Review Journal of Social Psychology & Social Works

http://socialworksreview.com

ISSN-E: 3006-4724 Volume: 3
ISSN-P: 3006-4716 Issue: 4 (October - December, 2025)

The Impact of Nature on Mental Health: A Study of Nature Exposure and Mental Health Outcomes

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DOI: https://doi.org/10.71145/rjsp.v3i4.432

Abstract

The present research investigates the relationship between mental health and exposure to natural environments among 250 participants aged 18 to 65 years from Lahore, Karachi, and Islamabad, three major cities in Pakistan. Within a quantitative framework, mental health outcomes over a six-month period were surveyed using the Depression Anxiety Stress Scale (DASS-21) and Nature Exposure Scale (NES) translated into Urdu. The researchers asked respondents to keep weekly diaries to record the amount of time they spent in natural environments, including public parks, riversides, botanical gardens, and in the mountains. Results from SPSS demonstrated that exposure to nature is associated with a decrease in anxiety, depression, and stress. The study attempted to offset the effects of socioeconomic status, physical activity, cultural background, prior mental health issues, and other depression/anxiety disorders using multiple regression. Notably, the study's psychological findings were corroborated by cortisol level tests. Qualitative data from 30 respondents, who were interviewed using semi-structured guides, enriched the quantitative findings. Respondents who spent 120 minutes or more in a week in natural environments reported greater mental health improvements than those who had little or no time spent in nature. This demonstrates the need for nature intervention strategies to be included in mental health management in Pakistan.

Keywords: Relationship, Mental Health, Exposure, Natural Environments, Depression Anxiety Stress Scale (DASS-21), Nature Exposure Scale (NES)

Introduction

Public mental health issues became important in Pakistan and impacted many people of different ages and socioeconomic groups. After the World Health Organization inserted mental health into overall health for the first time, Pakistan started experiencing gaps in mental health awareness and service provision (Chachar and Mian 2022). With the fast pace of low depression, the relationship of Pakistanis with their environment, and changes from industrialization, urbanization, and the growth of cities with little to no green spaces, the population became more detached from the environment in ways that begin to foster poor mental health. The lack of attention to the psychological and mental health benefits of spending time in green spaces explains the poor mental

health service provision gaps. These alternative mental health traditions and treatments in Pakistan relate to the healing power of nature that many cultural and religious traditions incorporate (Noorullah, Asad et al. 2024). The interplay between exposure to natural environments and one's mental health has been a focal point of research in numerous countries and, for the most part, has produced favorable outcomes pertaining to psychological health in individuals who spend more time in nature. However, the majority of such studies are concentrated in the Western World, leading to a sparse body of literature dealing with the Western literature in more culturally, environmentally, and socioeconomically different contexts, such as in Pakistan (Choudhry, Khan et al. 2023). The varied topography of Pakistan, with coastal regions in Karachi and higher altitudes to the North, presents multiple opportunities for the study of diverse natural environments and different mental health outcomes. Like all other mega-cities in the country, the urban centers of Lahore, Karachi, and Islamabad have been subjected to rapid and uncontrolled population growth, bringing with it, urban stressors such as increased air and noise pollution, and a lack of access to natural, green space. The concomitant increase in urban mental health problems characterized by anxiety, depression, and other stress disorders has been alarming (Ahmad and Koncsol 2022). The exploration of the links between nature and mental health is supported by the work of scholars in a variety of fields such as public health, environmental psychology, and neuroscience. Attention Restoration Theory posits that environments enriched with nature facilitate mental restoration by capturing involuntary attention and allowing the directed attention system to rest and recuperate (Qureshi 2024). Stress Reduction Theory argued that contact with nature activates recouping physiological and psychological mechanisms that lower stress and aid in the recovery of mental fatigue. Carrying out the work of these theorists provided a valuable perspective in classic texts focused on describing the mechanisms that cause exposure to nature to be therapeutic. In the Pakistani socio-cultural environment, where mental health stigma is prevalent and access to mental health care is limited, nature-based practices can work as an alternative or a complement to more traditional approaches that are inexpensive, easily accessible, and culturally more appropriate (Scott, McDonnell et al. 2021). This research aimed to contribute to the understanding of how exposure to nature impacts mental well-being specifically among the Pakistani population. The analysis spanned three principal cities in Pakistan, each representing unique geographical and cultural frameworks, to deliver a thorough understanding that could be useful in any of Pakistan's urban settings because of the research's comprehensive urban analyses. The research examined various aspects of nature exposure, including how often and how long participants spent in different forms of nature settings. The research findings also considered the multiple, often interrelated, factors impacting mental well-being, including socioeconomic considerations, physical activity, cultural factors, and mental comorbidity. The significance of the multifaceted nature of these factors on mental well-being, and, therefore, the necessity of India specific mental health, innovative and low-cost, solutions is evident. The research findings hold potential for enhancing urban design, urban public health, and clinical practice by incorporating ecotherapy and other nature-based strategies to improve mental health. This research also enriches the global understanding of the relationship between mental health and nature by adding data from a culturally and environmentally distinctive context.

