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Modeling the Effects of Urban Recreational Infrastructure on Anxiety and Life Satisfaction Through Sport Participation

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Abstract

Background: Urban recreational infrastructure has been increasingly recognized as a determinant of mental health; however, the behavioral mechanisms through which it influences psychological outcomes remain insufficiently understood. This study examined the direct and indirect effects of urban recreational infrastructure on anxiety and life satisfaction, with sport participation as a mediating variable.

Methods: A cross-sectional survey was conducted among 452 urban residents. Validated self-report measures assessed perceived recreational infrastructure, sport participation, anxiety, and life satisfaction. Structural equation modeling (SEM) with maximum likelihood estimation was used to test the hypothesized model, and mediation effects were examined using bootstrapping (5,000 resamples).

Results: The measurement model demonstrated good fit (CFI = .94, TLI = .93, RMSEA = .056). Recreational infrastructure was positively associated with sport participation (β = .51, $p < .001$). Sport participation was negatively related to anxiety (β = −.45, $p < .001$) and positively related to life satisfaction (β = .49, $p < .001$). Recreational infrastructure also had significant direct effects on anxiety (β = −.18, $p < .01$) and life satisfaction (β = .21, $p < .01$). Bootstrapping results confirmed that sport participation partially mediated the relationships between recreational infrastructure and both anxiety (indirect β = −.23, 95% CI [−.31, −.15]) and life satisfaction (indirect β = .25, 95% CI [.17, .34]).

Conclusion: Urban recreational infrastructure contributes to improved mental health outcomes both directly and indirectly by promoting sport participation. These findings highlight the importance of integrating recreational planning into urban public health strategies.

Keywords: Urban recreational infrastructure; Sport participation; Anxiety; Life satisfaction; Structural equation modeling

Introduction

In an era marked by rapid urbanization and escalating pressures on mental health, understanding how the built environment shapes psychological well-being has become an imperative for urban planners, public health scholars, and policymakers alike. Cities around the world are experiencing unprecedented levels of anxiety, stress, and reduced subjective well-being among residents—outcomes that have been linked not only to individual lifestyle factors but also to broader structural and environmental determinants (Abdoshahi &

Ghorbani, 2022; Rhodes et al., 2025). Against this backdrop, urban recreational infrastructure—ranging from parks and recreational green spaces to community sports facilities—has emerged as a central element in promoting healthier, more satisfying urban lives. Yet, although the availability and quality of such recreational spaces have been associated with positive psychosocial outcomes, the mechanisms through which they influence mental health remain inadequately understood (Christodoulides et al. 2023).

Recreational infrastructure plays an integral role in shaping opportunities for physical activity, social interaction, and engagement with nature, all of which have been shown to promote mental well-being. Physical activity, and in particular participation in sports and recreational activities, is strongly associated with improvements in life satisfaction and reductions in negative emotional states including anxiety and stress (Monadi, 2025; Rhodes et al., 2025). Regular involvement in sport and physical activity may confer psychological benefits such as lower levels of stress, higher social functioning, greater enjoyment, and increased overall quality of life, beyond the well-documented physical health advantages (Rhodes et al., 2025). Moreover, these outcomes appear to arise not merely from the physiological effects of exercise, but also from social, cognitive, and emotional processes inherent in recreational participation. For example, team sports can provide a sense of community and belonging that further reinforces psychological resilience and life satisfaction (Moradi et al., 2020).

The potential for urban recreation environments to influence mental health extends beyond individual participation to encompass broader aspects of urban design. Research comparing physical activity in natural green spaces with activities in built environments has indicated that engagement in urban green spaces is associated with enhanced mood, stress reduction, and decreased anxiety levels among adults (Monadi, 2025). These effects are hypothesized to be mediated by restorative properties of nature, a reduction in physiological stress responses, and increased opportunities for social connection. Simultaneously, evidence from structural equation modeling studies suggests that the quality and accessibility of recreational environments can have direct and indirect impacts on subjective outcomes such as resident satisfaction and happiness (Kang, Yang & Han, 2021; Seraj et al., 2013).

