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Correlation Between Access to Nature and Psychological Resilience in Everyday Activity Spaces in Nairobi CBD

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Abstract
The settings approach to health posits that spaces where people live, work, find leisure, and move between destinations influence health outcomes. While residential settings dominate the literature, interstitial spaces remain underexplored. This study explores Nairobi CBD as an activity space and examines how exposure to access-to-nature constructs correlates with psychological resilience, operationalised through flourishing and sense of coherence (SOC). Using 1,407 valid responses, exposure was established from places respondents frequently visited or deliberately avoided and mapped using QGIS. Exploratory factor analysis identified two constructs: open spaces and street trees. PLS-SEM examined linear correlations, while generalised additive models explored non-linearity. Explained variance peaked at the 24m buffer. Open spaces negatively correlated with SOC and positively with flourishing, while street trees positively correlated with SOC. Moderation and mediation correlations suggested that trajectories emerged from users' exposure, socioeconomic status and perception. SOC mediated relationships between the constructs and flourishing, highlighting interstitial spaces as significant correlates of psychological resilience.

Keywords: Universal Health Proposition, salutogenesis, activity space, urban design, mental health, non-linearity

INTRODUCTION

The Universal Health Proposition (UHP) challenges us to rethink what it means to create conditions where all individuals can attain the highest standards of wellbeing. This proposition transcends Universal Health Care (UHC), with its focus on equitable access to medical services. It demands attention to the social, environmental and structural determinants of health and asserts health as a socially produced condition. This position moves health beyond the confines of healthcare. Environments where people live, work and find leisure become relevant to health concerns. While addressing the social determinants of health, broader goals, including preventive, promotive, curative, rehabilitative and palliative processes, are considered.

Health in this proposition is a right and not a privilege. To pursue it means addressing systematic inequalities that shape access to conditions necessary for wellbeing. UHP foregrounds the structures that shape health beyond individual choices. Among others, economic policies, urban planning and climate conditions are as critical to health as healthcare facilities. The dominance of the biomedical model for considering health has been challenged. The recent COVID pandemic showcased the need to pull other levers to avert the collapse of healthcare systems. This paper explores one potential condition outside the healthcare system that aligns with the principles of the Universal Health Proposition: urban design for mental health.

Urban spaces, which are now the dominant mode of living, have been correlated with poor mental health outcomes whose asymmetries follow socioeconomic contours. When read together, Sustainable Development Goals (SDGs) 3 (universal health coverage), 11 (sustainable cities) and 13 (climate action) recognise the role of urbanisation and environmental sustainability

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as core health determinants. This paper considers the contribution of urban design and planning within a Central Business District (CBD) context in promoting mental health. The WHO Commission on Social Determinants of Health linked urban planning to health equity (World Health Organization, 2008). Because spatial appropriation is culturally sensitive, the study responds to the call for countries in the Global South to shed light on cultural and contextual factors that affect the mental health–urban space dialectic (Zumelzu & Herrmann-Lunecke, 2021; Ives et al., 2017).

Spatial sensitivity demands a re-evaluation of the settings in which these studies have been conducted. The settings approach to health proposes consideration of the spaces where people live, work or study, and find leisure activities. Spaces that connect these destinations also have a role in exposing users to health-promoting conditions. Connecting spaces have not been significantly explored in the literature; residential settings, however, remain the most studied (Biloria et al., 2022). Helbich (2018) argues for better exposure assessments, positing that because human life unfolds over multiple spaces and across time, neighbourhood-based assessments may be questionable. A CBD setting is thus explored. Jensen (2013) proposes a network of connectivity in overcoming the distinction between destinations (enclaves) and the spaces in between (armatures), a proposition this study intends to explore.

The research problem therefore arises from the limited attention given to connecting and interstitial spaces in comparison with residential settings. Although people move between places of residence, work, study and leisure, the environmental exposures encountered within these connecting spaces remain comparatively underexplored. Consequently, neighbourhood-based assessments may not adequately capture everyday exposure to urban environmental conditions. This creates a knowledge gap concerning whether urban design features that enable everyday access to nature within a CBD activity space correlate with psychological resilience. Nairobi CBD provides a suitable context for exploring this relationship beyond the conventional residential setting. Accordingly, the study examines correlations rather than causal effects between everyday access to nature and psychological resilience.

Research Objectives

The study examines whether urban design features that enable everyday access to nature within connective spaces in Nairobi CBD correlate with psychological resilience. Specifically, it aims to:

i. Identify urban features constituting everyday access to nature in the CBD.
ii. Examine their correlation with psychological resilience as a dialectic between Sense of Coherence (SOC) and flourishing (FLR).
iii. Explore a method for integrating objectivist, subjectivist and relational epistemologies in human–nature connections.
iv. Explore the underlying mechanism for the correlation as linked to the Universal Health Proposition.

This framing allows the study to extend the settings approach beyond residential environments by examining Nairobi CBD as an activity space and considering the connective spaces encountered within users' everyday routines.

THEORY

Access to Nature and Mental Wellbeing

McCay (2017) proposes four ways that urban design and planning could promote mental health: by directly affecting access to nature, promoting physical activities in daily routines, providing prosocial places and offering safe and secure spaces. This study focuses on access to nature as a possible lever that can be pulled to draw closer to the Universal Health Proposition. Access to nature has been shown in numerous studies to contribute to physical, social and mental health and wellbeing. Access to nature is a wide- and far-ranging concept, varying in form from spatial or temporal scale, proximity and sensory pathway (Frumkin et al., 2017), to the level of interaction.

Frumkin et al. (2017) draw on Bratman's definition of nature as areas containing elements of living systems, including plants and non-human animals across different scales and degrees of human management, together with abiotic elements such as sunset or mountain views. While this definition does not exhaust what nature is or what access to it entails, it provides a substantial point of departure for engaging the discussion within the context of

everyday CBD experiences and affordances for accessing nature within pedestrian zones.

Ives et al. (2017) offer three epistemological human–nature connections: an objectivist epistemology, where connection resides within the mind and psychological entities affect behaviour; a constructionist epistemology, which views the human–nature connection through place by exploring relational interactions between people and specific places; and a subjectivist epistemology, which views connections as individual experiences and tracks the uniqueness of individuals' experiences of nature. They propose that studies integrate these perspectives to pursue theoretically and empirically rich, solutions-oriented research. The study pursues this integrative approach by capturing access to nature as an objectively measurable feature of the CBD environment, a subjectively perceived experience and a relational quality of specific pedestrian places.

