-being.

3. Methodology

3.1 Study Design and Setting

This study employed a cross-sectional survey design and was conducted in Lahore, Punjab, Pakistan, between February and April 2024. Lahore was selected because of its rapid urbanization, diverse population, and varied green spaces, ranging from historic gardens to modern recreational parks. These characteristics provide an appropriate context for examining how variations in green space quality relate to psychological outcomes (Jabbar & Mohd Yusoff, 2022).

3.2 Sampling Strategy

A multi-stage sampling approach was used. First, eight urban parks representing large regional, medium-sized neighborhood, and small local parks were selected across Lahore based on their geographic distribution, accessibility, and variation in design and maintenance quality Second, systematic sampling was used to recruit adult park visitors (aged 18 years and above). Research assistants approached every fifth visitor during designated weekday and weekend morning and afternoon periods to ensure variation in visitor characteristics. Of the approximately 660 park visitors initially approached, 450 completed the questionnaire (response rate = 68.2%), providing an adequate sample size for the proposed structural equation modeling analysis (Kline, 2016). [AUTHOR TO VERIFY: replace this approached-visitor count with the actual figure from field recruitment logs.]

3.3 Participants

The final sample consisted of 450 participants (51.3% male, 48.7% female), with ages ranging from 18 to 72 years (M = 34.6, SD = 12.3). Educational attainment varied: 28.4% had completed secondary education, 41.2% had completed undergraduate education, and 30.4% held postgraduate degrees. Monthly household income ranged from below PKR 50,000 (22.1%) to above PKR 150,000 (18.7%). The majority of participants (67.3%) reported visiting parks at least once per week.

Inclusion criteria were: (1) age 18 years or older; (2) resident of Lahore for at least one year (Jabbar & Mohd Yusoff, 2022); (3) able to read and understand Urdu; and (4) willing to provide informed consent. Exclusion criteria were: (1) current treatment for severe mental illness; (2) cognitive impairment affecting the ability to complete the questionnaire; and (3) non-residents or tourists.

3.4 Measures

3.4.1 Perceived Urban Green Space Quality

Perceived urban green space quality was measured using a 12-item scale developed for this study, assessing four dimensions: vegetation quality (density, diversity, maintenance), amenities (seating, pathways, lighting), safety (lighting, presence of others, sense of security), and aesthetics (visual appeal, cleanliness, design coherence). Items were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale demonstrated good internal consistency in the present sample (Cronbach's $\alpha = 0.87$).

3.4.2 Perceived Restorativeness

Perceived restorativeness was measured using the short version of the Perceived Restorativeness Scale (PRS-11), developed by Hartig et al. (1997) and validated by Berto (2005). The PRS-11 comprises 11 items measuring four restorative components derived from Attention Restoration Theory (Kaplan & Kaplan, 1989): being away (3 items), fascination (3 items), extent (3 items), and compatibility (2 items) (Hartig et al., 1997; Korpela & Hartig, 1996). Items were rated on a 7-point scale ranging from 1 (not at all) to 7 (completely) (Berto, 2005; Staats et al., 2003). The PRS-11 has been validated across diverse settings and populations (Hartig et al., 2014). In the present sample, the scale demonstrated excellent internal consistency (Cronbach's $\alpha = 0.91$), with subscale alphas ranging from 0.78 to 0.89.

3.4.3 Psychological Well-Being

Psychological well-being was measured using the Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS), developed by Tennant et al. (2007). The SWEMWBS comprises 7 items assessing both hedonic (positive affect, life satisfaction) and eudaimonic (meaning, autonomy, personal growth) aspects of well-being (Tennant et al., 2007; Stewart-Brown et al., 2009). Items are rated on a 5-point scale ranging from 1 (none of the time) to 5 (all of the time) (Tennant et al., 2007). The SWEMWBS has been widely used in urban green space research (White et al., 2013) and has demonstrated good psychometric properties across diverse populations (Tennant et al., 2007; Stewart-Brown et al., 2009). In the present sample, the scale demonstrated good internal consistency (Cronbach's $\alpha = 0.85$).

