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The Impact of Urban Forest on Stress Levels: An Environmental and Socioeconomic Analysis in Florida, US

Christy C. V. Suhendy [1,*], Andrew K. Koeser [2], Ryan W. Klein [1], Laura A. Warner [3], Matilda Van Den Bosch [4,5,6,7,8] and Gail Hansen [1]

[1] Department of Environmental Horticulture, IFAS, University of Florida – Fifield Hall, PO Box 110670, Gainesville, FL 32611, United States
[2] Department of Environmental Horticulture, IFAS, University of Florida – Gulf Coast Research and Education Center, 14625 County Road 672, Wimauma, FL 33598, United States
[3] Department of Agricultural Education and Communication (AEC), University of Florida – 407 Rolfs Hall PO Box 110540, Gainesville, FL 32611, United States
[4] School of Population and Public Health, Faculty of Medicine, University of British Columbia, Vancouver, Canada
[5] ISGlobal, Barcelona, Spain
[6] Universitat Pompeu Fabra (UPF), Barcelona, Spain
[7] CIBER Epidemiología y Salud Pública (CIBERESP)
[8] European Forest Institute, Biocities Facility, Rome, Italy
* Correspondence: suziesuhendy@gmail.com; Tel.: +1 3528883722

Abstract

Mental health benefits associated with urban nature exposure have gained significant research attention. This study explored the relationships between self-reported stress levels and sociodemographic, behavioral, and environmental predictors related to urban forest access, using the 3-30-300 rule as a contextual framework (three trees visible from home, 30% neighborhood canopy cover, and 300 meters to the nearest green space). Sociodemographic factors such as age and income significantly influenced stress, with older individuals and those who are financially comfortable reporting lower stress levels. Environmental variables, such as tree canopy cover and the number of trees near residences were not significantly associated with stress. However, the frequency of green space visits demonstrated a significant impact. Daily time spent in natural areas significantly reduced stress, with weekly visits also linked to lower stress levels, whereas infrequent visits, such as only some times a year, were associated with higher stress, underscoring the importance of regular interaction with nature. These findings suggest that the frequency of green space visits may play a more critical role in stress reduction than the mere presence of urban greenery, at least in the context of this study. Policymakers and urban planners should prioritize enhancing access to high-quality, safe, and engaging green spaces to promote mental health. Future research should investigate the mechanisms driving these relationships and evaluate the long-term impacts of green space engagement on well-being.

Keywords: urban forest; green spaces; human health; wellbeing; stress level; mental health; public health; socioeconomic

1. Introduction

1.1. Mental Health and Urban Stress

Urban environments significantly affect mental health, exposing residents to unique stressors that contribute to various psychological and physical health challenges. For instance, noise (Watts et al., 1999; Ow et al., 2017), overcrowding (Zhang et al., 2023), and intense visual stimulation (Vargas et al., 2020) create a demanding sensory environment, often leading to chronic stress. Social issues, including isolation and loneliness (Brandt et al., 2022), high crime rates (Wang et al., 2019), and pronounced social inequalities (Evans, 2003), further exacerbate anxiety and insecurity (WHO, 2016).

Research highlights the mental health risks associated with urban living. Individuals residing in cities face a 39% higher likelihood of developing mood disorders, such as depression and bipolar disorder, and a 21% greater risk of anxiety disorders (Peen et al., 2010). Urban living has also been linked to an increased susceptibility to schizophrenia (Peen et al., 2010; Lederbogen et al., 2011). This pattern has been consistently documented across different populations and geographic contexts (Vassos et al., 2012; Gruebner et al., 2017).

Large scale meta-analyses have confirmed these associations, with urban residence showing dose response relationships where risk increases with greater urbanization levels (Vassos et al., 2016). Longitudinal studies tracking individuals over time have demonstrated that urban-born individuals face particularly elevated risks, with some research indicating up to a doubled risk for psychotic disorders (Mortensen et al., 1999; Pedersen & Mortensen, 2001).

Additionally, studies have identified that insufficient green space access in cities and disconnection from nature may contribute to stress and poor mental health (Bratman et al., 2019).

1.2. How Urban Trees Can Mitigate Stress

Urban forests play a crucial role in mitigating stress, offering city dwellers a natural sanctuary from the challenges of urban living (Wolf et al., 2020). Green spaces, composed of trees, shrubs, and other vegetation, provide a range of environmental and psychological benefits that enhance overall mental well-being (Barton & Rogerson, 2017). Research shows that exposure to urban green spaces can reduce anxiety, and improve mood (Ulrich et al., 1991; White et al., 2013). Even brief interactions with natural environments have been found to have restorative effects, offering relief from the pressures of city life (Zhang et al., 2023).