Numerous studies have linked access to nature to mental wellbeing (Bratman et al., 2019; Twohig-Bennett & Jones, 2018). Most studies have, however, limited the scope of access to nature to structured green spaces such as parks located within residential neighbourhoods (Hartig et al., 2014; Lachowycz & Jones, 2013). Two main references cited in studies on nature and mental health are Ulrich et al. (1991), on stress recovery during exposure to nature and urban environments, and Kaplan (1995), on the restorative benefits of nature. Whereas both propose plant-rich environments as beneficial to mental health, their theoretical frameworks neither limit the scope of nature access to plants and structured green spaces nor confine its ameliorative effect to residential neighbourhoods. A need to expand access to nature across diverse urban environments therefore arises in order to sustainably and equitably promote health benefits.

Equity and Alternative Access to Nature

Structured green spaces have been shown to have unexpected outcomes for marginalised communities (Wolch, Byrne, & Newell, 2014; Checker, 2011). Studies such as Rigolon et al. (2021) have shown limitations, especially among marginalised communities, in accessing structured green spaces, which are often not within reasonable reach of marginalised residential communities (Rigolon et al., 2018; Tian et al., 2024). This suggests the need to explore alternative avenues of accessing nature within the reach of marginalised communities.

Given that research studies shape dominant opinions, which in turn shape policies—the "causes of causes"—the continued prominence of structured green spaces within residential neighbourhoods is shaping policies. Yet these policies may face equitable implementation challenges, especially when considering barriers marginalised communities face in accessing and benefiting from structured green spaces. To move the Universal Health Proposition forward through equitable access to health resources, alternative avenues of accessing nature, especially for disadvantaged communities, should therefore be studied.

Mental Health and the Urban Environment

Mental health has been marginalised within universal health discourse despite being one of the three key pillars of health (Patel & Saxena, 2019; Samuel, Flores, & Frisancho, 2020). The importance of distinguishing mental health from mental illness has been highlighted as critical to understanding mental health (Galderisi et al., 2015; Manwell et al., 2015).

McPhie (2019) challenges the assumption that mental health is bounded within a body or brain and instead proposes mental health and wellbeing as a process spread within the environment and through a permeable, a-centred self. This perspective moves beyond considering nature as a detached objective other towards understanding mental health and wellbeing as a distributed process. McPhie (2019) further argues that the health of the land is not separate from human health; neither can be healthy without the other.

Research Gap

The reviewed literature demonstrates substantial evidence linking access to nature with mental health and wellbeing. However, the dominant emphasis remains on structured green spaces, particularly parks and greenery located within residential neighbourhoods. This provides limited understanding of how people may access and experience nature through connective and interstitial spaces encountered as part of their everyday urban routines.

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The literature also shows that access to structured green spaces is not necessarily equitable. Marginalised communities may experience physical and socioeconomic barriers that restrict access. Concentrating primarily on residential parks and structured green spaces may therefore overlook other forms of nature encountered through everyday urban environments. The gap is also contextual, as existing literature provides limited explanation of how these relationships operate within dense African CBD environments such as Nairobi. The study addresses this gap by examining everyday access to nature within Nairobi CBD as an activity space and integrating objectively measurable environmental features, subjective perceptions and relational experiences of pedestrian places.

Theoretical Framework

Studies considering the mental health–urban space nexus are dominated by the biomedical model of looking for the causes of disease (Lauwers et al., 2021; Zumelzu & Herrmann-Lunecke, 2021; Wandersman & Nation, 1998). The study instead adapts the salutogenic model of health, advanced by Antonovsky (1996), which focuses on how people leverage resources or assets to remain on the ease side of the dis-ease–ease spectrum. Salutogenesis is concerned with seeking the causes of health rather than the causes of disease.

The study leverages three concepts within this umbrella: Sense of Coherence (SOC), flourishing (FLR) and resilience. SOC comprises comprehensibility, the cognitive ability to discern structure and order in stimuli; manageability, the ability to acknowledge resources available to engage situations; and meaningfulness, the motivational dimension that moves one to act and pursue solutions (Mittelmark et al., 2022). Flourishing, as advanced by Keyes (2007) in the complete mental health model, proposes that beyond avoiding mental illness, individuals should thrive in their personal and social lives. It encompasses emotional or hedonic wellbeing, psychological or eudaimonic wellbeing, and social wellbeing through functioning in society.

Psychological resilience connects the physical world to mental processes and sits at the interface between the internal and external environment in McPhie's (2019) a-centred continuum. The study adopts Fletcher and Sarkar's (2013) definition of psychological resilience as the role of mental processes and behaviour in promoting personal assets and protecting individuals from potential negative effects of stressors. Within the salutogenic framework, everyday life events provide the context within which resilience is sought (Mittelmark, 2021). Nairobi CBD is therefore taken as an ambient antecedent, SOC as the protective buffering mechanism and flourishing as the promotive, generative component of positive adaptation.

The study consequently foregrounds the salutogenic perspective, focusing on the causes of health rather than disease. The dialectic between SOC and flourishing is conceptualised as psychological resilience: the outcome of leveraging assets within the CBD to move towards the ease end of the mental health continuum and the flourishing band of complete mental health advanced by Keyes (2007). The theoretical framework therefore links the urban environment and everyday access to nature with SOC and flourishing, through which psychological resilience is examined (**Figure 1**).

RESEARCH METHODS

Research Design and Study Area

The research design was a cross-sectional intra-urban spatial-exposure and quantitative analytical study. The study was conducted in Nairobi, Kenya's capital city, within the Central Business District (CBD). The study area is delimited by University Way to the north, Nairobi River to the east, Haile Selassie Avenue and Ring Road to the south, and Uhuru Highway to the west. The Integrated Transport System and Loop Line in the Nairobi Urban Core report by JICA estimated 900,000 pedestrian users moving through this area per day. With this as the sampling frame, Yamane's formula suggested approximately 400 samples for a 95% confidence level.

The geographical extent of the study area is presented in **Figure 2**.

Data Collection and Sampling

Two data types were collected. First, urban design features of the built environment whose affordance enables access to nature were captured through an audit by recording actual pedestrian experiences with on-person mounted cameras—one shoulder,