Research Objectives

1. To analyze how the amount of time spent in nature and the frequency of such encounters affect mental health (including anxiety, depression, and stress) for individuals living in urban and suburban areas of Lahore, Karachi, and Islamabad.
2. To determine which natural settings (whether public parks, areas by rivers, botanical gardens, or mountainous regions) in the Pakistani context are most closely linked to positive mental health outcomes.

3. To investigate the impact of socioeconomic status, levels of physical activity, and culturally specific practices as potential moderating variables in the relationship between exposure to nature and mental health outcomes.

Research Questions

1. How does the frequency and duration of contact with nature affect anxiety, depression, and stress levels of individuals in major Pakistani cities?
2. What types of natural environments are most likely to promote positive mental health in urban and peri-urban Pakistan?
3. How do socioeconomic status, levels of physical activity, and culturally determined activities influence the relationship between contact with nature and mental health?

Significance of the Study

The significance of this research extends to public health, urban planning, and mental health in Pakistan. The mental health literature in Pakistan documents the first instance of research demonstrating the therapeutic value of nature in the Pakistan context. It also addresses an important imbalance in literature. The findings of the research have real significance for urban planners and public health policymakers in Pakistan, as they demonstrate the need for maintaining and creating accessible urban green spaces in the context of rapid urban growth. For mental health practitioners, the research provided evidence for the use of nature-based activities as additional mental health activities and treatment options. This is especially important in Pakistan, where mental health practitioners have very limited resources available to them. The research also served to build on the available literature internationally, as it explored the nature and mental health connection in Pakistan, an under-researched South Asian country, thus enhancing the understanding of global and culturally diverse perspectives on the relationship. Additionally, by recognizing inexpensive, easily accessible natural settings, the scope of the research expanded mental health interventions in a cost-effective manner to include low-resourced communities, potentially mitigating inequities surrounding access to mental health resources.

Literature Review

The impact of exposure to nature on mental health has received an overwhelming amount of research, albeit mostly in Western countries. In the field of environmental psychology, the research has been foundational in the development of theories regarding the impact of natural settings on mental well-being (Jimenez, DeVille et al. 2021). In the late twentieth century, the Attention Restoration Theory argued that mentally demanding urban settings deplete cognitive resources, but temporary immersion in restorative natural environments facilitates recuperation because it captures effortless attention. The scope of restorative environments is defined by four attributes: (1) being away from daily demands, (2) the span of the environment, (3) fascination with the setting, and (4) an affinity with the channel surroundings. There is substantial empirical literature demonstrating the attention-restoration effects of nature; that is, exposure to greenery and nature aids in the recovery from mental fatigue and boosts cognitive performance in comparison to urban settings (Ribeiro, Triguero-Mas et al. 2021). Stress Reduction Theory provides another critical explanation of the psychological benefits of nature. This theory states that individuals have a built-in appreciation of nature that is evolutionary and that immediate exposure to nature results in psychological and physiological stress relief. Studies that support this theory have shown a significant reduction in cortisol levels, heart rate, blood pressure, and muscle tension in people who have spent time in nature. These physiological alterations align with the positive psychological changes reported by individuals, such as improvements in mood, anxiety, and overall psychological wellbeing (Yao, Zhang et al. 2021). Longitudinal studies showed that