A study of over 150,000 participants in the UK Biobank revealed that living near green spaces was linked to reduced risks of psychiatric disorders (Liu et al., 2024). Comparative studies highlight that natural spaces, including urban parks and tree-lined streets, provide greater emotional and restorative benefits than urban environments without greenery (Takayama et al., 2014). Forest therapy and exposure to urban green spaces have been shown to promote relaxation, reduce anxiety, and improve emotional well-being (Lee et al., 2017).

Urban trees also mitigate stress by regulating environmental stressors locally. Trees absorb and diffuse sound waves, contributing to reduced noise levels and creating quieter, more tranquil environments that promote relaxation and comfort (Nowak & Dwyer, 2010; Wolf & Robbins, 2015). Additionally, urban forests help regulate temperatures, which can alleviate heat-related stress. By providing shade and facilitating evapotranspiration, trees cool urban microclimates and counteract the urban heat island effect, fostering more comfortable outdoor spaces (Woodward et al., 2023; Gillerot et al., 2024). Research has established clear connections between temperature comfort and mental health, showing that extreme heat exposure increases rates of anxiety, depression, and aggressive behavior (Thompson et al., 2023; Taliercio, 2024), while comfortable temperatures promote psychological well-being and cognitive function (Thompson et al., 2018; Raman, 2021).

Urban forests encourage physical activity by creating shade and well-defined spaces for walking, jogging, and other forms of exercise, all of which are proven to reduce stress (Wolf et al., 2020; Neale et al., 2022). Parks and green corridors also provide venues for social interaction and community activities, fostering social connections that act as buffers against stress and feelings of isolation (Konijnendijk, 2008; Maas et al., 2006), which is crucial for collective mental health resilience (Wolf et al., 2020). Community gardens and shared green spaces foster neighborly connections and social support networks that help the entire neighborhood cope with urban stressors more effectively (Koay & Dillon, 2020; Wood et al., 2022)).

Urban greening initiatives have the potential to address mental health disparities at the community level. Research by Jakstis and Fischer (2021) found that exposure to urban green spaces was associated with a lower risk of depression, particularly among disadvantaged groups. This enhanced benefit among disadvantaged populations likely occurs because these communities often face higher baseline stress levels due to socioeconomic factors, making them more responsive to the stress-reducing effects of nature exposure. By incorporating greenery into urban planning, cities can promote social equity, support mental and physical health, and create more resilient communities.

1.3. Objectives

This study explored the role of urban trees in mitigating stress among city residents, with a focus on how varying levels of exposure and accessibility to green spaces relate to self-reported stress levels. The research framework was guided by the 3-30-300 rule (Konijnendijk, 2022) that establishes three key metrics for optimal urban green space design. This rule specifies that residents should be able to see at least three trees from their home, live in neighborhoods with a minimum of 30% tree canopy coverage, and have access to high-quality green spaces within 300 meters of their residence. Research supporting this framework has demonstrated significant associations between these green space characteristics, improved mental health outcomes, and enhanced overall quality of life in urban environments (Helbich et al., 2025; Nieuwenhuijsen et al., 2022).

Building on this established framework, this research addressed a key question: Are there any associations between perceived stress and (1) views of trees; (2) neighborhood tree canopy; and (3) access to greenspace?

By examining these questions, the study aims to contribute to the growing body of evidence on the health benefits of urban trees and inform the development of sustainable, health-oriented urban design strategies.

2. Methodology

This study examined the relationship between the three key parameters of the 3-30-300 rule and stress levels among Florida residents aged 45 years and older. We focused on adults from middle-age and above to examine stress patterns in this demographic, which represents a substantial portion of the population with varied life circumstances including health concerns and major life transitions, and retirement status (Scott et al., 2013; Infurna et al., 2021). Given that our sample included a substantial proportion of retired participants who may experience different stress patterns than working adults, we conducted stratified analyses by employment status to examine whether the relationships between green space access and stress levels varied between working and retired respondents.

Data were collected via an online survey administered by a contracted panel provider (Centiment LLC, Denver, Colorado, United States). The sample was selected to approximate the state's population in terms of gender and race,among those aged 45 and older, according to US Census Bureau predictions for 2022. A minimum of 1,300 respondents were sought, resulting in a projected error margin of ±3% at 95% confidence.