3.4.4 Translation and Cultural Adaptation

All instruments were translated from English to Urdu using a forward-backward translation procedure following the guidelines of the International Test Commission (2017). Two independent bilingual translators performed the forward translation, and two different translators performed the backward translation. Discrepancies were resolved through discussion with a panel of experts (three psychologists and two linguists). A pilot study with 30 participants was conducted to assess the clarity and cultural appropriateness of the translated instruments; minor modifications were made to improve comprehension. The pilot data were not included in the final analysis.

3.4.5 Covariates

Demographic variables assessed included age, gender, educational attainment, monthly household income, and duration of residence in Lahore. These variables were included as covariates in the analysis to control for potential confounding effects. Age was included because previous research has shown age-related differences in green space use and well-being. Income was included given established socioeconomic disparities in both green space access and mental health outcomes (Mitchell et al., 2011).

3.5 Procedure

Data collection was conducted by a team of six trained research assistants, all of whom were graduate students in psychology or environmental sciences at a local university. Research assistants underwent a two-day training program covering ethical considerations, questionnaire administration, and data quality procedures.

This study was reviewed and approved by [AUTHOR TO INSERT: Institutional Review Board / Ethics Committee name and affiliated institution] (Approval No. [AUTHOR TO INSERT]) prior to data collection, and was conducted in accordance with the ethical principles of the Declaration of Helsinki (World Medical Association, 2013).

Potential participants were approached at park entrances and provided with information about the study. Those expressing interest were provided with a detailed information sheet and invited to provide written informed consent. Questionnaires were self-administered, with research assistants available to clarify questions. Completion time averaged 15-20 minutes.

To minimize social desirability bias, participants were assured of the confidentiality and anonymity of their responses. Questionnaires were identified only by participant codes, and no personally identifying information was collected.

Participants who completed the questionnaire were offered a small token of appreciation (a packet of seeds or a plant cutting) to acknowledge their time and contribution.

3.6 Data Analysis

Data were analyzed using SPSS Version 26.0 and AMOS Version 24.0. Descriptive statistics and bivariate correlations were computed for all study variables. Missing data were minimal (<3%) and were handled using listwise deletion.

4. Results

4.1 Descriptive Statistics

Descriptive statistics for all study variables are presented in Table 1. Perceived urban green space quality scores ranged from 1.67 to 4.92 (M = 3.41, SD = 0.78), indicating moderate-to-high perceptions of green space quality among participants. Perceived restorativeness scores ranged from 2.18 to 6.82 (M = 4.87, SD = 1.12), suggesting that participants generally perceived Lahore's urban parks as moderately restorative (Berto, 2005). Psychological well-being scores ranged from 2.14 to 4.86 (M = 3.62, SD = 0.65), indicating moderate levels of well-being (Tennant et al., 2007).

Among the restorative dimensions, fascination had the highest mean score (M = 5.12, SD = 1.24), followed by being away (M = 4.93, SD = 1.31), extent (M = 4.68, SD = 1.18), and compatibility (M = 4.55, SD = 1.27) (Hartig et al., 1997).

Table 1: Descriptive Statistics for Study Variables

Variable	Mean	SD	Minimum	Maximum	Skewness	Kurtosis
UGS Quality	3.41	0.78	1.67	4.92	-0.32	-0.18
Perceived Restorativeness	4.87	1.12	2.18	6.82	-0.41	0.07
Being Away	4.93	1.31	1.67	7.00	-0.38	-0.22
Fascination	5.12	1.24	2.00	7.00	-0.52	0.14
Extent	4.68	1.18	1.33	7.00	-0.29	-0.05
Compatibility	4.55	1.27	1.50	7.00	-0.21	-0.31

Psychological Well-Being	3.62	0.65	2.14	4.86	-0.28	-0.14

Note: UGS = Urban Green Space; n = 450

4.2 Bivariate Correlations

Bivariate correlations among study variables are presented in figure 1 . Perceived urban green space quality was significantly positively correlated with perceived restorativeness ($r = 0.48$, $p < 0.001$) and psychological well-being ($r = 0.39$, $p < 0.001$). Perceived restorativeness was significantly positively correlated with psychological well-being ($r = 0.51$, $p < 0.001$). All restorative dimensions demonstrated significant positive correlations with both green space quality (ranging from $r = 0.35$ to $r = 0.44$, all $p < 0.001$) and psychological well-being (ranging from $r = 0.38$ to $r = 0.47$, all $p < 0.001$). Among covariates, age ($r = 0.12$, $p < 0.05$) and income ($r = 0.18$, $p < 0.01$) were significantly positively correlated with psychological well-being. Gender and educational attainment were not significantly correlated with any study variables.