exposure to nature improves psychological wellbeing over time, providing more than temporary relief (Aslam, Aslam et al. 2025). Meta-analyses of multiple studies have documented strong, positive correlations between the exposure to nature and mental health variables, particularly with decreases in depression, anxiety, and stress (Escolà-Gascón and Houran 2021). Studies assessing the impact of certain natural environments on mental health yielded varied outcomes. Specifically, the practice of forest bathing, or shinrin-yoku, is associated notably with steep reductions in stress and improvements in mood. Research carried out in wooded areas revealed steep reductions in cortisol and improvements in the functioning of the parasympathetic nervous system. Coastal and freshwater environments also proved beneficial (Antonelli, Donelli et al. 2022). Some studies note, being close to a water body is associated with decreased psychological distress and increased life satisfaction. For city residents, the urban green spaces of parks and gardens provided some relief, and there was a record of decreased symptoms of depression and anxiety. Nonetheless, the mental health benefits of these urban green spaces, which, of these, the green spaces in larger and more developed therapeutic landscapes provided the most relief, were determined by the quality, size, and accessibility of these urban green spaces (Li, Ochiai et al. 2022). The mental health benefits of nature also rest on additional mechanisms other than the attention restoration and stress reduction theories. There are several other pathways affecting psychological wellbeing. Engaging in physical activities outdoors is the combination of exercising and being in nature. Thus, both activities positively affect mental health. Other mental health benefits come from social activities in nature, as they improve social integration and help decrease loneliness. Spending time outdoors improves mental health as it helps regulate the circadian rhythm, and consequently, the sleep cycle due to being exposed to natural light and fresh air. Other early-stage research suggests the diverse microbial communities found in nature and contact with them can also affect mental health through the gut-brain axis (Jiang, He et al. 2021). Extensive studies have emerged in Western countries, research focusing on the nature-mental health relationship in South Asia, particularly in Pakistan, remains sparse. The limited research in the region highlighted the impact of culture on how people encounter and benefit from exposure to nature. As far as Pakistan is concerned, there are Islamic cultural practices which appreciate the spiritual value of nature and recognize the cultural value of engaging in outdoor activities. This context means that the relationship between nature and psychological wellness may differ from Western countries (Sadruddin and Kaukab 2021). Socioeconomic conditions have also been critical in determining one's exposure, and access to natural settings, and in exposing one to the benefits of nature. During urbanization, the Pakistani population in cities faced a constellation of challenges that differ from the challenges of Western countries including high levels of air pollution, the absence of safe and sufficient infrastructure of green spaces, and safety challenges that might have altered the nature-mental health relationship differently than the other countries (Oswald, Rumbold et al. 2021).

Some of the factors constraining exposure to nature in urban Pakistan contexts relate to barriers to access identified in the literature. Pakistan's rapid urbanization led to the conversion of more areas of the urban green to residential and commercial use. Consequently, the amount of accessible nature diminished (Arshad, Ahmad et al. 2022). Socioeconomic inequalities meant that affluent neighborhoods enjoyed better access to green infrastructure, including parks and gardens, whereas low-income neighborhoods faced inadequate green infrastructure. Restrictions, most notably gendered ones, impacted the exposure of large sections of the population to nature, since women face greater limits to circulation and the outdoor environment. Concerns about crime and harassment, especially in the early morning and evening, dissuaded many from accessing the green spaces that were available. In addition, cultural perceptions about the use of time placed a low priority on recreational exposure to nature and leisure activities, especially in the context of more utilitarian tasks (Azhar, Javed et al. 2024).

Research Methodology

The researchers adopted quantitative research design to study the association of exposure to nature with mental health in the Pakistan context. The researchers used stratified random sampling to recruit 250 participants from urban and suburban populations of Lahore, Karachi, and Islamabad. Over a period of six months and using the Urdu translated DASS (21) and Nature Exposure Scale instruments, the researchers collected data. Participants filled out baseline records and weekly diaries where they recorded hours spent in nature settings which were classified as public parks, riverside areas, botanical gardens, and mountainous regions. The researchers carried out mental health assessments in follow-up surveys and monthly physiological assessments, which included cortisol measurements three times during the study. The researchers used accessibility to green spaces, number of visits, and the time spent in nature as independent variables, while the stress, anxiety and depressive states of the participants were the dependent variables. Multiple regression analysis was used to control for confounding variables of the participants like socio-economic status, mental health problems, physical activity, culture, and other variables. Nature exposure and its impact on mental health were analyzed using SPSS. To obtain qualitative information and corroborate the quantitative results, the researchers conducted semi-structured interviews with thirty participants who were randomly chosen and interrogated in their language of choice, either Urdu or English.

Results and Data Analysis

The comprehensive analysis of data collected from 250 participants across Lahore, Karachi, and Islamabad revealed significant relationships between nature exposure and mental health outcomes. The demographic characteristics of the study population provided essential context for interpreting the findings and understanding the generalizability of results.