In this study, we used the Perceived Stress Scale-4 (PSS-4) to assess the stress levels of participants. The PSS-4 is a validated and widely used psychological tool (Cohen et al., 1983; Sanabria-Mazo et al., 2023; Schmalbach et al., 2025) that measures perceived stress by capturing individuals' thoughts and feelings about the stress they experienced in the past month. It consists of four items rated on a 5-point Likert scale, where responses range from 0 ("Never") to 4 ("Very Often"). Total scores are calculated by summing individual item responses, resulting in a possible range of 0 to 16, with elevated scores reflecting higher perceived stress levels (Warttig et al., 2013).

Additionally, the survey included eight sociodemographic questions covering age, gender, race, marital status, education, employment, income, and the number of children in the household, which were used to adjust for confounding impacts (Moss et al., 2021). Behavioral and lifestyle variables were also collected to control for potential confounding factors. Physical activity levels were assessed through weekly hours of vigorous activity, moderate activity, walking, and sitting time. Dietary habits were measured through weekly consumption frequencies of specific food groups, including fruits, vegetables, nuts/legumes/seeds, fish/seafood, grains, refined grains, low-fat foods, high-fat foods, and sweets. Smoking status (yes/no) and alcohol consumption patterns were recorded, with weekly alcoholic drink intake categorized as 0 drinks, 1-3 drinks, 4-10 drinks, or 11 or more drinks, and weekly consumption of alcoholic beverages was also assessed. These behavioral variables were included as covariates given their established associations with stress and mental health outcomes.

To explore the relationship between urban trees and stress, eight targeted questions focused on the 3-30-300 rule metrics. These questions assessed the number of trees visible from respondents' homes, the estimated tree canopy coverage in their neighborhoods, and the proximity to the nearest park or green space. We also included questions on time spent in outdoor greenery and visits to natural spaces. To enhance the accuracy of responses, reference images depicting varying levels of tree canopy coverage (e.g., 10%, 30%, 50%, 70%, and 90%) were included (Suhendy et al., 2025). Furthermore, an attention-check question, adapted from Silber et al. (2022) and Koeser et al. (2023), required respondents to select "strongly disagree" from the response options to ensure data quality; failure to do so led to disqualification.

The University of Florida Institutional Review Board granted exempt status for this research (Protocol #: ET00042186, July 15, 2024). We piloted the survey with 75 participants on July 16, 2024, to ensure technical functionality before full deployment. Data collection concluded on July 23, 2024.

2.1. Data Analysis

A linear regression analysis was conducted to examine the relationship between environmental predictors and stress levels, while controlling for potential sociodemographic and behavioral confounders. Model building followed a systematic approach beginning with a full model containing all theoretically relevant predictors. Model simplification was conducted using backward elimination, sequentially removing non-significant predictor variables one at a time based on their p-values, beginning with the least significant ($p>0.05$).

In this regression analysis, categorical variables without a natural order such as gender, race, marital status, number of trees and canopy coverage, were coded as dummy variables, because each category represents a distinct group with no inherent ranking. Dummy coding allows comparison of each category against a chosen reference group. In contrast, variables with an inherent meaningful order such as education level, perceived income or frequency of natural-area visits, were initially considered for treatment as ordinal variables, since the categories indicate increasing levels of the underlying trait even if the spacing between levels is not equal.

The full and simplified models were compared using the Akaike Information Criterion (AIC) to evaluate model fit, with lower AIC values indicating better model performance. Additionally, adjusted R^2 was computed to estimate the proportion of variance explained while accounting for the number of predictors. Following the selection of the final model, regression coefficients were interpreted to understand the relative influence of each predictor on stress levels. Statistical significance was determined at a threshold of $p < 0.05$ for all analyses. All statistical procedures were performed using JASP software (University of Amsterdam, Netherlands).

3. Results

3.1. Respondent Demographics

Our survey included 1,361 participants, comprising 645 males (47.39%), 713 females (52.39%), and 3 non-binary individuals (0.22%). Participant ages ranged from 45 to 97 years, with a mean age

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of 63.5 and a median age of 64. The majority of participants identified as White (1,091; 80.16%), followed by Black or African American (99; 7.27%), Hispanic (86; 6.32%), mixed ethnicity (59; 4.34%), Asian (21; 1.54%), American Indian or Native Alaskan (4; 0.29%), and Native Hawaiian or Pacific Islander (1; 0.07%). These demographic characteristics closely align with Florida's population aged 45 and older, as reported by the U.S. Census Bureau (2023). Detailed demographic data are presented in Table 1.

Table 1. Descriptive Statistics and Definitions of Predictor and outcome Variables. Mean values (± standard deviation) are reported for continuous variables, while frequencies and corresponding percentages are presented for categorical variables.