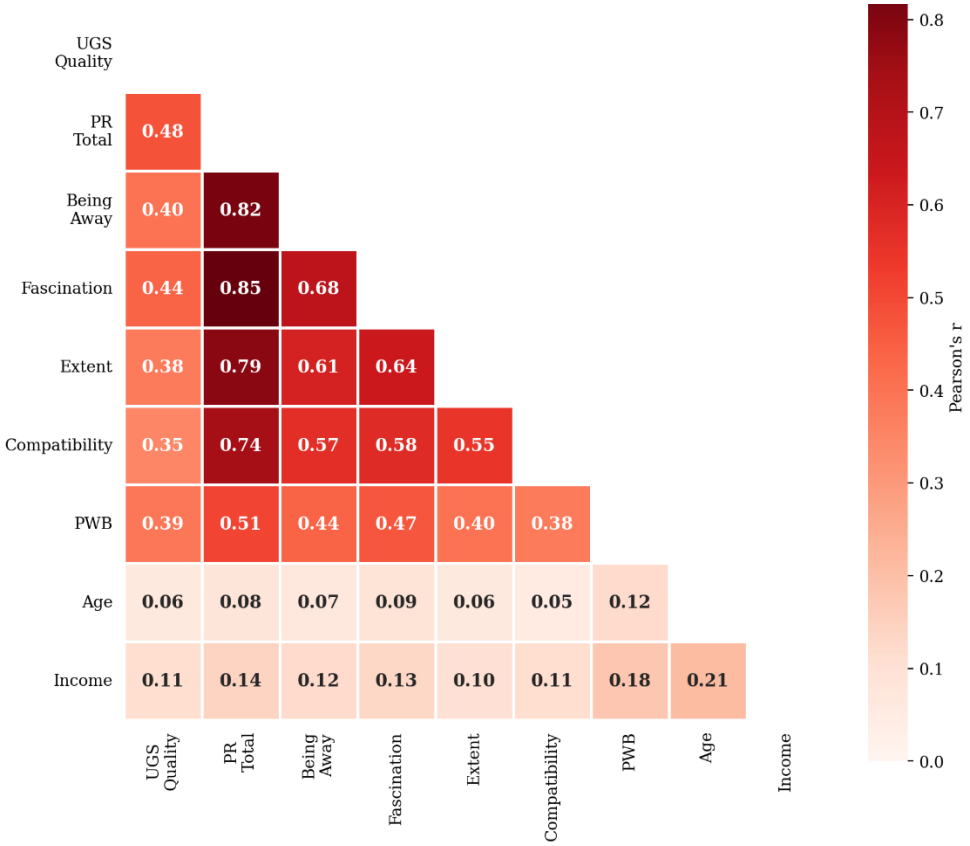


Figure 1 Bivariate Correlations Among Study Variables

4.3 Measurement Model

Confirmatory factor analysis was conducted to assess the measurement model comprising three latent constructs: perceived urban green space quality (four indicators: vegetation, amenities, safety, aesthetics), perceived restorativeness (four indicators: being away, fascination, extent, compatibility), and psychological well-being (seven indicators corresponding to SWEMWBS items) (Kline, 2016).

The measurement model demonstrated acceptable fit: $\chi^2(116) = 268.47$, $p < 0.001$; CFI = 0.94; TLI = 0.92; RMSEA = 0.054 (90% CI: 0.046-0.062); SRMR = 0.048 (Hu & Bentler, 1999; Kline, 2016). All factor loadings were statistically significant ($p < 0.001$) and ranged from 0.58 to 0.82, supporting