Table 1: Demographic Characteristics of Participants (N=250)

Characteristic	Category	Frequency	Percentage
Gender	Male	118	47.2%
	Female	132	52.8%
Age Group	18-30 years	95	38.0%
	31-45 years	89	35.6%
	46-65 years	66	26.4%
City	Lahore	85	34.0%
	Karachi	83	33.2%
	Islamabad	82	32.8%
Education	Secondary	42	16.8%
	Undergraduate	98	39.2%
	Graduate	110	44.0%
Income Level	Low	68	27.2%
	Middle	112	44.8%
	High	70	28.0%

The demographic distribution demonstrated balanced representation across gender, age groups, and cities, enhancing the reliability and generalizability of findings. The sample included slightly more female participants (52.8%) than male participants (47.2%), reflecting the gender distribution in Pakistani urban populations. Age distribution showed that younger adults (18-30 years) comprised the largest group at 38.0%, followed by middle-aged adults (31-45 years) at 35.6%, and older adults (46-65 years) at 26.4%. Geographic distribution across the three cities was nearly

equal, ensuring that findings captured diverse urban contexts. Educational attainment was relatively high, with 83.2% having at least undergraduate education, which was typical of urban populations participating in research studies. Income distribution showed that middle-income participants comprised the largest group at 44.8%, with relatively balanced representation from low-income (27.2%) and high-income (28.0%) categories.

Table 2: Baseline Mental Health Scores Using DASS-21 (N=250)

Mental Health Domain	Mean Score	Standard Deviation	Range
Depression	14.32	8.67	0-38
Anxiety	12.85	7.94	0-36
Stress	16.47	9.23	0-40
Total DASS-21 Score	43.64	23.18	0-114

Baseline mental health assessments revealed moderate levels of depression, anxiety, and stress among participants prior to the intervention period. The mean depression score of 14.32 (SD=8.67) indicated mild to moderate depression symptoms across the sample, consistent with prevalence rates reported in previous studies of urban Pakistani populations. The mean anxiety score of 12.85 (SD=7.94) suggested mild anxiety symptoms, while the mean stress score of 16.47 (SD=9.23) indicated moderate stress levels. The total DASS-21 score averaged 43.64 (SD=23.18), reflecting overall psychological distress in the sample. The substantial standard deviations across all domains demonstrated considerable variability in mental health status among participants, highlighting the heterogeneity of the population and the importance of controlling for baseline differences in subsequent analyses.

Table 3: Nature Exposure Patterns at Baseline (N=250)

Nature Exposure Variable	Mean	Standard Deviation	Range
Weekly Nature Visits (frequency)	1.84	1.52	0-7
Weekly Nature Hours (duration)	3.26	2.91	0-14
Nature Exposure Score (NES)	28.45	12.37	0-75

Baseline nature exposure patterns indicated that participants initially engaged in limited contact with natural environments. The average weekly nature visits of 1.84 (SD=1.52) revealed that most participants accessed natural settings less than twice per week, reflecting the challenges of incorporating nature exposure into busy urban lifestyles. Weekly nature hours averaged only 3.26 hours (SD=2.91), substantially below the recommended 120 minutes per week suggested by international guidelines for optimal mental health benefits. The Nature Exposure Score, which comprehensively assessed frequency, duration, and quality of nature interactions, averaged 28.45 (SD=12.37) out of a possible 75 points, indicating moderate to low levels of nature engagement. These baseline patterns underscored the need for interventions promoting increased nature exposure among urban Pakistani populations.

Table 4: Types of Natural Environments Accessed by Participants

Environment Type	Users (N)	Percentage	Average Weekly Hours
Public Parks	187	74.8%	2.14
Riverside Areas	92	36.8%	1.83
Botanical Gardens	64	25.6%	1.56
Mountainous Regions	43	17.2%	3.47
Multiple Types	108	43.2%	4.62

Analysis of natural environment preferences revealed that public parks were the most commonly accessed type of nature, utilized by 74.8% of participants, likely due to their greater availability and accessibility in urban areas. Riverside areas attracted 36.8% of participants, primarily in cities with accessible waterways. Botanical gardens were visited by 25.6% of participants, possibly limited by fewer such facilities and potential entrance fees. Mountainous regions, accessed by only 17.2% of participants, required greater time and resource investment but were associated with longer average visit durations of 3.47 hours. Notably, 43.2% of participants accessed multiple types of natural environments, and these individuals spent significantly more time in nature overall, averaging 4.62 hours weekly, suggesting that environmental variety enhanced nature engagement.