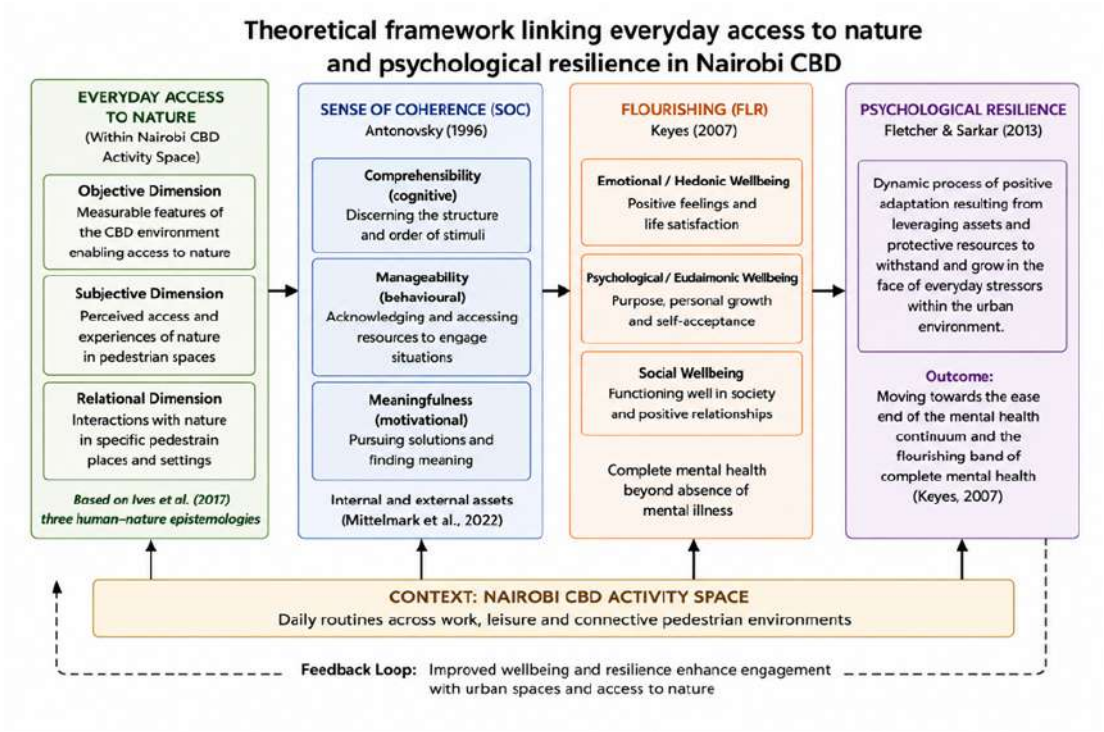


FIGURE 1
Theoretical framework linking everyday access to nature and psychological resilience in Nairobi CBD
Source: Authors' conceptualisation based on Antonovsky (1996), Keyes (2007), Fletcher and Sarkar (2013), Ives et al. (2017), McPhie (2019), and Mittelmark et al. (2022).



FIGURE 2
Study area
Source: Adapted from Google Maps, 2026

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two rear and one front. Feature identification was undertaken through desktop analysis of the footage using a fieldwork protocol. Google Street View supplemented the footage where visibility was blocked by parked vehicles or crowded streets. Counts were transformed into probability densities by dividing counts by street length.

Activity spaces were derived from respondents' reported frequently visited and deliberately avoided places in the CBD and the place-based Positive and Negative Affect Scale (PANAS). These were used to generate exposure buffers by leveraging the v.net.steiner tree algorithm in QGIS. A plugin was developed to integrate frequently visited segments over a pedestrian network weighted with avoided places and responses to PANAS. Six exposure buffers following Kenyan road reserve conventions were built around this route: 12 m, 24 m, 36 m, 48 m and 60 m, together with two cross-scale buffers derived from the first five—one maximising the variance of features by interquartile range (IQR) and the other by standard deviation (SD).

The second dataset captured respondents' urban experiences and state of psychological resilience. In recognition of differences in health-promoting and salutary potential as well as vulnerability over the life course, the study limited engagement to individuals ranging from early adulthood (20 years) to late adulthood (above 65 years), according to Erik Erikson's psychosocial development stages.

The study employed convenience sampling. Stratified random sampling was adapted in a bid to approach sample representativeness of the accessed population. The survey was administered both online using the KoBoCollect toolbox and in person at convenient locations, mainly public transport stop points. Research assistants guided respondents through the questionnaire, while others independently completed the version circulated through social media. Online circulation began in December 2023 and continued to the end of February 2024. Physical circulation began in January 2024.

A total of 2,518 responses were collected. After cleaning through removal of highly incomplete responses, responses lacking identifiable activity-space locations and responses with high single-response patterns to most questions, 1,407 valid responses remained for analysis.

Measurement of the Urban Built Environment and Access to Nature

The unit of analysis was a street segment—the length between two junctions—split at the centre of the reserve and further divided into zones following the complete streets framework: building/lot, pedestrian, access carriageway and road carriageway zones. Each has transition zones that may present opportunities or become barriers to accessing nature.

In the context of this study, access to nature was limited to flora and access to sunlight, both extensively documented as influencing mental health. The quality of vegetation, amount of exposure or dosage, access afforded by the built environment and level of maintenance were also considered, responding to knowledge gaps proposed in the literature (Bratman et al., 2019).

Under land use, open-space types based on size were counted, including plazas, gardens, courtyards, mini-plazas and other ad hoc open spaces. Access types were identified as none, visual, physical access with a fee, and physical access with no fee. Management structures were categorised as private, public-private partnerships and council-managed. Blue spaces were initially included but removed because of limited variance.

At block level, average block setbacks and street-segment orientation were recorded because both influence sunlight exposure. At building level, segment enclosure was measured based on the average street canyon, assuming an average height of three metres per building level. The sky view factor was computed, while sky visibility was assessed from the centre of each segment in four directions. Within pedestrian walkways, street trees, façade plants, potted plants, ground-cover plants and shrubs were recorded. Plant quality was assessed on a 1–10 scale considering age, visual health and maintenance. Vegetation within transition zones was also recorded.

Measurement of Psychological Resilience, Perception and Exposure

The questionnaire included two standard instruments for measuring psychological resilience: the 13-item Sense of Coherence Scale (SOC-13) and the 14-item Mental Health Continuum Short Form (MHC-SF). Flourishing was measured using the MHC-SF developed by

Keyes (2009), covering emotional, psychological and social wellbeing. SOC-13, developed by Antonovsky (1993), measured comprehensibility, manageability and meaningfulness. The five-level Likert scale proposed by Holmefur et al. (2015) was used.

Exploratory factor analysis of responses to perception questions generated the perception constructs. The survey also captured temporal scales of exposure. Long-term exposure was assessed through metropolitan tenure, medium-term exposure through residential tenure, and short-term exposure through frequency of visits to the CBD per week and where respondents spent their waking hours. A principal component analysis (PCA)-1 of time spent in different activities was used in the analysis. Socioeconomic status was also captured.

The data sources, construct development and sequence of analytical procedures adopted in the study are summarised in **Figure 3**.

Data Analysis

Exploratory factor analysis (EFA) was first applied to perceived CBD experience items to uncover latent structure empirically because no pre-established latent model existed for these items. For SOC and flourishing (FLR), confirmatory factor analysis (CFA) was conducted. Subsequently, PLS-SEM measurement-model assessment was conducted. Reliability and validity of the emergent structures were therefore evaluated through EFA, CFA and the PLS-SEM measurement model.