In the context of urban settings, accessibility and perceptions of recreational infrastructure are crucial determinants of whether residents utilize these resources for sport and leisure. Studies from China have demonstrated that residents' perceptions of recreational sports spaces—including their spatial characteristics and support structures—significantly influence their engagement in recreational sports activities (Monadi, 2025). Importantly, these relationships often differ according to demographic characteristics, emphasizing the multifaceted nature of participation decisions. Other research applying structural equation modeling has identified numerous barriers, such as intrapersonal and environmental constraints, that limit sport participation among urban residents (Sheikh et al., 2021). These findings underscore that meaningful engagement with recreational infrastructure is conditioned not only on its physical availability but also on individual perceptions, social contexts, and structural supports that facilitate or hinder participation.

Parallel to these recreational and environmental factors, life satisfaction constitutes a critical component of subjective well-being and mental health. Defined broadly as the cognitive appraisal of one's life as a whole, life satisfaction is influenced by multiple domains including physical health, social relationships, and environmental contexts (O'Connor et al., 1993; Bray & Gunnell, 2006). Prior research highlights that engagement in physical activities and sports can promote higher levels of life satisfaction by enhancing self-esteem, social interactions, and positive affect, while reducing stress and anxiety symptoms (Nour Mohammadi et al., 2026; Rhodes et al., 2025). The psychological benefits of recreational environments are also reflected in higher subjective happiness scores among residents who have access to well-designed urban recreational sites (Kang, Yang & Han, 2021; Monadi, 2025).

Despite the growing body of literature pointing to these linkages, few studies have employed comprehensive modeling approaches to explore the complex relationships among urban recreational infrastructure, sport participation, anxiety, and life satisfaction. Structural equation modeling (SEM) offers a powerful analytical framework for testing such multivariate relationships, allowing researchers to specify direct and indirect pathways among latent constructs and observable indicators. SEM facilitates the disentanglement of the multifaceted pathways through which the built environment affects psychological outcomes, capturing both direct effects of infrastructure on well-being as well as indirect effects mediated by individual behaviors such as sport participation. For example, Kang, Yang & Han (2021) used SEM to decompose the direct and indirect effects of the urban recreation environment on resident happiness, finding that subjective satisfaction with the environment mediated many of the observed effects on well-being. Similarly, other SEM studies have examined how recreational spaces influence subjective outcomes like satisfaction with community life through multiple psychosocial pathways (Environmental Health Perspectives review).

Given this backdrop, the present study seeks to build on existing evidence by modeling the effects of urban recreational infrastructure on anxiety and life satisfaction, with a specific focus on sport participation as a central mediating mechanism. By integrating insights from environmental psychology, recreation studies, and public health, this research aims to provide a nuanced understanding of how structural and environmental

provisions in urban areas shape mental health outcomes. Moreover, employing SEM enables the testing of theoretically grounded pathways that reflect the interplay between environmental features (e.g., accessibility and quality of recreational infrastructure), individual behaviors (e.g., frequency and intensity of sport participation), and psychological outcomes (anxiety and life satisfaction).

Methods

Research Design

This study employed a cross-sectional quantitative research design to examine the structural relationships among urban recreational infrastructure, sport participation, anxiety, and life satisfaction. Structural equation modeling (SEM) was used to test both direct and indirect (mediated) effects among latent constructs. SEM was selected because it allows for simultaneous estimation of measurement and structural models, accounts for measurement error, and enables the testing of mediation pathways within a theoretically grounded framework (Kline, 2016; Hair et al., 2019).

The hypothesized model proposes that perceived urban recreational infrastructure positively influences sport participation, which in turn reduces anxiety and enhances life satisfaction. Additionally, direct effects of recreational infrastructure on anxiety and life satisfaction were tested to determine whether sport participation functions as a partial or full mediator.

Participants and Sampling Procedure

Participants were urban residents aged 18 years and older recruited from Tehran, Iran. A multistage sampling strategy was adopted. First, urban districts were selected based on population density and availability of recreational infrastructure. Second, community centers, parks, and residential communities were randomly selected within each district. Participants were approached through both on-site recruitment and online survey distribution.

In SEM research, adequate sample size is critical for model stability and statistical power. Following recommendations of at least 10–20 participants per estimated parameter (Kline, 2016) and a minimum of 200 cases for robust SEM estimation (Hair et al., 2019), the target sample size was set at approximately 400–500 respondents. After removing incomplete or invalid responses, the final analytical sample consisted of N = 452 participants.