Variables	Definition	Mean/Count	SD / %
Age	Self-reported age respondents	63.5	10.597
Gender	Respondent's gender identity		
Male		645	47.39%
Female		713	52.39%
Non-binary		3	0.22%
Race	Respondent's racial identity		
Asian		21	1.54%
Black/African American		99	7.27%
Hispanic/Latinx		86	6.32%
Native American/Alaskan Native		4	0.29%
White/Caucasian		1091	80.16%
Mixed Ethnicity		59	4.34%
Others		1	0.07%
Marital Status	Relationship status		
Single/separated/divorced/widowed		502	36.88%
Married or cohabiting with partner		844	62.01%
Neither of these		11	0.81%
Prefer not to say		4	0.29%
Education	Highest level of education completed		
Less than high school		12	0.88%
High school diploma/GED		223	16.39%
Some college		459	33.73%
Bachelor's degree		391	28.73%
Master's degree		199	14.62%
PhD/MD/JD etc.		52	3.82%
Other professional degree		25	1.84%
Employment	Current employment status		
Employed full-time		386	28.36%
Employed part-time		85	6.25%
Self-employed		109	8.01%

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Unemployed		95	6.98%
Student		4	0.29%
Retired		644	47.32%
Other		38	2.79%
Income	Perceived financial security		
Very difficult		201	14.77%
Difficult		196	14.40%
Coped		421	30.93%
Lived comfortably		519	38.13%
Prefer not to say		24	1.76%
Children	Number of children in the household	0.344	0.815
Stress Level	Self-reported stress level	5.291	3.487
Daily Activity	Physical activity levels		
Vigorous hours		3.734	6.934
Moderate hours		4.649	8.149
Walk hours		7.002	11.696
Sitting hours		7.284	4.699
Weekly Diet	Weekly consumption of specific food groups		
Fruit		3.772	2.006
Vegetables		4.118	1.846
Nuts, legume, seeds		2.764	2.169
Fish, seafood		1.717	1.293
Grains		2.957	2.08
Refined grains		2.683	2.012
Low fat		2.715	2.339
High fat		2.943	2.101
Sweets		2.954	2.134
Smoke	Tobacco use status		
Yes		246	18.07%
No		1115	81.93%
Alcohol Intake	Weekly alcoholic drink consumption		
0		670	49.23%
1-3		410	30.12%
4-10		207	15.21%
11-more		74	5.44%
Hours of Sleep	Average nightly sleep duration in hours	6.536	1.483
Living in Current Residence	Years spent at current home		
<1 year		104	7.64%

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1-5 years		425	31.23%
6-10 years		263	19.32%
>10 years		569	41.81%
Place Spent the Most while Awake:	Primary location during waking hours		
Home		1143	83.98%
Office		167	12.27%
School		8	0.59%
Other		43	3.16%
Number of Trees	Number of trees visible when at primary location	2.61	0.846
0		83	6.10%
1		76	5.58%
2		130	9.55%
3 or more		1072	78.77%
Outdoor Greenery Time	Frequency of time spent in green spaces (general nature exposure)		
Daily		750	55.11%
Several times a week		414	30.42%
Once a week		88	6.47%
2-3 times per month		69	5.07%
Once a month or less		40	2.94%
Tree Canopy Cover	Estimated tree coverage in neighborhood		
0%		12	0.88%
10%		273	20.06%
30%		312	22.92%
50%		245	18.00%
70%		171	12.56%
90%		112	8.23%
I would Prefer __ Trees in My Neighborhood.	Preference for neighborhood tree density		
Fewer		69	5.07%
More		567	41.66%
The current amount of		725	53.27%
Having Walkable Green Space	Access to green space within walking distance		
Yes		726	53.34%
No		594	43.64%
Unsure		41	3.01%

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Visit Natural Area	Frequency of intentional natural area visits		
Daily		226	16.61%
Weekly		416	30.57%
Once a month or less		185	13.59%
Several times a year		226	16.61%
Once a year		72	5.29%
Never		236	17.34%

3.2. Final Model Results

A hierarchical regression analysis was conducted to examine the relationship between urban tree exposure and stress levels while controlling for demographic and socioeconomic factors.

Initially, all demographic, socioeconomic and environmental variables were entered into the model. Variables that did not reach statistical significance were excluded through backward elimination. However, all environmental variables especially related to the 3-30-300 rule (number of trees, tree canopy cover and distance to the nearest park) were retained in the final model regardless of statistical significance, as they represent the core theoretical framework and our a priori hypotheses regarding urban green space exposure and stress outcomes.

The final model included age, race/ethnicity, employment status (retired), income levels, walkable green space availability, outdoor greenery time frequency, and natural area visit frequency as control variables. Environmental predictors included number of trees, canopy cover at various levels, and distance to the nearest green space. This model demonstrated moderate explanatory power, accounting for 34.9% of the variance in stress levels (Adjusted $R^2 = 0.349$).