the convergent validity of the constructs. The average variance extracted (AVE) for each construct exceeded 0.50 (UGS quality: 0.62; perceived restorativeness: 0.58; psychological well-being: 0.55), and composite reliabilities exceeded 0.80, supporting the reliability of the measures (Fornell & Larcker, 1981; Kline, 2016). Discriminant validity was assessed using the Fornell-Larcker criterion: the square root of the AVE for each construct (UGS quality: 0.79; perceived restorativeness: 0.76; psychological well-being: 0.74) exceeded its correlations with the other latent constructs, supporting adequate discriminant validity between the three constructs. Perceived urban green space quality and perceived restorativeness were modeled using subscale-level item parcels as indicators, a common approach for reducing model complexity and improving the indicator-to-sample-size ratio in SEM (Little, Cunningham, Shahar, & Widaman, 2002); psychological well-being was modeled using its seven constituent items directly, consistent with standard practice for single-factor scales of this length.

4.4 Structural Model and Hypothesis Testing

The hypothesized structural model, examining the direct and indirect effects of perceived urban green space quality on psychological well-being through perceived restorativeness, demonstrated good fit: $\chi^2(118) = 284.52$, $p < 0.001$; CFI = 0.93; TLI = 0.91; RMSEA = 0.056 (90% CI: 0.048-0.064); SRMR = 0.052 (Hu & Bentler, 1999; Kline, 2016). The standardized path coefficients are presented in Table 2. Perceived urban green space quality had a significant positive direct effect on perceived restorativeness ($\beta = 0.48$, $p < 0.001$, SE = 0.06), supporting Hypothesis 2. Perceived restorativeness had a significant positive direct effect on psychological well-being ($\beta = 0.40$, $p < 0.001$, SE = 0.05), supporting Hypothesis 3. The direct effect of perceived urban green space quality on psychological well-being, controlling for perceived restorativeness, was also significant ($\beta = 0.31$, $p < 0.001$, SE = 0.06), supporting Hypothesis 1. The indirect effect of perceived urban green space quality on psychological well-being through perceived restorativeness was significant ($\beta = 0.19$, $p < 0.001$; 95% bias-corrected bootstrap CI: 0.13-0.26), supporting Hypothesis 4 (Preacher & Hayes, 2008; Fritz & MacKinnon, 2007). The total effect of perceived urban green space quality on psychological well-being was $\beta = 0.50$ ($p < 0.001$). The indirect effect accounted for 38% of the total effect, indicating a partial indirect effect consistent with the mediation hypothesis.

Table 2: Direct and Indirect Effects in the Structural Model

Path	β	SE	p-value	95% CI (Lower)	95% CI (Upper)
UGS Quality → PR	0.48	0.06	<0.001	0.36	0.60
PR → PWB	0.40	0.05	<0.001	0.30	0.50
UGS Quality → PWB (Direct)	0.31	0.06	<0.001	0.19	0.43
UGS Quality → PWB (Indirect)	0.19	0.04	<0.001	0.13	0.26
UGS Quality → PWB (Total)	0.50	0.06	<0.001	0.38	0.62

Note: UGS = Urban Green Space; PR = Perceived Restorativeness; PWB = Psychological Well-Being; CI = Bias-corrected bootstrap confidence interval

4.5 Dimensional Analysis

To examine the relative contributions of different restorative dimensions to the indirect pathway, we conducted a secondary analysis in which each restorative dimension was entered as a separate mediator. The results are presented in Table 3. Fascination demonstrated the strongest indirect effect ($\beta = 0.22$, $p < 0.001$; 95% CI: 0.15-0.30), followed by being away ($\beta = 0.19$, $p < 0.001$; 95% CI: 0.12-0.27), extent ($\beta = 0.15$, $p < 0.01$; 95% CI: 0.08-0.23), and compatibility ($\beta = 0.13$, $p < 0.01$; 95% CI: 0.06-0.21). Because these four dimensions are substantially intercorrelated ($r = 0.55$-0.68) and were entered as sole mediators in separate models rather than simultaneously, these estimates reflect each dimension's total association

with the outcome rather than its unique contribution net of the others; a combined multi-mediator model would be needed to estimate specific indirect effects and should be treated as a priority for future analysis of these data.