Inclusion criteria were:

1. Age 18 years or older
2. Residency in the selected urban area for at least one year
3. Ability to complete the questionnaire independently

Participation was voluntary, and informed consent was obtained prior to data collection.

Measures

All constructs were measured using previously validated scales. Items were rated on Likert-type scales unless otherwise specified.

Urban Recreational Infrastructure

Perceived urban recreational infrastructure was assessed using an adapted version of the Neighborhood Environment Walkability Scale (NEWS) (Cerin et al., 2006) and items measuring perceived accessibility, quality, safety, and availability of recreational facilities. Participants evaluated statements such as:

- "There are many recreational facilities (e.g., parks, sports fields) in my neighborhood."
- "Recreational facilities in my area are well maintained."
- "It is easy to access sports facilities from my residence."

Responses were measured on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Prior research has demonstrated acceptable reliability and construct validity of perceived environmental measures in predicting physical activity behaviors (Saelens & Handy, 2008).

Sport Participation

Sport participation was measured using a modified version of the International Physical Activity Questionnaire (IPAQ; Craig et al., 2003), focusing specifically on structured sport and recreational activities. Participants reported:

- Frequency of participation (days per week)
- Duration (minutes per session)
- Type of sport activity

A composite score was computed to reflect overall sport participation intensity (frequency × duration). In SEM analysis, sport participation was treated as a latent construct indicated by frequency, duration, and self-reported engagement level.
The IPAQ has demonstrated acceptable reliability and validity across multiple countries (Craig et al., 2003).

Anxiety

Anxiety was measured using the Generalized Anxiety Disorder Scale (GAD-7; Spitzer et al., 2006). The GAD-7 consists of seven items assessing anxiety symptoms over the past two weeks. Participants rated items such as:

- "Feeling nervous, anxious, or on edge"
- "Not being able to stop or control worrying"

Responses were rated on a 4-point scale (0 = not at all to 3 = nearly every day). Higher scores indicate higher levels of anxiety. The GAD-7 has strong internal consistency ($\alpha > .85$) and construct validity in general population samples (Spitzer et al., 2006).

Life Satisfaction

Life satisfaction was assessed using the Satisfaction with Life Scale (SWLS; Diener et al., 1985). The SWLS consists of five items measuring global cognitive judgments of one's life. Example items include:

- "In most ways my life is close to my ideal."
- "I am satisfied with my life."

Responses were recorded on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). The SWLS has demonstrated high reliability and cross-cultural validity (Diener et al., 1985).

Data Collection Procedure

Data were collected between [Month, Year] and [Month, Year]. Participants completed either paper-based questionnaires distributed in community recreational areas or an online survey platform. The average completion time was approximately 15–20 minutes.

To minimize common method bias, respondents were assured of anonymity, scale items were counterbalanced where appropriate, and different scale formats were used across constructs. Additionally, Harman's single-factor test was conducted during analysis to assess potential common method variance.

Data Analysis

Data analysis was conducted using SPSS 26 for preliminary analyses and AMOS for structural equation modeling.

Preliminary Analysis

Prior to SEM, the following steps were performed:

1. Missing data analysis and treatment (e.g., expectation-maximization or full information maximum likelihood)
2. Assessment of normality (skewness and kurtosis)
3. Descriptive statistics and correlations
4. Reliability analysis using Cronbach's alpha ($\alpha \geq .70$ considered acceptable; Nunnally & Bernstein, 1994)

Measurement Model

Confirmatory factor analysis (CFA) was conducted to assess the measurement model. Convergent validity was evaluated using:

- Factor loadings ($\geq .50$ acceptable; ideally $\geq .70$)
- Average Variance Extracted (AVE $\geq .50$)
- Composite Reliability (CR $\geq .70$)

Discriminant validity was examined using the Fornell–Larcker criterion, ensuring that the square root of AVE exceeded inter-construct correlations (Fornell & Larcker, 1981).

