International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

The path to mental health: Associations between walkability and depression prevalence in west Virginia

Sadaf Adhami [1,*] and Arman Moradi [2]

[1] *Department of Architecture and Design, Polytechnic University of Turin, Turin, Italy.*
[2] *Interuniversity Department of Regional and Urban Studies and Planning, Polytechnic University of Turin, Turin, Italy.*

International Journal of Science and Research Archive, 2025, 15(02), 1576–1582

Publication history: Received on 16 April 2025; revised on 25 May 2025; accepted on 28 May 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.2.1593

Abstract

Despite increasing awareness of walkable neighborhoods' health benefits, the relationship between walkability and mental health remains unclear. This study examined the relationship between walkability and depression in West Virginia which has the highest rate of depression according to 2023 CDC report. Increasing neighborhood walkability was hypothesized to result in a reduction in mental health encounters. Using the most recent census tract boundaries in West Virginia (N = 546), National Walkability Index (NWI) scores were aggregated from 2019 block group data to tract-level averages. Depression prevalence was obtained from CDC PLACES, and population data were sourced from the U.S. Census Bureau. Multiple imputations were applied to address missing data as the result of mismatches between the 2019 NWI and 2024 tract boundaries, and regression analyses were conducted using both imputed and complete-case datasets. In the imputed model, no significant association was found between walkability and depression ($\beta = 0.03$, $p = 0.631$). However, the complete-case model revealed a small but statistically significant positive relationship between walkability and depression ($\beta = 0.04$, $p = 0.046$). Population showed a consistent inverse association with depression in both models. Contrary to prior assumptions, higher walkability was associated with increased depression in the complete-case analysis. These findings highlight the complex relationship between the built environment and mental health and suggest that walkability alone may not be protective against depression. Future studies should incorporate additional contextual and sociodemographic factors while examining such a relationship.

Keywords: Built Environment; Depression; Neighborhood Walkability; Population

1. Introduction

Mental health issues remain highly prevalent and severe all over the world.[1] Nearly 19.86% of adults in the United States suffer from mental illness and West Virgina has have the highest rate of depression in the nation, being 29% in 2023.[2] Depression is a significant risk factor contributing to several physical and mental health issues, like lack of energy, physical pain, fatigue, loss of interest, low self-esteem, anxiety, sleep disturbance, cognitive function, mobility disability, and social withdrawal.[3], [4] Comorbid medical conditions such as diabetes, hypertension, chronic obstructive pulmonary disease, and coronary artery disease can be aggravated by depression. As a coping mechanism, depression can also lead to self-destructive behavior.[5], [6] Thus, it is important for various professionals to prioritize interventions and strategies to decrease the rate of depression, especially in areas where this issue is severe.

One of the influential sectors where experts can potentially help reduce the rate of depression is the built environment (BE).[7] Numerous researchers have established the extraordinary benefits of the BE on overall community well-being,[8] including reducing mental health issues.[9], [10] A systematic literature review by Sokale et al[11] identified 617 articles published in English from 2000-2018 examining associations between BE attributes (i.e., greeneries, walkability, land use mix, public transportation, traffic safety and aesthetics, street illumination, garbage disposal) and

* Corresponding author: Sadaf Adhami

depression. Results, including 13 final articles, showed that studies assessed different BE attributes; however, all reported a relationship between depression and at least one BE attribute. A protective association between green spaces and depression was reported in four out of six papers, while no consistent association was found between other BE attributes (e.g., walkability and transportation) and depression.[11] A study by Pellizzari et al[12] assessed the relationship between park access and quality and various health metrics and found a significant negative association between neighborhood quality concerns and depression. Focusing on other attributes of the BE, a scoping review by Warner et al[13] investigated the definition of walkability and its association with depression and anxiety symptoms. They found that the composite/overall walkability score of five out of 13 included articles was significantly associated with depression and anxiety outcomes.[13] Also, Guo et al[14] found out that the walkability of neighborhoods had a negative association with depressive symptoms, regardless of the activity levels of individuals. These studies turn attention more toward considering the walkability of the BE as a crucial factor that potentially could mitigate the rate of depression.[11]

Walkability, as a well-known attribute of the BE, contributes significantly to people's overall well-being.[15] Several studies have shown the benefits of neighborhoods with a high rate of walkability in addressing multiple health outcomes, as it enables the population to have physical activity[16] at no cost[17] and reach to meaningful destinations safely,[18] like groceries, shops, parks, public places, etc.[19] According to multiple studies, physical activity not only enhances the physical function of individuals but also acts as a healing tool to decrease depressive symptoms.[20] Many people choose active transportation as a means of physical activity.[21] A study by Chupak et al[21] exhibited a significant negative association between walkability and pedestrian and cyclist crash count across all census tracts in South Carolina. Thus, it is crucial to create a walkable neighborhood to provide people with free physical activity opportunities that are safe and secure.