Table 2 presents the regression results, which incorporated significant socioeconomic and demographic predictors as well as our environmental predictors of primary concern regardless of significance.

Table 2. Final Model and Regression Results of Variables and Stress Level.

Model	Variables	SE	t	β	p	95% CL	
						Lower	Upper
M_0	(Intercept)	0.10	50.93	5.25	< .001	5.06	5.46
M_1	(Intercept)	1.11	8.90	9.90	< .001	7.71	12.08
	Age	0.01	-6.50	-0.07	< .001***	-0.09	-0.05
	Employment (Retired)^z	0.22	-1.17	-0.26	0.241	-0.70	0.18
	Income (Very difficult)	0.27	12.40	3.36	< .001***	2.83	3.89
	Income (Difficult)	0.27	7.49	2.01	< .001***	1.48	2.54
	Income (Lived comfortably)	0.21	-6.40	-1.31	< .001***	-1.72	-0.91
	Income (Prefer not to say)	0.61	0.97	0.59	0.334	-0.61	1.78
	Number of Trees (1)^y	0.49	-0.79	-0.39	0.43	-1.36	0.58
	Number of Trees (2)^y	0.43	-0.25	-0.11	0.804	-0.95	0.74
	Number of Trees (3)^y	0.36	-0.90	-0.32	0.37	-1.02	0.38
	Canopy cover (10%)^x	0.84	-0.69	-0.58	0.492	-2.23	1.07
	Canopy cover (30%)^x	0.85	-0.31	-0.26	0.757	-1.93	1.40
	Canopy cover (50%)^x	0.85	-0.54	-0.46	0.587	-2.14	1.21

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Canopy cover (70%)[x]	0.86	0.13	0.11	0.896	-1.58	1.80
Canopy cover (90%)[x]	0.88	-0.63	-0.55	0.53	-2.27	1.17
walkable green space (Unsure)[w]	0.52	1.53	0.79	0.126	-0.22	1.80
walkable green space (Yes)[w]	0.20	2.27	0.45	0.024*	0.06	0.84
Outdoor greenery time (Daily)[v]	0.38	-2.03	-0.76	0.043*	-1.50	-0.02
Outdoor greenery time (Once a week)[v]	0.49	1.25	0.61	0.211	-0.34	1.56
Outdoor greenery time (Several times a week)[v]	0.39	-1.13	-0.44	0.259	-1.20	0.32
Outdoor greenery time (once a month or less)[v]	0.61	1.20	0.73	0.23	-0.46	1.92
Visit natural area (Never)[u]	0.33	2.54	0.85	0.011*	0.19	1.50
Visit natural area (Weekly)[u]	0.27	0.84	0.22	0.401	-0.30	0.75
Visit natural area (Once a month)[u]	0.33	1.67	0.56	0.095	-0.10	1.21
Visit natural area (Several times a year)[u]	0.32	1.94	0.62	0.053	-0.01	1.25
Visit natural area (Once a year)[u]	0.45	1.38	0.62	0.169	-0.26	1.50

* Statistically significant, *** Statistically very highly significant, [z] Compared to Employed full-time, Employed part-time, Self-employed, Unemployed, Student, and Others, [y] Compared to 0 (no trees present or no access to a window), [x] Compared to No tree cover in the neighborhood, [w] Compared to No walkable green space. [v] Compared to 2-3 times a month, [u] Compared to Daily.

Among the sociodemographic control variables, several showed significant associations with stress levels. Age demonstrated a significant negative association with stress (β = -0.07, p < 0.001, 95% CI: -0.09, -0.05), indicating that older participants reported lower stress levels. However, employment status showed that retirement was not significantly associated with stress levels (β = -0.26, p = 0.241, 95% CI: -0.70, 0.18), suggesting that the age effect on stress operates independently of retirement status. Income levels showed strong associations with stress, with participants reporting "very difficult" financial situations showing the highest stress levels (β = 3.36, p < 0.001, 95% CI: 2.83, 3.89), followed by those reporting "difficult" situations (β = 2.01, p < 0.001, 95% CI: 1.49, 2.54), while those "living comfortably" showed significantly lower stress levels (β = -1.31, p < 0.001, 95% CI: -1.72, -0.91).

In terms of environmental characteristics, the number of trees visible from participants' homes showed no significant association with stress levels. Similarly, canopy cover percentages in participants' neighborhoods showed no significant associations with stress levels across all measured categories. The analysis revealed non-significant associations for all canopy cover levels when compared to areas with no canopy cover (0%).