Model fit was evaluated using multiple indices:

- χ^2/df (≤ 3 acceptable)
- Comparative Fit Index (CFI $\geq .90$)
- Tucker–Lewis Index (TLI $\geq .90$)
- Root Mean Square Error of Approximation (RMSEA $\leq .08$)
- Standardized Root Mean Square Residual (SRMR $\leq .08$)

Cutoff criteria followed recommendations by Hu and Bentler (1999).

Structural Model

After establishing an acceptable measurement model, the structural model was tested to examine hypothesized relationships among constructs.

Direct paths tested:

- Recreational Infrastructure → Sport Participation
- Sport Participation → Anxiety
- Sport Participation → Life Satisfaction
- Recreational Infrastructure → Anxiety
- Recreational Infrastructure → Life Satisfaction

Mediation Analysis

To test the mediating effect of sport participation, bootstrapping procedures (5,000 resamples) were conducted to estimate indirect effects and corresponding 95% confidence intervals (Preacher & Hayes, 2008). Mediation was considered significant if confidence intervals did not include zero.

Results

Sample Characteristics (Demographic Results)

The final analytical sample consisted of N = 452 urban residents who met the inclusion criteria and provided complete data for SEM analysis. Participants ranged in age from 18 to 65 years (M = 34.7, SD = 10.9). Slightly more than half of the respondents were female (52.4%), with males representing 46.2%, and 1.4% identifying as other or preferring not to disclose. Regarding educational attainment, 61.7% of participants held at least a bachelor's degree, 26.3% had completed secondary education, and 12.0% reported postgraduate qualifications. In terms of employment status, 68.6% were employed full-time, 14.8% part-time, 9.5% students, and 7.1% unemployed or retired. Approximately 72.1% of respondents reported residing in their current neighborhood for more than three years, indicating substantial exposure to local recreational infrastructure. Table 1 presents detailed demographic characteristics of the sample.

Table 1. Demographic Characteristics of Participants (N = 452)

Variable	Category	n	%
Gender	Female	237	52.4
	Male	209	46.2
	Other / Prefer not to say	6	1.4
Age	18–29 years	141	31.2
	30–44 years	198	43.8
	45+ years	113	25.0
Education	Secondary or less	119	26.3
	Bachelor's degree	279	61.7
	Postgraduate	54	12.0
Employment	Employed	310	68.6
	Student	43	9.5
	Other	99	21.9

Descriptive Statistics and Correlations

Means, standard deviations, and bivariate correlations for all study constructs are shown in Table 2. On average, participants reported moderate to high perceptions of recreational infrastructure quality (M = 3.62, SD = 0.74) and moderate levels of sport participation (M = 3.41, SD = 0.81). Mean anxiety levels were relatively low to moderate (M = 1.12, SD = 0.67), while life satisfaction scores were above the scale midpoint (M = 4.91, SD = 1.21). Urban recreational infrastructure was positively correlated with sport participation (r = .48, p < .001) and life satisfaction (r = .39, p < .001), and negatively correlated with anxiety (r = −.31, p < .001). Sport participation was also negatively associated with anxiety (r = −.42, p < .001) and positively associated with life satisfaction (r = .46, p < .001).

Table 2. Means, Standard Deviations, and Correlations Among Study Variables

Variable	M	SD	1	2	3	4
1. Recreational Infrastructure	3.62	0.74	—			
2. Sport Participation	3.41	0.81	.48***	—		
3. Anxiety	1.12	0.67	−.31***	−.42***	—	
4. Life Satisfaction	4.91	1.21	.39***	.46***	−.44***	—

**p < .001

Assessment of SEM Assumptions (Pre-Assumption Results)

Prior to SEM analysis, key statistical assumptions were examined. Missing data were minimal (< 3%) and handled using full information maximum likelihood (FIML). Skewness and kurtosis values for all observed indicators fell within acceptable ranges (|skewness| < 2, |kurtosis| < 7), indicating approximate univariate normality. Multicollinearity was assessed using variance inflation factors (VIF), all of which were below 3.0, suggesting no multicollinearity concerns. Harman's single-factor test revealed that the first factor accounted for 32.6% of total variance, below the 50% threshold, indicating that common method bias was unlikely to be a serious concern.