While most research has considered walkability and physical and social health,[16], [18], [22], [23] a limited number of studies have investigated the association of neighborhood walkability and mental health issues, like depression.[24] To address this gap, the present study investigates the association between neighborhood walkability and depression prevalence at the census tract level. We selected one of the U.S. states with the highest reported rate of depression in 2023 as the study setting, aiming to explore whether neighborhoods with higher walkability levels are associated with lower depression rates. Specifically, we asked: *Is there a relationship between the walkability of neighborhoods and the prevalence of depression across census tracts in this high-burden state?* To account for differences in population size, we included the total population at the census tract level as a control variable in our analysis, recognizing its potential confounding influence on both BE characteristics and health outcomes.

2. Methods

2.1. Study setting

West Virginia (WV), with 546 census tracts, was selected as our study setting. WV contains a land area of 24,041.15 square miles, as of 2020, and an estimated 2024 population of 1,770,071. 19.9% of the population is under 18 years of age, 21.5% is above 65, and 92.8% of the population is White.

2.2. Measures

	1 – 5.75	Least walkable
	5.76 – 10.5	Below average walkable
	10.51 – 15.25	Above average walkable
	15.26 – 20	Most walkable

Figure 1 National Walkability Index score categories

Walkability of the built environment: To measure the walkability of the BE, we used National Walkability Index (NWI), developed by CDC EPA.[25] Specifically, based on three main factors of street intersection density, proximity to transit stops, and diversity of land uses, this measure ranks block groups a range from 1 to 20 (Figure 1) to determine their walkability level.[26]

Depression: To measure the rate of depression, we used publicly available data from the CDC PLACES, which provides local data for better health.[27] Specifically, the rate of depression was measured at the census tract level by using a self-report survey. Individuals were being asked if they had been diagnosed with depression by a health care provider at any time in their life (prevalence, Figure 2).

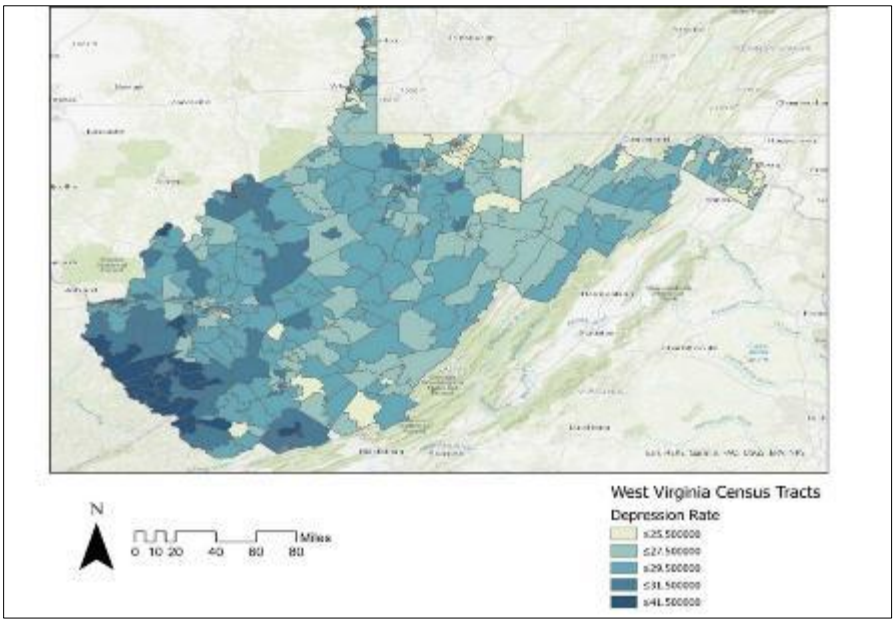

Figure 2 Depression prevalence across census tracts in West Virginia

Total population: Information regarding the total population of each census tract of WV was obtained from the US Census Bureau, which is a publicly available dataset.[28]