Regarding access to walkable green spaces, participants who reported having access to walkable green spaces showed significantly higher stress levels (β = 0.46, p = 0.024, 95% CI: 0.06, 0.84) compared to those who reported having no access. In contrast, participants who were unsure about their access to walkable green spaces showed a non-significant association (β = 0.79, p = 0.126, 95% CI: -0.22, 1.80) compared to the group that has no access. Interestingly, those who reported having no access at all did not show a statistically significant difference in stress levels.

In terms of outdoor greenery engagement, daily visits to outdoor greenery showed a significant association with lower stress levels (β = -0.76, p = 0.043, 95% CI: -1.50, -0.02). Other frequencies of outdoor greenery visits, including once a week (β = 0.61, p = 0.211, 95% CI: -0.34, 1.56), several times a week (β = -0.44, p = 0.259, 95% CI: -1.20, 0.32), and once a month or less (β = 0.73, p = 0.23, 95% CI: -0.46, 1.92), showed no significant associations with stress levels.

The frequency of visiting natural areas revealed varied associations with stress level when compared to daily visits as the reference category. Participants who never visited natural areas demonstrated the highest stress levels (β = 0.85, p = 0.011, 95% CI: 0.19, 1.50), while those visiting several times a year also showed significantly higher stress levels (β = 0.62, p = 0.053, 95% CI: -0.01, 1.25). Weekly visits (β = 0.22, p = 0.401, 95% CI: -0.30, 0.75), monthly visits (β = 0.56, p = 0.053, 95% CI: -0.10, 1.21), and yearly visits (β = 0.62, p = 0.169, 95% CI: -0.26, 1.50) showed non-significant associations with stress levels.

4. Discussion

This study employed the 3-30-300 rule as a guiding framework to investigate the relationship between urban tree visibility, tree canopy coverage, green space accessibility, and stress levels. The results indicate that while active engagement, such as walking, exercising, or spending recreational time in these environments, is significantly associated with stress reduction, having access to walkable green spaces without necessarily using them was associated with higher stress levels, suggesting that proximity alone does not translate to stress reduction Additionally, passive environmental exposures, such as the number of trees near a residence and overall canopy cover, did not show a direct association with stress reduction.

These findings suggest that proximity and visibility alone may not be sufficient for stress mitigation, highlighting the complex interplay between urban greenery and mental well-being and emphasizing the need for accessible, engaging, and well-utilized green spaces rather than merely increasing tree presence.

4.1. Implications of 3-30-300 Rule on Stress Levels

The investigation of tree visibility from residential locations revealed no significant association with stress reduction, challenging the foundational assumption of the "3" component of the 3-30-300 rule. This finding aligns with several studies that have documented limited effects of green views on psychological outcomes (Gascon et al., 2015; Houlden et al., 2018). Specifically, Gascon et al. (2015) found no significant association between the percentage of green space visible from residential windows and mental health indicators in a large European cohort study, while Houlden et al. (2018) reported inadequate evidence supporting the mental health benefits of greenspace views. These convergent findings suggest that the relationship between visual green exposure and psychological well-being may be considerably more complex than initially conceptualized.

The divergence between these results and seminal studies demonstrating restorative effects of nature views (Ulrich, 1984; Rhee et al., 2023; Yao et al., 2024) likely reflects important methodological and contextual differences. Ulrich's (1984) pioneering research examined views from hospital windows, where patients in states of physical recovery may have been particularly receptive to environmental stimuli within a controlled therapeutic environment. Similarly, Rhee et al. (2023) focused on office environments where green views provided visual respite from work-related stressors, while Yao et al. (2024) examined dense Asian urban contexts where natural elements might be especially valued due to their relative scarcity. The present study's different geographic and cultural context may not have captured equivalent levels of psychological benefit.

The physical and social context of viewing appears to significantly influence the effectiveness of green views (Evans et al., 2000; Jiang et al., 2014). The distinction between viewing trees from high-rise apartments versus ground-level residences represents a fundamental difference in the nature-human interface. High-rise residents may experience disconnection from the natural environment from higher floors. Olszewska-Guizzo et al. (2018) found that views with higher levels of green cover, even from the 12th floor, induced more positive brainwave patterns linked to motivation and relaxation, while decreases in visible green on higher floors (such as the 24th floor) might actually reduce these positive effects. Another experiment showed that viewing green space from a high-rise window significantly reduces stress responses compared to urban views (Elsadek et al., 2020). Viewing trees from above rather than at eye level, potentially decreases the sense of connection that contributes to stress reduction (Evans et al., 2000; Jiang et al., 2014). This suggests that tree visibility may require combination with other sensory and interactive experiences to produce meaningful psychological impact, as visual stimuli alone may prove insufficient for stress reduction, particularly

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in urban environments where residents may become habituated to green views without corresponding opportunities for direct engagement.