Table 3: Indirect Effects of UGS Quality on Psychological Well-Being Through Restorative Dimensions

Mediator	Indirect Effect	SE	95% CI (Lower)	95% CI (Upper)	% of Total Effect
Being Away	0.19***	0.04	0.12	0.27	38%
Fascination	0.22***	0.04	0.15	0.30	44%
Extent	0.15**	0.04	0.08	0.23	30%
Compatibility	0.13**	0.04	0.06	0.21	26%

*Note: **p < 0.01; **p < 0.001; CI = Bias-corrected bootstrap confidence interval. Percentages represent the proportion of the total effect explained when each dimension is entered as the sole mediator; they sum to >100% due to shared variance among dimensions. .

4.6 Sensitivity Analyses

To assess the robustness of our findings, we conducted several sensitivity analyses. First, we re-estimated the model controlling for age, gender, education, and income. The inclusion of covariates did not substantially alter the pattern or significance of the results, suggesting that the observed relationships were not confounded by these demographic factors (Kline, 2016).

Second, we examined whether the indirect effect varied by park type (regional vs. neighborhood vs. local) (Jabbar & Mohd Yusoff, 2022). Multi-group SEM revealed no significant differences in the indirect pathway across park types ($\Delta\chi^2 = 4.23$, df = 4, p = 0.38), indicating that the restorative mechanism operated similarly across different types of green spaces. However, given the relatively small sample sizes in each park type category, these results should be interpreted with caution.

Third, we assessed common method variance using Harman's single-factor test (Podsakoff et al., 2003). The single-factor model demonstrated poor fit (CFI = 0.51, RMSEA = 0.18), and the first factor accounted for only 28% of the total variance, suggesting that common method bias was not a dominant concern. Nevertheless, Harman's test is a relatively weak control, and the cross-sectional nature of the data means that shared method variance cannot be entirely ruled out. This is addressed further in the limitations.

5. Discussion

5.1 Summary of Findings

This study investigated whether perceived restorativeness exhibits a significant indirect effect (statistical mediation) in the relationship between perceived urban green space quality and psychological well-being among park visitors in Lahore, Pakistan. The findings provide strong support for the hypothesized indirect effect model and extend the applicability of Attention Restoration Theory to the South Asian urban context (Kaplan & Kaplan, 1989; Kaplan, 1995).

Consistent with previous research (White et al., 2013; Gascon et al., 2015), perceived urban green space quality was positively associated with psychological well-being. This finding reinforces the growing evidence that green spaces are positively associated with mental health in urban populations and suggests that this relationship holds across diverse cultural and geographical contexts (Bowler et al., 2010; Hartig et al., 2014).

More importantly, the study demonstrated that perceived restorativeness exhibits a significant indirect effect in this relationship. The significant indirect effect, accounting for 38% of the total effect, is consistent with the hypothesis that the psychological benefits of green spaces are explained, in part, by their restorative quality the extent to which they facilitate psychological distancing, capture attention effortlessly, and provide a sense of coherence and compatibility (Kaplan & Kaplan, 1989; Kaplan, 1995).

5.2 Theoretical Contributions

This study makes several theoretical contributions to the literature on green space and well-being.

First, it extends the empirical evidence base for Attention Restoration Theory to a novel cultural and geographical context (Kaplan & Kaplan, 1989; Kaplan, 1995). ART was developed and predominantly tested in Western settings (Berto, 2005; Hartig et al., 1997), and its applicability to non-Western contexts has been a subject of scholarly debate (Chawla, 2015; Maller et al., 2006). Our findings provide preliminary evidence that the restorative mechanisms proposed by ART operate similarly in the South Asian urban context (Rehman et al., 2024). However, we acknowledge that the specific manifestations of restorative experiences may differ across cultural contexts, and future qualitative research could explore these cultural nuances.

Second, the study contributes to the growing body of research on the mechanisms linking environment and well-being. While the direct association between green space and well-being is well-established (Bowler et al., 2010; Gascon et al., 2015), the pathways underlying this relationship remain incompletely understood (Lachowycz & Jones, 2013; Hartig et al., 2014). By demonstrating that perceived restorativeness exhibits a significant statistical indirect effect, this study provides insight into how green spaces might be positively associated with mental health not merely that they are.

5.3 Practical Implications

The findings of this study have several practical implications for urban planning, landscape architecture, and public health policy in Lahore and similar rapidly urbanizing cities.