All measurement models were evaluated following recommended thresholds (Hair et al., 2022): indicator loadings > 0.708; Cronbach's Alpha (α), rhoA (ρ_a) and composite reliability (rhoC) > 0.70; AVE > 0.50; and adherence to the Fornell–Larcker and HTMT criteria for discriminant validity.

The study first identified empirical patterns through PLS-SEM, including direct, mediated and moderated paths. PLS-SEM was selected as the primary modelling strategy because of its robustness to non-normal data, capacity to accommodate complex models with multiple mediators and moderators, and appropriateness for exploratory, prediction-oriented research (Hair Jr. et al., 2021; Hair et al., 2022). Rather than claiming causal explanation, the structural model was used to map directional associations consistent with theoretically expected ordering. Latent-variable scores from validated PLS-SEM models were then extracted for nonlinear analyses.

Generalised additive models (GAMs) were subsequently fitted to these latent scores to examine potential nonlinear functional forms. GAMs were selected because they allow flexible smooth terms without imposing arbitrary parametric shapes. Significant smooth terms (EDF > 1, $p < 0.05$) suggested threshold correlations and diminishing returns for several predictors.

Ethical Considerations

The study was approved by the Kenyatta National Hospital–University of Nairobi Ethics and Research Committee, Protocol No. P81/02/2023, and authorised by the National Commission for Science, Technology and Innovation (NACOSTI), Licence No. NACOSTI/P/23/23684.

RESULTS

Given the highly nuanced and numerous nature of urban design elements, an initial dimension-reduction stage was applied to the objective indicators using principal component analysis (PCA) and multiple correspondence analysis (MCA), yielding parsimonious composites while retaining maximum explained variance (Husson, Lê, & Pagès, 2017; Jolliffe & Cadima, 2016). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Revelle, 2017; Osborne, 2014) was used to assess whether the correlation matrix of the indicators contained sufficient common variance to justify factor analysis. Variance Inflation Factor (VIF) was used to check how much variance of a regression coefficient was inflated because of linear dependency among predictors. Predictors were dropped from the model when VIF exceeded the established threshold (Dormann et al., 2013; O'Brien, 2007). This sequencing ensured that only theoretically meaningful and statistically stable constructs progressed into subsequent analyses.

Exploratory factor analysis identified two access-to-nature factors across the buffers, except at the 60 m buffer, where the constructs converged. **Table 1** presents the indicators contributing to the two constructs and identifies indicators excluded because of multicollinearity, inadequate factor loading or insufficient KMO factor adequacy.

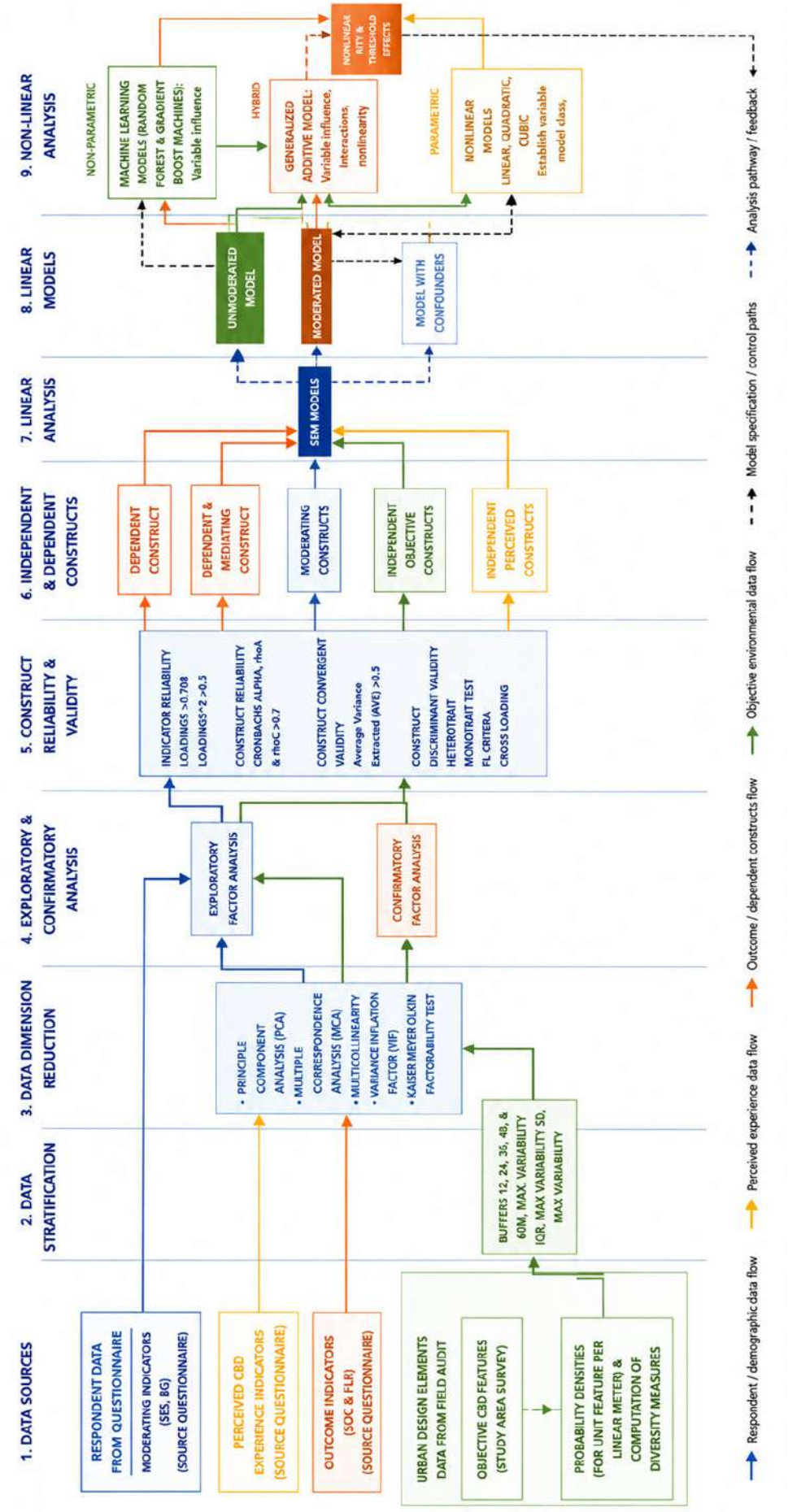


FIGURE 3
Data sources, construct development and analytical procedure sequence
Source: Authors' conceptualisation, 2026