Table 5: Post-Intervention Mental Health Scores (6-Month Follow-up, N=250)

Mental Health Domain	Mean Score	Standard Deviation	Range	Change from Baseline
Depression	10.28	7.14	0-32	-4.04
Anxiety	9.37	6.52	0-30	-3.48
Stress	12.65	7.89	0-35	-3.82
Total DASS-21 Score	32.30	19.47	0-97	-11.34

Post-intervention assessments demonstrated significant improvements in all mental health domains after six months of tracked nature exposure. Depression scores decreased by an average of 4.04 points, representing a 28.2% reduction from baseline, indicating clinically meaningful improvement. Anxiety scores declined by 3.48 points (27.1% reduction), and stress scores decreased by 3.82 points (23.2% reduction). The total DASS-21 score showed a substantial reduction of 11.34 points (26.0% reduction), reflecting overall improvement in psychological wellbeing. Reduced standard deviations across all domains suggested more homogeneous mental health outcomes post-intervention, potentially indicating that increased nature exposure benefited participants across varying baseline mental health statuses. These findings supported the hypothesis that regular nature exposure positively influenced mental health outcomes in the Pakistani urban context.

Table 6: Correlation Between Nature Exposure and Mental Health Outcomes

Variables	Correlation Coefficient (r)	p-value	Significance
Nature Hours & Depression	-0.623	<0.001	Strong negative
Nature Hours & Anxiety	-0.587	<0.001	Moderate negative
Nature Hours & Stress	-0.612	<0.001	Strong negative
Nature Frequency & Depression	-0.541	<0.001	Moderate negative
Nature Frequency & Anxiety	-0.498	<0.001	Moderate negative
Nature Frequency & Stress	-0.529	<0.001	Moderate negative
NES & Total DASS-21	-0.658	<0.001	Strong negative

Correlation analyses revealed significant negative relationships between nature exposure variables and mental health symptoms, confirming that increased nature exposure was associated with reduced psychological distress. The correlation between weekly nature hours and depression ($r = -0.623$, $p<0.001$) indicated a strong inverse relationship, suggesting that more time spent in nature substantially reduced depressive symptoms. Similar strong negative correlations were observed between nature hours and stress ($r=-0.612$, $p<0.001$). Moderate negative correlations emerged between nature frequency and all mental health domains, with coefficients ranging from -0.498 to -0.541, all statistically significant at $p<0.001$. The comprehensive Nature Exposure Score

demonstrated the strongest correlation with total DASS-21 scores (r=-0.658, p<0.001), indicating that holistic nature engagement encompassing frequency, duration, and quality most effectively improved mental health outcomes.

Table 7: Comparison of Mental Health Outcomes by Nature Exposure Level

Exposure Level	N	Mean DASS-21	SD	Depression	Anxiety	Stress
Low (<2 hrs/week)	78	42.15	18.93	14.67	12.84	14.64
Moderate (2-4 hrs/week)	94	31.82	16.47	9.93	8.76	13.13
High (>4 hrs/week)	78	23.47	14.28	6.21	6.52	10.74
F-statistic		38.42				
p-value		<0.001				

One-way ANOVA comparing mental health outcomes across different levels of nature exposure revealed significant differences, with participants in the high exposure group demonstrating substantially better mental health outcomes than those in low and moderate exposure groups. The mean total DASS-21 score for the low exposure group was 42.15, nearly double that of the high exposure group at 23.47, representing a 44.3% difference. The F-statistic of 38.42 (p<0.001) confirmed statistically significant differences between groups. Post-hoc analyses revealed that each incremental increase in exposure level was associated with significantly improved outcomes across all mental health domains. Depression scores showed the most dramatic gradient, with high exposure participants scoring 58% lower than low exposure participants. These findings suggested a dose-response relationship, indicating that greater nature exposure yielded proportionally better mental health outcomes.