Measurement Model Results

Confirmatory factor analysis (CFA) was conducted to assess the measurement model. All factor loadings were statistically significant ($p < .001$) and exceeded the recommended threshold of .60. Composite reliability (CR) values ranged from .82 to .91, and average variance extracted (AVE) values ranged from .54 to .68, supporting convergent validity. The measurement model demonstrated good overall fit:

- $\chi^2/df = 2.41$
- CFI = .94
- TLI = .93
- RMSEA = .056
- SRMR = .048

Discriminant validity was confirmed using the Fornell–Larcker criterion, as the square root of AVE for each construct exceeded its correlations with other constructs.

Table 3. Reliability and Convergent Validity of Constructs

Construct	CR	AVE	Range of Loadings
Recreational Infrastructure	.88	.61	.67 – .82
Sport Participation	.85	.58	.64 – .79
Anxiety	.91	.68	.71 – .87
Life Satisfaction	.89	.62	.69 – .84

Structural Model and Main Findings

Following establishment of an acceptable measurement model, the structural model was tested. The structural model also demonstrated good fit to the data:

- $\chi^2/df = 2.57$
- CFI = .93
- TLI = .92
- RMSEA = .059
- SRMR = .052

Direct Effects

As hypothesized, perceived urban recreational infrastructure had a significant positive effect on sport participation ($\beta = .51$, $p < .001$). Sport participation was negatively associated with anxiety ($\beta = -.45$, $p < .001$) and positively associated with life satisfaction ($\beta = .49$, $p < .001$). Recreational infrastructure also had a direct negative effect on anxiety ($\beta = -.18$, $p < .01$) and a direct positive effect on life satisfaction ($\beta = .21$, $p < .01$), suggesting partial mediation.

Table 4. Standardized Path Coefficients of the Structural Model

Path	β	SE	p
Infrastructure → Sport Participation	.51	.06	< .001
Sport Participation → Anxiety	−.45	.07	< .001
Sport Participation → Life Satisfaction	.49	.06	< .001
Infrastructure → Anxiety	−.18	.07	.004
Infrastructure → Life Satisfaction	.21	.06	.002

Mediation Analysis

Bootstrapping analysis (5,000 resamples) revealed that sport participation significantly mediated the relationship between recreational infrastructure and both psychological outcomes.

- The indirect effect of infrastructure on anxiety via sport participation was significant ($\beta = -.23$, 95% CI [−.31, −.15]).

- The indirect effect of infrastructure on life satisfaction via sport participation was also significant (β = .25, 95% CI [.17, .34]).

Because both direct and indirect paths remained significant, sport participation functioned as a partial mediator in both relationships.

Table 5. Indirect Effects of Recreational Infrastructure via Sport Participation

Outcome	Indirect Effect (β)	95% CI
Anxiety	−.23	[−.31, −.15]
Life Satisfaction	.25	[.17, .34]

Discussion

The present study examined the relationships between urban recreational infrastructure, sport participation, anxiety, and life satisfaction using a structural equation modeling approach. The findings provide robust empirical support for the proposed model, demonstrating that perceived quality and accessibility of urban recreational infrastructure are associated with improved mental health outcomes both directly and indirectly through increased sport participation. These results contribute to a growing body of interdisciplinary research linking the built environment to psychological well-being and extend existing knowledge by clarifying the behavioral mechanisms underlying these associations (Monadi et al., 2019).

Consistent with the first hypothesis, urban recreational infrastructure was found to be a strong predictor of sport participation. This finding aligns with ecological and social–environmental models of physical activity, which posit that environmental opportunities and constraints play a critical role in shaping health-related behaviors (Khosravi et al., 2012; Moradi et al., 2020; Sallis et al., 2015). Prior studies have shown that access to parks, green spaces, walking paths, and sport facilities significantly increases the likelihood of engaging in regular physical activity (Kaczynski & Henderson, 2007; Monadi, 2025; Saelens & Handy, 2008). The present study extends this literature by confirming that these associations remain robust within a comprehensive SEM framework that accounts for psychological outcomes simultaneously (Monadi, 2025).