TABLE 1
Outcome of exploratory factor analysis for access-to-nature indicators

Segment zone	Indicator/metric	Analysis code	Factor	12 m	24 m	36 m	48 m	60 m	IQR	SD
Land use	Open spaces – PCA composite, first principal component of open-space count	X37044	oNTACS_F1	0.7172	0.9086	0.9126	0.9288	0.8971	0.8253	0.7172
Land use	Open-space management	X37044.6	oNTACS_F1	0.9544	0.9605	0.9543	0.9567	—	0.9607	0.9544
Land use	Open-space access type – PCA composite, first principal component	X37044.7	oNTACS_F1	0.9202	—	—	—	0.8805	0.8420	0.9202
Building enclosure	Average canyon of buildings on both sides of reference segment	X37050.7.2	oNTACS_F2	0.7649	0.7682	0.7953	0.8569	—	0.7236	0.7649
Pedestrian walkway	Street-tree count	X37061.21	oNTACS_F2*	0.8684	0.8934	0.8864	0.8040	0.7496*	0.8551	0.8684
Pedestrian walkway	Vegetation quality and overall level of maintenance	X37061.27	oNTACS_F2	0.8363	0.8661	0.9074	—	—	0.8627	0.8363
Access carriageway	Vegetation – MCA composite, first component for presence of shrubs and ground cover	X37085.12S	oNTACS_F2	0.5963	0.5476	—	0.6984	—	0.6406	0.5963

Source: Authors' analysis, 2026

Note: Values represent factor loadings. A dash (—) indicates that the indicator was excluded at the respective buffer because of multicollinearity, Kaiser-Meyer-Olkin (KMO) factor adequacy below 0.6, inadequate factor loading, or failure to load onto a factor. *At the 60 m buffer, street-tree count (X37061.21) loaded onto oNTACS_F1 (0.7496) rather than oNTACS_F2. Indicators excluded from the final factor structure included total open-space count (X37044.099), street orientation (X37050.7.1), sky factor (X37050.7.3), visible-sky enclosure (X37050.8), average building setbacks (X37053.1), movable potted plants (X37061.6S), access-carriageway vegetation quality and maintenance (X37085.2), roadway median trees (X37105.31), and roadway median façade plants (X37105.3S). Their exclusion resulted from multicollinearity, inadequate KMO factor adequacy or insufficient factor loading.

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Exploratory factor analysis identified two access-to-nature constructs across the spatial buffers, comprising the open spaces construct (oNTACS_F1) and the street trees construct (oNTACS_F2), as presented in **Table 1**.

Linear Correlations

The PLS-SEM unmoderated linear model examined the correlations between the access-to-nature constructs and the two psychological resilience outcomes, SOC and flourishing (FLR). Adjusted R^2 ranged from 0.3434 to 0.3473 for SOC and from 0.6138 to 0.6145 for FLR. **Figure 4** presents the PLS-SEM model for SOC and FLR.

When predicting SOC, the open spaces construct (oNTACS_F1) was statistically significant at the 24 m buffer (99% CI, F^2 = 0.00528), 36 m buffer (95% CI, F^2 = 0.00321) and 48 m buffer (95% CI, F^2 = 0.00299). SOC was negatively correlated with oNTACS_F1.

The street trees construct (oNTACS_F2) was statistically significant when predicting SOC across the buffers, except where the constructs converged. At the 12 m, 24 m, 36 m and 60 m buffers, significance was at the 99% confidence level, with F^2 values ranging from 0.00619 to 0.00838. When predicting FLR, the open spaces construct had significant positive correlations at the 24 m buffer (95% CI, F^2 = 0.00194) and 36 m buffer (95% CI, F^2 = 0.00351).

Moderating Effects

The moderated PLS-SEM linear models produced adjusted R^2 values ranging from 0.3434 to 0.3567 for SOC and 0.6303 to 0.6335 for FLR. Changes were observed in the statistically significant direct correlations after moderation.

For the open spaces construct predicting SOC, significant correlations remained at the 24 m (99% CI), 36 m (99% CI) and 48 m (95% CI) buffers. Where respondents spent most of their waking hours (EXP_F3) moderated this relationship at the 24 m (99% CI) and 48 m (95% CI) buffers, while metropolitan tenure (EXP_F1) moderated it at the 36 m buffer (95% CI).

The street trees construct remained significantly correlated with SOC across the buffers, except where the constructs converged. Residential density (SES_F1) moderated this relationship at the 12 m, IQR and SD buffers, all at the 95% confidence level, while highest level of education (SES_F3) moderated the relationship at the 36 m buffer (95% CI).

When predicting FLR, direct correlations for the open spaces construct were found only at the 36 m buffer (95% CI). At the 60 m buffer, where all indicators converged into the construct, employment status (SES_F2) moderated the effect at the 99% confidence level. Correlations between the street trees construct and FLR emerged through residential density (SES_F1) at the 24 m buffer (95% CI) and employment status (SES_F2) at the 24 m buffer (95% CI).

Mediation Effects

Mediation analysis showed that SOC and perception constructs mediated relationships between access-to-nature constructs and the outcome variables. **Figure 5** presents the filtered mediation matrix, showing the direct, indirect and specific path components across the spatial buffers for SOC and flourishing.

When predicting SOC, perceived stress at work and at home (PRC_CBD_F1) mediated correlations of the street trees construct, with full mediation at the 48 m buffer. Salience of route safety and security competitively mediated the negative correlations of the open spaces construct across the buffers, except at 60 m, where the indicators merged into one construct. Both complementary and buffering correlations were observed. At the 60 m buffer, perception of CBD interactions (PRC_CBD_F3) and perception of pedestrian experiences (PRC_CBD_F4) complemented the correlations between oNTACS_F1 and SOC.

When predicting FLR, perceived stress at work and at home (PRC_CBD_F1) fully mediated the correlations of the street trees construct at the 12 m, 24 m, 48 m, IQR and SD buffers. SOC partially mediated correlations between the open spaces construct and FLR at the 24 m, 36 m and 48 m buffers and fully mediated correlations of the street trees construct at the 12 m, 24 m, 36 m, IQR and SD buffers.