Table 8: Impact of Different Natural Environment Types on Mental Health (N=250)

Environment Type	Mean Depression	Mean Anxiety	Mean Stress	Total DASS-21
Public Parks	10.84	9.87	13.24	33.95
Riverside Areas	9.12	8.34	11.67	29.13
Botanical Gardens	8.76	8.01	11.23	27.00
Mountainous Regions	7.43	7.12	10.18	24.73
Multiple Types	7.89	7.45	10.52	25.86

Analysis of mental health outcomes based on the primary type of natural environment accessed revealed differential effects, with some environment types associated with greater mental health benefits than others. Participants who primarily accessed mountainous regions demonstrated the lowest psychological distress across all domains, with a total DASS-21 score of 24.73, suggesting that more immersive natural environments provided superior therapeutic benefits. Botanical gardens and riverside areas also showed strong associations with positive outcomes, with total scores of 27.00 and 29.13 respectively. Public parks, while most accessible and commonly used, were associated with somewhat higher distress scores (33.95), though still reflecting improvement from baseline. Participants who accessed multiple types of environments showed outcomes comparable to those accessing mountainous regions (25.86), indicating that environmental diversity enhanced mental health benefits. These findings suggested that quality and immersiveness of nature experiences influenced therapeutic effects beyond mere accessibility.

Table 9: Physiological Indicators - Cortisol Levels (nmol/L)

Time Point	Mean Cortisol	SD	Range	Change from Baseline
Baseline	487.32	142.67	210-845	-
3 Months	423.18	128.43	195-782	-64.14
6 Months	381.47	115.92	178-721	-105.85

Physiological assessments through cortisol level measurements provided objective validation of the psychological improvements observed through self-report measures. Baseline cortisol levels averaged 487.32 nmol/L (SD=142.67), indicating elevated stress hormone levels consistent with urban populations experiencing chronic stress. After three months of tracked nature exposure, cortisol levels decreased by an average of 64.14 nmol/L to 423.18 nmol/L, representing a 13.2% reduction. By six months, cortisol levels further declined to 381.47 nmol/L, a total reduction of 105.85 nmol/L or 21.7% from baseline. Repeated measures ANOVA confirmed significant differences across time points ($F=47.83$, $p<0.001$). The progressive decline in cortisol levels paralleled improvements in self-reported mental health symptoms, strengthening the evidence that nature exposure produced measurable physiological benefits underlying psychological improvements.

Table 10: Multiple Regression Analysis - Predictors of Mental Health Outcomes

Predictor Variable	B	SE	Beta	t	p-value
Weekly Nature Hours	-1.847	0.312	-0.394	-5.92	<0.001
Nature Visit Frequency	-1.234	0.428	-0.187	-2.88	0.004
Socioeconomic Status	-2.156	0.547	-0.243	-3.94	<0.001
Physical Activity Level	-1.678	0.389	-0.268	-4.31	<0.001
Baseline DASS-21 Score	0.523	0.087	0.412	6.01	<0.001
$R^2 = 0.687$	$F = 52.34$	$p < 0.001$			

Multiple regression analysis identified significant predictors of mental health outcomes while controlling for confounding variables, explaining 68.7% of variance in post-intervention DASS-21 scores. Weekly nature hours emerged as the strongest predictor (Beta=-0.394, $p<0.001$), indicating that duration of nature exposure exerted the most substantial independent effect on mental health improvement. Physical activity level (Beta=-0.268, $p<0.001$) and socioeconomic status (Beta=-0.243, $p<0.001$) also significantly predicted outcomes, confirming the importance of controlling for these factors in examining nature-mental health relationships. Nature visit frequency independently contributed to improved outcomes (Beta=-0.187, $p=0.004$), though less strongly than duration, suggesting that extended nature experiences provided greater benefits than brief, frequent visits. Baseline DASS-21 scores positively predicted post-intervention scores (Beta=0.412, $p<0.001$), indicating that individuals with more severe initial symptoms required longer intervention periods or more intensive nature exposure to achieve comparable improvements.

Table 11: Mediating Effect of Socioeconomic Status

Nature Exposure Level	Low SES (N=68)	Middle SES (N=112)	High SES (N=70)
Low (<2 hrs/week)	47.23	40.87	38.12
Moderate (2-4 hrs/week)	38.45	30.24	26.89
High (>4 hrs/week)	29.87	22.16	18.34
Within-group change	17.36	18.71	19.78

Analysis of socioeconomic status as a mediating variable revealed that while SES influenced absolute mental health scores, the relative improvement from increased nature exposure remained substantial across all socioeconomic groups. Low SES participants demonstrated higher overall DASS-21 scores at every exposure level compared to middle and high SES participants, reflecting the cumulative burden of socioeconomic disadvantage on mental health. However, the within-group change from low to high nature exposure showed remarkable consistency, ranging from 17.36 points for low SES to 19.78 points for high SES participants, a difference of only 2.42 points. This finding indicated that nature exposure benefits were relatively equitable across socioeconomic strata, though structural barriers limited access to high-quality natural environments for lower SES groups. The data suggested that expanding accessible green space infrastructure could be an effective mental health intervention with particular benefits for disadvantaged populations.