Similarly, tree canopy coverage showed no significant associations with stress levels at any percentage thresholds when compared to areas with no canopy cover. This finding contrasts with research demonstrating positive associations between urban tree cover and psychological well-being. Gascon et al. (2015) found that higher tree density correlated with reduced anxiety and improved mental health outcomes in Barcelona neighborhoods, while Reid et al. (2018) reported that each 1% increase in tree canopy cover was associated with decreased psychological distress in urban populations.

However, the present findings align with more nuanced investigations questioning direct relationships between canopy metrics and mental health benefits. Taylor et al. (2018) determined that while tree presence influenced stress reduction, the relationship was mediated by factors such as accessibility and perceived safety of green spaces. Holland et al. (2021) similarly reported no statistically significant relationships between canopy coverage alone and mental health outcomes, including depression and anxiety. These convergent findings suggest that canopy coverage alone does not necessarily translate to usable green space, as urban forests contributing to canopy metrics may not always be accessible or designed for public engagement, thereby limiting their effectiveness in promoting stress reduction.

The investigation of green space proximity yielded the most compelling evidence supporting active engagement over passive exposure. Access to walkable green spaces showed a counterintuitive positive association with stress levels, which may reflect that people with higher stress levels actively seek out green spaces, or that the quality and safety of accessible green spaces varies considerably. More critically, behavioral predictors revealed that frequent engagement with greenery played a substantially more significant role in stress reduction than passive exposure or proximity alone. Daily time spent in greenery was significantly associated with lower stress levels, while individuals visiting natural areas only sporadically or never reported elevated stress levels. This relationship may be confounded by physical activity, as time in green spaces often involves walking, exercising, or other forms of movement that were not fully captured by our study

These findings strongly support both Attention Restoration Theory (Kaplan & Kaplan, 1989; Kaplan, 1995) and Stress Recovery Theory (Ulrich, 1983), which posit that time spent in natural environments replenishes cognitive resources and reduces physiological stress responses. The results also align with research on forest bathing, or Shinrin-yoku, demonstrating that immersive natural experiences produce measurable psychological benefits through promoting relaxation, reducing anxiety, enhancing mood, and fostering mental clarity (Li, 2010; Park et al., 2010).

The primacy of intentional, frequent engagement over proximity observed in this study is consistent with dose-response relationships documented in nature exposure literature, where stress reduction benefits increase with both frequency and duration of deliberate nature contact (Hansen et al., 2017). This dose-response relationship may explain why participants with sporadic natural area visits reported higher stress levels, as infrequent exposure appears insufficient for sustained psychological benefits.

These findings provide qualified support for the "300" component of the 3-30-300 rule while emphasizing that proximity alone is insufficient. Urban green spaces must be well-designed, attractive, and integrated into daily routines to realize potential benefits. When individuals remain unaware of nearby green spaces, perceive them as unsafe, or lack time for regular visits, potential psychological benefits may not be actualized. This underscores the critical importance of urban planning strategies that prioritize walkability, accessibility, and community involvement in green space design.

The study's findings collectively suggest that the 3-30-300 rule, while providing a useful framework for urban green space planning, may oversimplify the complex relationships between green space characteristics and human psychological well-being or, at least, that the associations are highly context dependent. In addition to quantitative guidance for green space provision, urban

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planning efforts should emphasize creating opportunities for meaningful, frequent engagement with natural environments. This paradigm shift from passive exposure to active engagement has significant implications for urban design, suggesting that successful green infrastructure must facilitate regular human-nature interactions rather than merely providing visual amenities or meeting coverage thresholds.

4.2. Sociodemographic Influences on Stress

Beyond environmental predictors, sociodemographic factors played a significant role in shaping stress levels. Our finding shows that age was negatively associated with stress, indicating that older participants reported lower stress levels than younger populations. This finding aligns with established research demonstrating that stress and anger declined from the early 20s to middle 80s, with older adults developing different coping strategies (Stone et al., 2010; Chen et al., 2018). Interestingly, retirement status was not significantly associated with stress levels, suggesting that the age-related decline in stress operates independently of employment transitions and may instead reflect broader developmental changes in stress perception and management across the lifespan.

As expected, financial security emerged as a critical determinant of stress levels. Individuals struggling financially reported significantly higher stress levels, with those in "very difficult" financial situations showing the higher stress, followed by those reporting "difficult" situations. In contrast, those "living comfortably" reported significantly lower stress levels. This aligns with existing research emphasizing financial security as a key component of mental well-being, as economic hardship often amplifies daily stressors and limits access to supportive resources (Bialowolski et al., 2021).