Nonlinear Correlations

The hybrid moderated model using generalised additive models (GAMs) was used to examine nonlinear relationships. **Figure 6** presents the

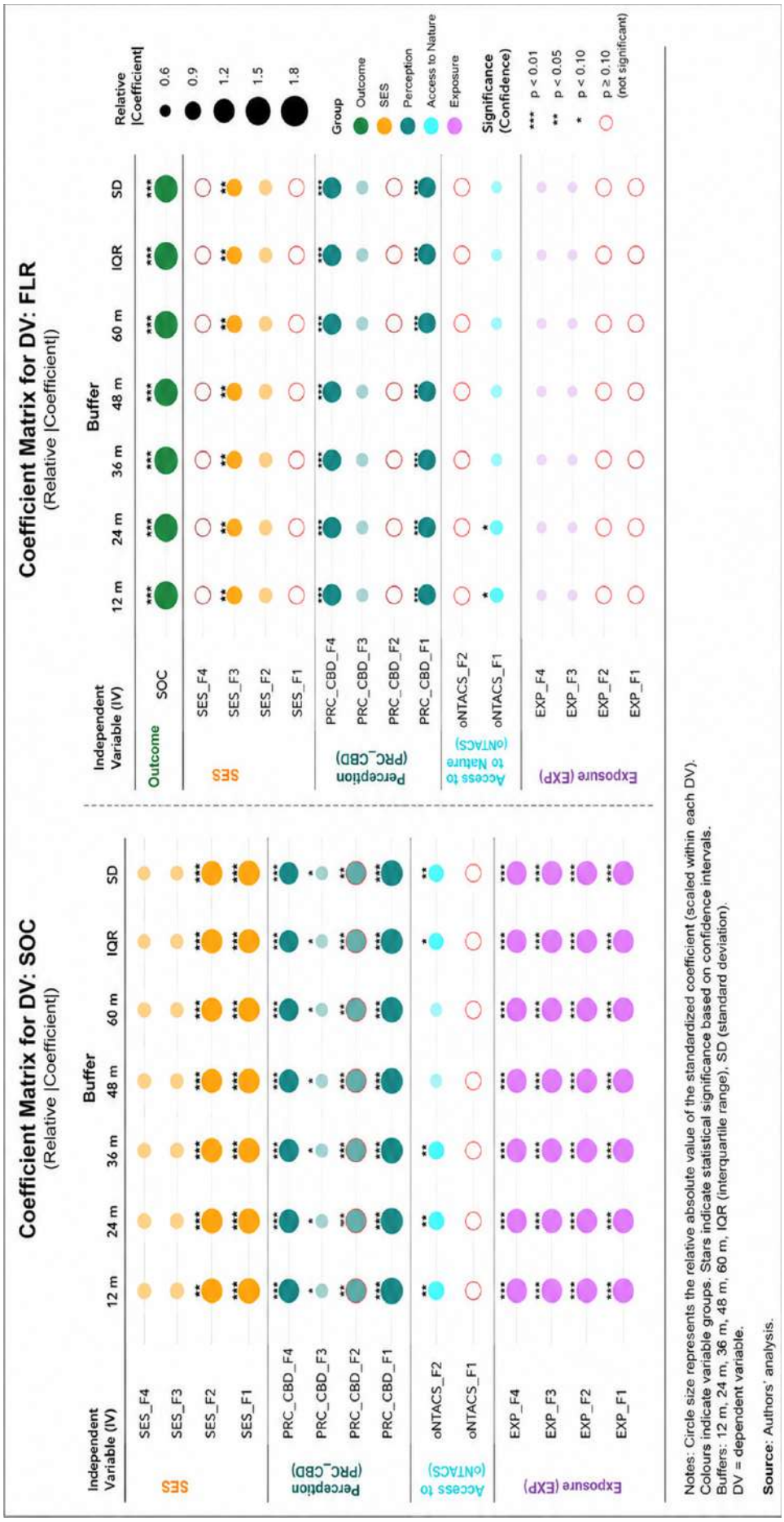


FIGURE 4
Outcome of PLS-SEM model for SOC and flourishing
Source: Authors' analysis, 2026