Table 12: Gender Differences in Nature Exposure and Mental Health Outcomes

Variable	Male (N=118)	Female (N=132)	t-value	p-value
Weekly Nature Hours	3.89	2.71	3.42	0.001
Baseline DASS-21	41.23	45.72	-1.89	0.060
Post-intervention DASS-21	30.45	33.87	-1.67	0.097
Change in DASS-21	-10.78	-11.85	0.52	0.604

Gender-based analysis revealed significant differences in nature exposure patterns but similar mental health improvements across genders. Male participants reported significantly higher weekly nature hours (M=3.89) compared to female participants (M=2.71), t(248)=3.42, p=0.001, reflecting gender-based constraints on mobility and outdoor activities prevalent in Pakistani society. Despite lower nature exposure, female participants demonstrated slightly larger absolute improvements in DASS-21 scores (11.85 points) compared to male participants (10.78 points), though this difference was not statistically significant (p=0.604). Both genders showed comparable effect sizes for nature exposure benefits, suggesting that when women accessed natural environments, they derived equal or potentially greater mental health benefits. These findings highlighted the importance of creating safe, accessible natural spaces that accommodate the needs and concerns of female users to ensure equitable access to nature's mental health benefits.

Qualitative Data Analysis

From the semi-structured interviews with 30 individuals, the following five were identified.

Theme 1: Spiritual Connection and Religious Resonance

Participants identified spiritually enriching encounters with nature, recalling Islamic teachings on contemplating creation. Many of these individuals acknowledged that the natural environment made it easier to pray, meditate, and reflect on the immanent attributes of God. The spiritually restorative dimensions of nature not only motivated individuals to engage with nature on a regular basis, but also, through meaningful religious constructs of nature, strengthened the healing nature of the environment even more.

Theme 2: Social Respite and Solitude

For participants, the natural environment was a much-needed break from the overwhelming social obligations and family pressures which, to a large degree, are characteristic of Pakistani culture. Participants appreciated natural environments as places where they could be alone, reflect, and momentarily escape the oppression of persistent social visibility. These social demands

considerably added to the participants' stress, and the solitude offered by the natural environment made a significant contribution to mental restoration.

Theme 3: Sensory Restoration and Urban Contrast
Participants highlighted the difference between the harsh and aggressive urban environment, which includes noise, pollution, and large crowds, and the calm restorative qualities of nature. Participants appreciated the sounds and sights of nature, including the greenery, and found it therapeutic and restorative, providing relief from sensory overload. Fresh air, the sounds of birds, and greenery provided comfort, both physically and psychologically, which was lacking during the urban exposure.

Theme 4: Barriers to Access and Safety Concerns
Respondents noted numerous limitations to women's access to nature. Regular visits were constrained by safety issues related to harassment, poorly lit surroundings, and the lack of safe facilities. Specific barriers included limited transportation options, entrance fees to high-quality spaces, and cultural norms that restrict women's movement in public spaces. These situations and challenges require systemic changes to enhance access equity.

Theme 5: Nostalgia and Cultural Identity
The participants' engagement with nature stimulated memories of their childhood, their Pakistani rural family roots, and the more traditional Pakistani lifestyles. Their descriptions of natural areas highlighted how they connected with their cultural identity and the simpler lives that swiftly disappeared with the onset of urbanization. The cultural-emotional aspects of their engagement with nature added value to their psychological restoration and strengthened their bond with nature activities.

Discussion
This study provides firm evidence of the relationship between contact with nature and urban populations' mental health within Pakistan. Improvement in the different aspects of mental health and the concomitant reductions in cortisol levels indicate that regular attendance at natural settings engenders positive psychological and physiological changes. The presence of a dose-response relationship suggests that the improvements in mental health were the result of increased contact with nature and not a placebo effect or general positive changes in mental health due to other lifestyle shifts. The association between contact with nature and mental health suggests a medium to large effect, with correlation coefficients between -0.498 and -0.658. This is in the range of effects reported in the literature internationally while accounting for the specific circumstances of Pakistan. Differential impacts of natural environments pointed out the need for consideration in urban design and public health assessments. Positive mental health correlations were stronger for the mental and psychological health for the public park compared to the public park. There may be some inflection point for the purity of the environment that determines a threshold. Still, public parks were built for vastly more participants. Public parks may be more expensive to build and maintain but they may not be a reasonable hypothesis to expect them to promote social equity. Visiting different urban environments provided some of the benefits of visiting more natural, immersive settings. This is especially true for urban populations with little or no access to wild natural settings. This is especially true for the urban contexts of Pakistan where socio-economic conditions and the rapid advance of urban sprawl make the creation of sizeable natural subdivisions a challenge.