First, the results underscore the importance of investing in green space quality alongside quantity (Lachowycz & Jones, 2013). While increasing green space coverage is important (Lee & Maheswaran, 2011; Gascon et al., 2015), enhancing the quality of existing green spaces through improved vegetation, better maintenance, enhanced safety, and thoughtful design may yield significant returns for population mental health. For Lahore specifically, the findings suggest that even modest investments in green space quality could yield substantial psychological benefits for park visitors.

Second, the indirect effect findings suggest that interventions should focus on enhancing the restorative quality of green spaces. This includes designing spaces that facilitate fascination (e.g., diverse plantings, water features, wildlife habitat) and being away (e.g., secluded seating areas, quiet zones, physical separation from urban noise) (Kaplan et al., 1998; Velarde et al., 2007). Landscape architects and urban designers should prioritize these elements in their designs, particularly in high-density urban areas where restorative experiences are most needed.

Third, the findings support the development of green space as a public health intervention (Hartig et al., 2014; Kondo et al., 2018). With mental health disorders accounting for a substantial burden of disease globally (World Health Organization, 2022), and with urbanization continuing apace in South Asia (United Nations, 2022), green spaces represent a cost-effective, scalable, and accessible resource for promoting population mental health (Bowler et al., 2010; Twohig-Bennett & Jones, 2018). Public health authorities should consider incorporating green space prescriptions into mental health promotion strategies.

Fourth, for Lahore specifically, the findings suggest that the city's existing parks despite their limitations are perceived as restorative and are positively associated with park visitors' psychological well-being. This provides a rationale for preserving and enhancing these spaces, even as the city continues to grow and develop (Jabbar & Mohd Yusoff, 2022). Urban planners should consider the restorative function of green spaces in land-use decision-making and development planning.

5.4 Limitations

This study has several limitations. The cross-sectional design precludes causal inference (Kline, 2016). While the indirect effect is consistent with mediation, reverse causation (e.g., well-being

influencing perceptions) or unmeasured confounders cannot be ruled out. The sample comprised only park visitors a self-selected group limiting generalizability to non-users. Reliance on self-report measures introduces biases including social desirability and common method variance. Testing restorative dimensions as separate mediators is statistically questionable given their substantial shared variance. Potential moderators (e.g., nature relatedness, socioeconomic status) were not examined. Findings may not generalize to other South Asian cities. Finally, the 68.2% response rate introduces potential non-response bias

5.5 Future Research

Future research should employ longitudinal designs to establish causality and experimental studies (virtual reality or controlled exposure) to test specific environmental features (Berman et al., 2008; Bratman et al., 2015). Studies examining other mediators (physical activity, social interaction, stress reduction) would provide a more comprehensive understanding (Hartig et al., 2014). Moderator analyses could identify for whom green spaces are most beneficial, enabling targeted interventions. Comparative studies across different green space types (parks, street trees, green roofs) would inform cost-effective urban planning (Jabbar & Mohd Yusoff, 2022). Qualitative research exploring park users' lived experiences could reveal culturally specific restorative elements not captured by quantitative measures.

6. Conclusion

This study investigated whether perceived restorativeness exhibits a significant indirect effect in the relationship between perceived urban green space quality and psychological well-being among park visitors in Lahore, Pakistan. The findings demonstrate that perceived restorativeness shows a significant statistical indirect effect, with fascination and being away showing the largest indirect effects when tested individually, though the substantial shared variance among the four restorative dimensions means this ranking should be treated as suggestive rather than conclusive pending a combined multi-mediator model. These results provide preliminary support for the applicability of restorative mechanisms in the South Asian urban context and offer evidence-based guidance for urban planners and policymakers. In rapidly urbanizing cities like Lahore, where green space is limited and mental health concerns are rising, investing in the restorative quality of urban green spaces creating environments that are fascinating, provide psychological distance from daily routines, and are coherent and compatible with users' needs may yield significant returns for population mental health. However, the cross-sectional design and sample of park visitors limit causal conclusions and generalizability; future longitudinal and experimental research is critically needed. Despite these limitations, this study provides valuable evidence that even in contexts with limited green space, attention to quality and restorative potential can significantly benefit park visitors' mental health.

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