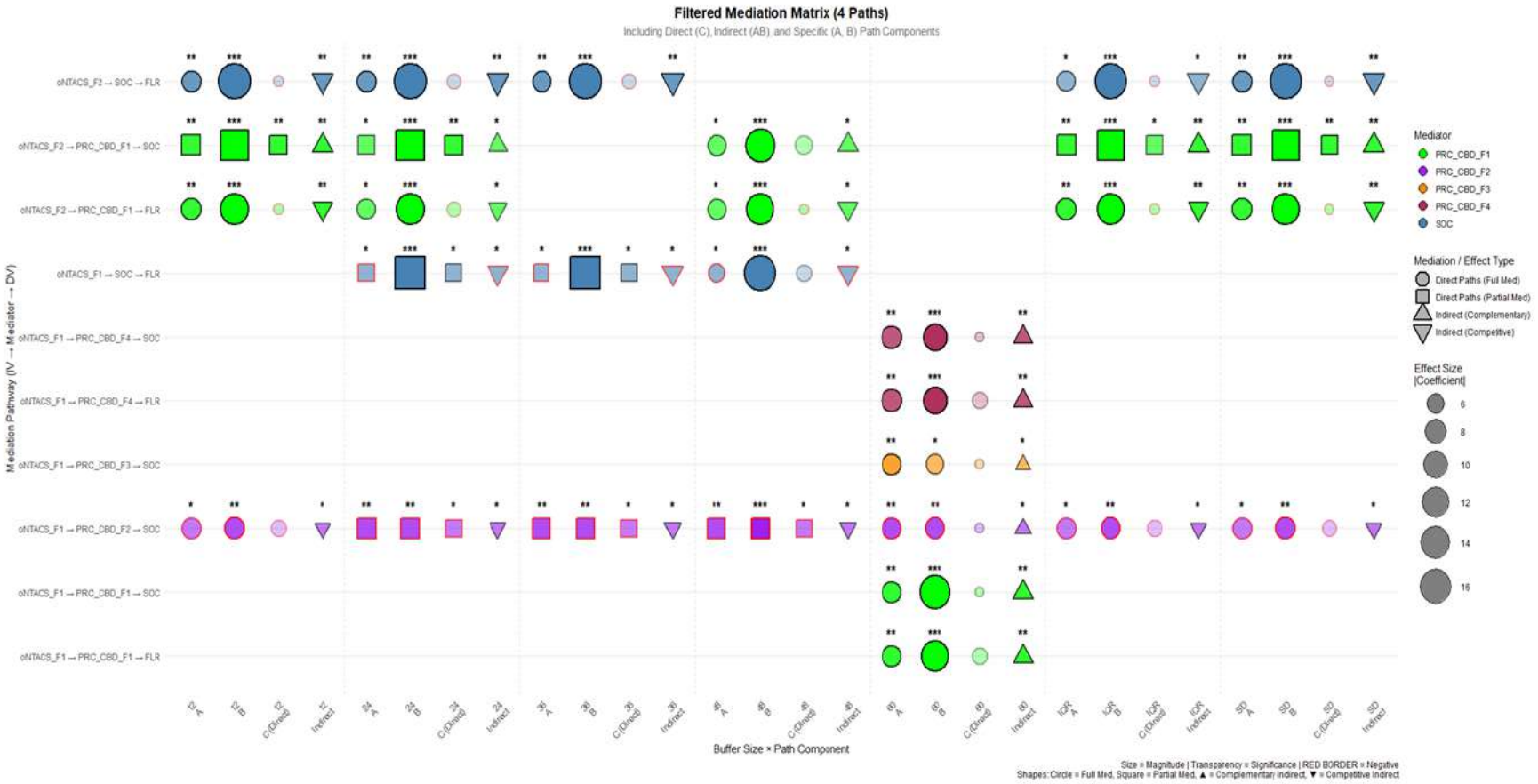


FIGURE 5
Mediation summary
Source: Authors' analysis, 2026

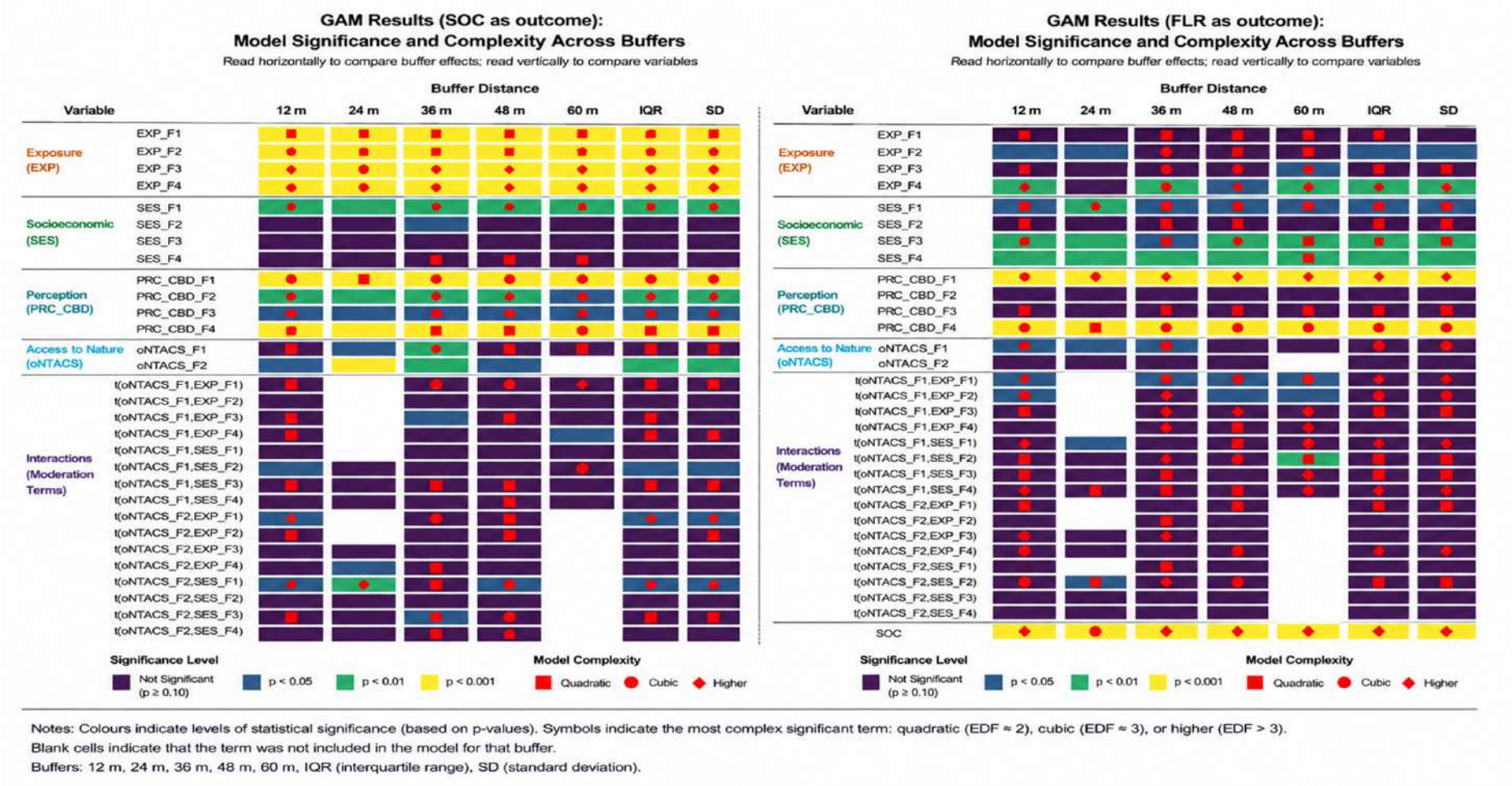


FIGURE 6
Outcome of GAM analysis for SOC and flourishing
Source: Authors' analysis, 2026

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GAM results for SOC and FLR.

When predicting SOC, the open spaces construct correlated at the 24 m buffer (EDF = 0.870, 95% CI) and 36 m buffer (EDF = 2.828, 99% CI). The street trees construct correlated at the 12 m (EDF = 1.000, 99% CI), 24 m (EDF = 1.036, 99.9% CI), 36 m (EDF = 1.000, 99% CI), and 48 m, IQR and SD buffers (EDF = 1.000, 95% CI).

Residential density (SES_F1), employment status (SES_F2) and highest level of education (SES_F3) moderated correlations from both constructs. Among exposure constructs, metropolitan tenure (EXP_F1), where respondents spent most of their waking hours (EXP_F3) and frequency of CBD visits (EXP_F4) also moderated the correlations.

For FLR, only the open spaces construct showed significant direct correlations at the 12 m (EDF = 2.644, 95% CI), 24 m (EDF = 0.770, 95% CI) and 36 m (EDF = 1.830, 95% CI) buffers. Metropolitan tenure (EXP_F1) and residential tenure (EXP_F2) moderated correlations involving oNTACS_F1, while residential density (SES_F1) and employment status (SES_F2) also influenced the relationship. The street trees construct correlated with FLR at the 24 m buffer (EDF = 2.254, 95% CI) when moderated by employment status; no direct correlations were found.

Overall, the results identify two principal access-to-nature constructs—open spaces and street trees—whose correlations with psychological resilience varied according to outcome, spatial buffer, perception, exposure and socioeconomic characteristics. The 24 m buffer emerged repeatedly across the linear, moderation, mediation and nonlinear analyses, while SOC also mediated relationships between access-to-nature constructs and flourishing.

DISCUSSION

The study explored the potential association between quotidian exposure to access-to-nature constructs in Nairobi CBD and psychological resilience, operationalised through Sense of Coherence (SOC) and flourishing (FLR). The findings indicate that the relationship is neither uniform nor inherently salutogenic. Instead, it varies according to the type of nature, governance and accessibility of urban space, socioeconomic characteristics of users, and patterns of exposure. The explained variance in the GAM analysis peaked at the 24 m buffer for both SOC and FLR, suggesting that associations between access to nature and psychological resilience were most detectable at an immediate micro-frontage scale rather than at a broader neighbourhood scale.