2.3. Data Analysis

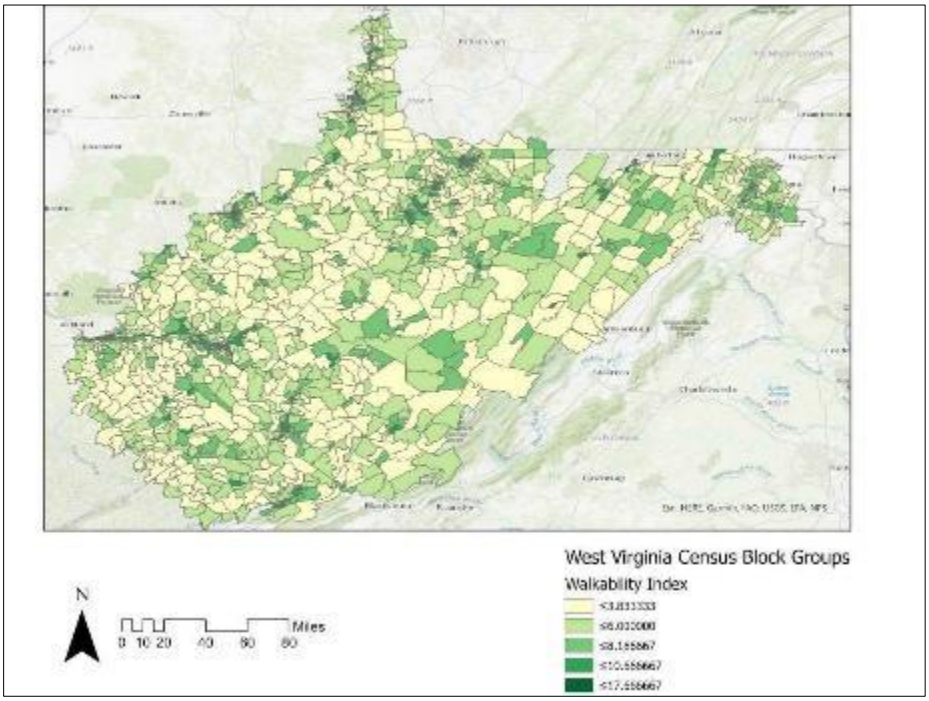

Figure 3 National Walkability Index across census tracts in West Virginia

Using IBM SPSS Statistics Software, Version 29, descriptive statistical analyses were conducted to examine the distribution, central tendency, and variability of key variables, including depression prevalence, walkability index, and population size across census tracts. The NWI was originally available at the block group level. To align with other datasets used in this study, the NWI data were aggregated at the census tract level. This was accomplished by using a pivot table in Excel to calculate the average NWI score for all block groups nested within a tract (Figure 3). Also, since the most recent NWI available was from 2019, it did not fully align with the 2024 WV census tract boundaries. As a result, we encountered a considerable amount of missing data for NWI (N=175). Therefore, we decided to address this issue using imputation methods. Then we ran regression analysis to examine the relationship between the NWI and depression prevalence, controlling for population at the census tract level, using the imputed data. To compare the results, we also repeated the analyses using a complete-case approach, excluding census tracts with missing NWI values. Significant tests were considered at P<0.05. The study did not require institutional review board approval since the data were secondary and publicly available and aggregated at the census tract level.

3. Results

Descriptive data analyses are shown in Table 1. Across all census tracts in WV, the average NWI was 4.82 (*SD* = 3.50), with scores ranging from 0 to 12.83. A total of 371 census tracts had available NWI data. The mean prevalence of depression among adults was 28.31% (*SD* = 2.44), with tract-level rates ranging from 17.10% to 41.60% across all 546 census tracts. The average population per tract was 2,624 residents (*SD* = 955.10), ranging from 644 to 5,822 individuals.

Table 1 Descriptive analysis

Variables	Objects	M	Std. dev.	Min	Max
GeoIDs of Census Tracts	546				
National Walkability Index	371	4.82	3.50	0	12.83
Depression	546	28.31	2.44	17.10	41.60
Population	546	2624.418	955.10	644	5822

Table 2 presents the results of the regression analysis using the imputation method to address missing NWI values. The analysis did not yield a statistically significant association between NWI and depression prevalence across WV's census tracts (β = 0.03, p = 0.631). However, population was found to be a significant negative predictor of depression (β = -0.0005, p < 0.001), indicating that tracts with higher populations were associated with slightly lower depression rates.

Table 2 Regression between neighborhood walkability and depression across West Viginia's census tracts using imputation

	Coefficient	SE	t	P>|t|	[95% conf. interval]
Neighborhood Walkability	0.03	0.07	0.49	0.631	-.1126399 .1811395
Population	0.00	0.00	-4.39	0.000	-.0007026 -.000268

Table 3 shows the results of the same regression analysis using a complete-case approach, excluding census tracts with missing walkability data. In this model, NWI was significantly associated with depression (β = 0.04, p = 0.046), suggesting that higher walkability is related to increased depression prevalence. Population remained a significant negative predictor (β = -0.0005, p < 0.001), consistent with the imputed model.

Table 3 Regression between neighborhood walkability and depression across West Viginia's census tracts using a complete-case approach

	Coefficient	SE	t	P>|t|	[95% conf. interval]
Neighborhood Walkability	0.04	0.02	1.99	0.046	.000602 .0718498
Population	0.00	0.00	-11.53	0.000	-.0006357 -.0004509

4. Discussion

The purpose of this study was to determine whether neighborhood walkability is associated with depression prevalence in different census tracts in WV, which has the highest rate of depression in 2023. The relationship between walkability and depression was not statistically significant when using imputation. However, using a complete-case analysis, there was a small but statistically significant positive correlation between higher walkability scores and depression prevalence. Both models consistently showed lower depression rates with larger populations.