The mediating impacts of socioeconomic status, physical activity, and cultural practices delineated the ways in which nature exerted influence on mental health. While SES is transformative on the absolute mental health scores and on the access to quality natural settings, the relative benefits of greater exposure to nature remained constant across different socioeconomic strata. This finding demonstrates the relative equity of nature-based mental health interventions. The importance of physical activity undertaken in natural settings to relieve mental distress suggests the influence of nature on mental health through several channels, not solely through the enhancement of physical activity. Qualitative data collected during semi-structured interviews provided evidence of cultural aspects, with participants emphasizing that exposure to nature reinforced socially restorative values in the spirit of IST that promoted reflective contemplation about the divine in nature. This cultural construction framing nature engagement may have intensified the restorative benefits of nature through the act of purposeful engagement.

Conclusion

The concluded work indicates exposure to greenery positively impacts mental health for urban Pakistanis. These findings suggest considerations for clinical practice, public health, and urban development. The combination and integration of the various qualitative, physiological, and quantitative data sets built a profound argument for the conclusion that longer and more frequent exposure to nature leads to considerable drops in depression, anxiety, and stress symptoms. The identification of the dose-response links and varying impacts of different environment types offer useful insights to enhance nature-based strategies in interventions that consider the available resources. The differentials across socioeconomic groups and the position of nature exposure suggest the intervention's net effect of diminishing mental health inequities. The removal of accessibility barriers could increase the scope of impact.

These results help to fill a gap in understanding how nature impacts mental health in South Asian countries. Similar to people in the West, Pakistanis experience the effects of nature on mental health. However, the phenomenon is modified by local culture, environment, and society. Among the strengths of the study were: a longitudinal design, the use of objective physiological measures, a detailed control for confounding variables, and spatial coverage of three major cities. The weaknesses of the study were reliance on self-reported nature exposure logs, possible selection bias on the part of people who are already interested in nature, and the inability to draw definitive causal conclusions because of the observational design used. The use of experimental designs with randomized control for nature exposure would allow for much stronger causal claims.

The lack of scalable, economically viable mental health interventions in Pakistan opened up the potential for using nature-based alternatives. Considering that mental health services accessible to less than one percent of the people in Pakistan, alternative and supplementary services using the primary environmental resources certainly merited investigation. This study was the first in Pakistan to support the advocacy for the prioritization of investments in the urban green growth, the designing mental health interventions based on nature, and the considering of environmental factors as part of the overall mental health policies. With urbanization in Pakistan, the deliberate maintenance and improvement of the accessible high-quality natural environments ought to be seen as important public health necessities that promote mental health, as opposed to the mere aesthetic or recreational value.

Recommendations

Multiple recommendations were derived from the study findings and should be addressed by policymakers, urban planners, healthcare professionals, and community agencies. By acting on the

recommendations, local government authorities will be able to maintain and improve the planning of the provision and equitable distribution of preserves, parks, gardens, and other natural areas—especially those in-built zones and in areas of lower socioeconomic status. More healthcare professionals should consider integrating recommendations on the provision of nature and nature contact in ecosystems into mental health plans on nature-based interventions and other therapies. Specific recommendations on the amount and type of nature contact should be incorporated into mental health plans. Public health messages should be focused on promoting the mental health benefits of nature contact and integrating communicative styles and patterns from the dominant public. The messages should also include the moral/ethical and religious/spiritual aspects of nature contact. The creation of safe and accessible natural areas and spaces should also accommodate the needs of the women. Educational institutions should integrate nature in the design of educational activities and in the design of their campuses. Students, especially, should have opportunities for connected and unstructured outdoor activities in nature. The design and proposed activities of corporate wellness should include outdoor board meetings, and, during the workday, employees should be allowed to access green spaces for breaks. Subsequent studies should focus on longitudinal experimental designs with larger sample sizes, capture and test specific mechanisms related to the therapeutic effects of nature in the Pakistan context, determine best practice intervention frameworks with clinically defined therapeutic populations, and assess the scalability of nature-based mental health initiatives in urban and rural Pakistan.

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