For SOC, the street trees construct (oNTACS_F2) showed a positive association, supporting earlier restorative-environment research that identifies vegetation as an environmental resource for psychological recovery (Kaplan, 1995; Ulrich et al., 1991). Much of this literature, however, has concentrated on parks, gardens, urban forests and residential environments. The present findings extend this perspective by suggesting that street trees within a non-residential pedestrian armature may also support coherence. Within the salutogenic perspective, street trees may therefore function as General Resistance Resources that help individuals manage everyday environmental demands. Their contribution in Nairobi may also extend beyond psychological restoration through shade and thermal comfort, although these pathways could not be disentangled in the present study.

The open spaces construct (oNTACS_F1), however, showed a markedly different pattern. Its predominantly negative and conditional relationship with SOC challenges a simple assumption that greater access to nature necessarily improves psychological wellbeing. The finding is consistent with the environmental adaptive-cost perspective of Evans and Cohen (2004), whereby environmental conditions may impose demands that require coping rather than automatically providing restoration. The composition of oNTACS_F1 helps explain this result. The construct was strongly influenced by open-space management, with privately managed and council-managed spaces dominating, while public-private partnerships contributed relatively little. Thus, the presence of open space alone appears insufficient; management, accessibility and the conditions under which users appropriate the space are consequential.

The moderation findings reinforce this conditional interpretation. Residential density moderated the relationship between street trees and SOC, suggesting that users from high-density

residential environments may derive different regulatory value from CBD vegetation than those from lower-density settings. This is consistent with Antonovsky's (1987) argument that General Resistance Resources are effective to the extent that they are available, accessible and meaningful within an individual's life context. Street trees may therefore provide a compensatory environmental resource for respondents whose residential settings provide comparatively limited everyday exposure to vegetation.

Residential density also moderated the relationship between open spaces and flourishing. For respondents from higher-density settings, greater exposure to the open-spaces construct was associated with lower flourishing under some conditions. This seemingly counter-intuitive relationship becomes clearer when access and governance are considered. Low (2000) demonstrates that urban public and semi-public spaces are shaped by socially negotiated boundaries of belonging, safety and appropriate conduct. Consequently, physically available open spaces may still require users to negotiate access, visibility and legitimacy. The finding therefore shifts attention from merely providing green or open spaces towards considering what type of space is provided, who can use it, and under what governance conditions.

Employment status further moderated the relationship between street trees and flourishing, indicating that the same environmental feature may have different implications depending on the conditions under which it is encountered. For employed respondents, repeated exposure may occur through obligatory and time-pressured mobility, where congestion and cognitive demands potentially reduce restorative value. For unemployed respondents, street trees may instead buffer harsher environmental conditions without necessarily producing high flourishing. This interpretation is consistent with environmental-load and stress-buffering perspectives (Evans & Cohen, 2004; Cohen & Wills, 1985). The same feature can therefore operate differently according to users' resources and everyday mobility conditions.

Finally, the mediation findings demonstrate the importance of perception and SOC in connecting environmental exposure to flourishing. Perceived stress at work and home and perceived route safety mediated some relationships between the access-to-nature constructs and psychological resilience. This supports the view that environmental experiences are embedded within broader social and psychological contexts rather than operating independently. Bronfenbrenner and Morris (2006) similarly emphasise interactions across nested contexts, while Low (2000) shows that safety and belonging are culturally negotiated through spatial practices. SOC's mediating role is particularly important: consistent with Antonovsky (1987) and Keyes (2002), coherence appears to provide a stabilising capacity through which environmental experiences may contribute to flourishing. Overall, the findings suggest that the salutogenic potential of Nairobi CBD lies not simply in increasing nature, but in aligning environmental affordances, governance, accessibility and conditions of encounter with the resources users can mobilise in everyday life.

CONCLUSION

The study found empirical evidence that everyday exposure to access-to-nature constructs within Nairobi CBD is correlated with psychological resilience, despite the CBD being an under-examined setting. It also found that, at the micro-frontage scale, different types of nature exposure can be distinguished, revealing patterns that coarser, undifferentiated conceptualisations may miss. While high exposure to the street trees construct functioned as a compensatory resource for residents from high-density contexts, it simultaneously correlated with contexts in which time-pressured employed respondents experienced cumulative load. Similarly, respondents from high-density residential settings paid a relatively higher adaptive cost in CBD open spaces, where inaccessible high-quality spaces, coupled with accessible poor-quality and ad hoc spaces, imposed distinct regulatory demands.

These findings suggest that environmental features within interstitial spaces (armatures) are not inherently salutogenic. Their contribution to wellbeing depends on their governance structures, users' socioeconomic positions, and the circumstances under which they are encountered.

Methodologically, the operationalisation of Ives et al.'s (2017) integrative approach enabled direct correlations to capture the objective relational

plane, moderation to map the subjective plane, and mediation to trace the relational emergence of meaning through perception. This tripartite framing enabled the study to explore intersections between interstitial spaces (armatures) and enclaves (home, leisure and work settings), objective urban design features, individual capacity, structured exposure conditions and emergent subjective meaning. These are consistent with the distributed, acentred and ecological understanding of mental health advanced by McPhie (2019). While the study cannot confirm this ontology, it foregrounds what becomes visible when this position is adopted as an analytical starting point.

RECOMMENDATIONS

Following the Universal Health Proposition, if health is a socially produced condition, a right and not a privilege, urban design for mental health should not stop at providing access to nature. The presence of objective nature features does not guarantee SOC or FLR; the kind of nature, its governance structures, accessibility and the conditions under which it is encountered must also be considered.

In Nairobi CBD, the street trees construct was found to partially contribute to this proposition, while open spaces in their current configuration did not. The findings therefore identify opportunities to improve the mental-health potential of CBD pedestrian zones through the following:

i. *Improve open-space availability, management and accessibility*. These dimensions were associated with users' Sense of Coherence. Greater attention should therefore be given to the availability, quality, management and accessibility of open spaces within Nairobi CBD. The underrepresented public-private partnership model presents an opportunity to improve access while enhancing the quality of these spaces. Although such provision exists in policy and legislation, its implementation remains limited. Future studies should investigate the reasons for this implementation gap.
ii. *Improve the quality and maintenance of street trees*. Street-tree presence alone was found to be insufficient. Overall vegetation quality and average canyon conditions were associated with Sense of Coherence, which mediates relationships with flourishing. Attention should therefore extend beyond increasing the number of street trees to improving their quality and maintenance and the conditions within which they are encountered. Public-private partnerships, including adopt-a-tree or adopt-a-verge initiatives, could support the quality and maintenance of existing and new vegetative features.

As these are publicly accessible General Resistance Resources, investment should involve both county government and private actors. Socially producing health as a right rather than a privilege foregrounds governance, equitable access and socioeconomic position. For psychological resilience, the burden of adaptation should therefore be shared rather than borne by users alone.

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