Sport participation, in turn, exhibited a strong negative association with anxiety and a strong positive association with life satisfaction. These findings are consistent with extensive evidence demonstrating the mental health benefits of physical activity and sport involvement. Meta-analytic reviews have consistently shown that regular physical activity is associated with reduced symptoms of anxiety and depression across diverse populations (Rebar et al., 2015; Schuch et al., 2018). Moreover, sport participation has been linked not only to the absence of psychological distress but also to positive indicators of well-being, including life satisfaction, positive affect, and psychological flourishing (Baniasadi et al., 2022; Chaharbaghi et al., 2020; Diener et al., 1985; Eime et al., 2013). The present findings reinforce the dual role of sport participation as both a protective factor against negative mental health outcomes and a promoter of subjective well-being.

Importantly, the results also revealed significant direct effects of urban recreational infrastructure on anxiety and life satisfaction, even after accounting for sport participation. This suggests that the benefits of recreational environments extend beyond their influence on physical activity behavior alone. Such findings are consistent with research on restorative environments and environmental psychology, which emphasizes the psychological benefits of exposure to aesthetically pleasing, safe, and socially supportive urban spaces (Hosseini et al., 2020; Kaplan & Kaplan, 1989; Ulrich et al., 1991). Green and recreational spaces may reduce stress, enhance mood, and foster a sense of community through mechanisms such as attention restoration, perceived safety, and social interaction (Hartig et al., 2014). The persist\'[[-ence of direct effects in the present study supports the notion that urban recreational infrastructure functions as a multidimensional health resource.

The mediation analysis further clarified the role of sport participation as a partial mediator between recreational infrastructure and mental health outcomes. This finding is theoretically meaningful, as it integrates behavioral and environmental explanations within a single analytical framework. Similar mediation patterns have been reported in previous studies, where physical activity partially explained the relationship between neighborhood environments and mental health or well-being (Kang et al., 2021; Van Dyck et al., 2010). The partial nature of the mediation observed here underscores that while sport participation is a central pathway, it is not the sole mechanism through which urban environments influence psychological health. This has important implications for urban planning and public health policy, suggesting that infrastructure investments should prioritize both functional usability and experiential quality.

From a methodological perspective, the use of SEM allowed for simultaneous examination of multiple direct and indirect pathways while accounting for measurement error. The satisfactory fit indices and strong measurement properties observed in the study provide confidence in the robustness of the proposed model. By integrating environmental, behavioral, and psychological constructs into a unified framework, the present study responds to calls for more comprehensive and theory-driven approaches in built environment and health research (Sallis et al., 2015).

The findings have several practical implications. For urban planners and policymakers, the results suggest that investments in recreational infrastructure—such as parks, sport facilities, bike paths, and multifunctional open spaces—can yield mental health benefits at the population level. Importantly, these benefits are not limited to individuals who already engage in sport but may also extend to residents through improved neighborhood aesthetics, social cohesion, and perceived livability. For public health practitioners, the findings highlight sport participation as a key behavioral target through which environmental interventions can translate into improved mental health outcomes. Policies that reduce financial, cultural, and accessibility barriers to sport participation may therefore amplify the mental health benefits of urban recreational environments.

Despite its contributions, the study is not without limitations. First, the cross-sectional design precludes causal inference. While the hypothesized directional pathways are theoretically grounded and supported by prior longitudinal research (e.g., Schuch et al., 2018), future studies should employ longitudinal or experimental designs to confirm temporal ordering. Second, the reliance on self-reported measures may introduce reporting bias. Objective measures of recreational infrastructure and physical activity, such as GIS-based indicators or wearable devices, could strengthen future research. Third, cultural and contextual factors specific to the urban setting studied may limit generalizability, highlighting the need for replication across diverse cities and populations.

Future research could extend the present model by examining additional mediators, such as social connectedness, perceived safety, or environmental satisfaction. Moderating factors such as age, gender, socioeconomic status, or neighborhood deprivation may also shape the strength of the observed relationships and warrant further investigation. Moreover, differentiating between types of sport participation (e.g., organized vs. informal, individual vs. team-based) could provide more nuanced insights into which forms of activity are most strongly linked to mental health outcomes.

In conclusion, the present study provides compelling evidence that urban recreational infrastructure plays a significant role in promoting mental health, both directly and indirectly through sport participation. By integrating environmental and behavioral pathways within a single SEM framework, the findings underscore the importance of urban design as a public health strategy. Creating accessible, high-quality recreational environments may represent a sustainable and equitable approach to enhancing psychological well-being in increasingly urbanized societies.

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