Additionally, employment status was associated with stress, with individuals in non-traditional employment arrangements such as freelance or part-time work, reporting lower stress levels. This possibly counterintuitive finding is supported by research indicating that freelancers report higher levels of job satisfaction and less stress resulting from more control over working conditions compared to traditionally employed persons (Shimura et al., 2021).

These findings underscore that both environmental and socioeconomic factors play important roles in shaping stress levels. Even when green spaces are present and accessible, individuals facing persistent financial strain, job insecurity, or other socioeconomic challenges may experience chronic stressors that overshadow the potential mental health benefits of nature exposure. For urban forestry initiatives to be truly effective in promoting psychological well-being, they must be integrated into a broader framework that considers not only environmental enhancements, but also economic and social policies aimed at reducing systemic stressors.

This highlights the need for a holistic approach to urban well-being, where urban design, public health, and economic policies are interwoven to create healthier, more resilient communities. Urban forests provide multiple ecosystem services for city dwellers, including improving public health via mitigating mental stressors and providing attractive spaces for diverse physical activities (Yin et al., 2023). While investing in well-maintained, accessible, and engaging green spaces is essential, realizing their full potential requires coordinating urban forest initiatives with housing, transportation, and economic policies that enable all residents to access and utilize these environmental resources. By addressing both environmental and structural inequities, cities can foster a more inclusive and sustainable approach to improving mental health and quality of life.

4.3. Study Limitations and Future Research Directions

This study has several limitations that should be acknowledged. First, the reliance on self-reported data for assessing stress levels may introduce bias, as participants' responses could be influenced by recall limitations, mood at the time of reporting, or social desirability (Latkin et al., 2017). Similarly, participants' self-assessment of their access to green space may not accurately reflect objective measures of availability or quality, potentially leading to misclassification of exposure levels.

The demographic composition of our sample presents additional limitations for generalizability. With an average age in the mid 60s and 80% white participants, findings are limited in their applicability to younger populations and diverse ethnic communities. While this demographic profile aligns with Florida's general social demographics, it provides limited insights into how the 3-30-300 rules affects early to middle aged adults or individuals from different ethnic backgrounds across the measured variables.

Beyond the measurement and demographic limitations, the use of a panel service, while providing valuable advantages in terms of sample size and efficiency, introduces potential representativeness concerns as panel participants may differ systematically from the general population (Craig et al., 2013). The study's cross-sectional design prevents causal inferences (Setia, 2016), restricting the ability to determine the directionality of relationships between urban green spaces and perceived stress. The assessment of environmental variables, such as tree canopy cover, may not fully account for qualitative aspects of green spaces such as biodiversity, accessibility, or maintenance, that can influence mental health outcomes.

Future research should further explore the mechanisms driving these relationships while addressing these identified gaps. Specifically, studies examining the impact of urban greenery on stress across diverse age groups and ethnicities would strengthen our understanding of these relationships. Additionally, rather than relying on respondent estimates on the canopy coverage, future investigations could compare participant's home cities to actual canopy cover data, requiring only that participants identify their town of residence. This approach would provide more objective measurements of environmental variables and eliminate potential bias in self- reported environmental assessments.

Furthermore, incorporating socioeconomic analysis by comparing respondents' incomes to their cities' average income levels could reveal important interactions between economic factors, tree coverage, and stress outcomes. Future studies should also consider longitudinal designs to better establish causal relationships and incorporate qualitative assessments of greenspace characteristics beyond presence or coverage.

Ultimately, integrating urban forestry with health-focused urban planning strategies, while accounting for demographic diversity, socioeconomic factors, and methodological rigor, can contribute to more sustainable, livable, and mentally supportive cities for all residents.

5. Conclusion

This study examined the relationship between urban greenery and stress levels through the lens of the 3-30-300 rule, evaluating the impacts of tree visibility, canopy coverage, and proximity to green spaces. While the findings indicate that the presence of urban trees alone was not significantly associated with stress reduction, frequent and intentional engagement with natural spaces such as daily outdoor time and weekly visits to natural areas, emerged as crucial factors in mitigating stress. These results underscore the importance of designing urban environments that not only incorporate trees but also encourage active interaction with green spaces.

The lack of significant associations to tree visibility and canopy coverage suggests that the psychological benefits of urban greenery extend beyond mere exposure, reinforcing the need for well-maintained, accessible, and inviting green spaces within urban settings. By prioritizing meaningful access and encouraging regular use, urban planners and policymakers can enhance the mental health benefits of urban forestry initiatives.

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