Our unexpected findings regarding the relationship between walkability and depression were both consistent with and divergent from previous research. While several studies have documented a negative association between certain features of the BE, such as access to green space and safe walkable infrastructure, and depression, others have reported no significant relationship between walkability and mental health outcomes.[29], [30] For instance, a study by Berke et al[31] found a significant association between walkability and depression in older men, while this relationship was not significant among women. The study adjusted for physical activity, income, age, ethnicity, education, the status of smoking, living alone or in a family, and chronic diseases. Conversely, a study found no association between the walkability of the neighborhood and depression in crude or adjusted analysis.[32] In addition, a scoping review conducted by Warner et al[33] revealed that only a subset of studies identified a significant association between composite walkability scores and depression or anxiety symptoms, highlighting the variability in measurement and context across studies.

Our study had a number of strengths. First, we aimed to use the most up-to-date census tract boundaries in WV (N = 546), despite the NWI being available only at the 2019 block group level. After aggregating NWI values from block groups to obtain tract-level scores, we encountered a mismatch between the 2024 census tracts and the 2019 NWI data, resulting in missing values for 175 tracts. To address this, we applied multiple imputations, a sophisticated statistical technique that enhances the robustness of our findings. Specifically, it allowed us to retain a larger sample size and reduce potential bias due to missing data. In addition, our study is among the first to consider a setting with the highest rate of depression to investigate. However, some limitations need to be acknowledged. First, considering walkability alone may not reveal the true associations and should be considered with a broader context of neighborhood quality (e.g., crime rate, safety, pedestrian facilities). Second, sociodemographic characteristics (e.g., race, ethnicity, education, income, poverty, employment status, renter occupied housing) need to be considered as a controlling variable alongside population. Third, our analyses did not account for the nested structure of census tracts within counties. All statistical analyses were conducted at the census tract level, without adjusting for potential clustering or contextual effects at the county level. To better understand how the BE influences mental health, future studies should consider incorporating a wider range of contextual and sociodemographic variables. Also, longitudinal or multilevel designs may provide more insight into causality and the interaction between individual-level outcomes and neighborhood characteristics over time

5. Conclusion

In conclusion, our results highlight the importance of considering neighborhood walkability within a broader context that includes environmental stressors, social factors, and demographic characteristics. While walkability is a valuable feature of the BE, its impact on mental health may vary by context and may be shaped by other unmeasured factors such as safety, crime, or socioeconomic disadvantage.

Compliance with ethical standards

Disclosure of conflict of interest

Not applicable. No conflict of interest exists to declare.

Statement of ethical approval

Not applicable. This study did not use any human or animal information. It only used secondary dataset publicly available.

References

[1] R. C. Kessler et al., "The global burden of mental disorders: an update from the WHO World Mental Health (WMH) surveys," Epidemiology and psychiatric sciences, vol. 18, no. 1, pp. 23–33, 2009.

[2] B. Lee, "National, State-Level, and County-Level Prevalence Estimates of Adults Aged ≥18 Years Self-Reporting a Lifetime Diagnosis of Depression — United States, 2020," MMWR Morb Mortal Wkly Rep, vol. 72, 2023, doi: 10.15585/mmwr.mm7224a1.

[3] R. R. Frerichs, C. S. Aneshensel, P. A. Yokopenic, and V. A. Clark, "Physical health and depression: an epidemiologic survey," Preventive Medicine, vol. 11, no. 6, pp. 639–646, 1982.

[4] D. S. Baldwin and G. I. Papakostas, "Symptoms of fatigue and sleepiness in major depressive disorder," Journal of Clinical Psychiatry, vol. 67, p. 9, 2006.

[5] N. Bains and S. Abdijadid, "Major depressive disorder," 2020, Accessed: May 04, 2025. [Online]. Available: https://europepmc.org/article/nbk/nbk559078

[6] E. Stover, W. Fenton, A. Rosenfeld, and T. R. Insel, "Depression and comorbid medical illness: the National Institute of Mental Health perspective," Biological Psychiatry, vol. 54, no. 3, pp. 184–186, 2003.

[7] F. Hou et al., "Cross-sectional associations between living and built environments and depression symptoms among Chinese older adults," International journal of environmental research and public health, vol. 19, no. 10, p. 5819, 2022.

[8] S. H. Hallum et al., "Unearthing Inequities in the Relationship between Multiple Sociodemographic Factors and Diverse Elements of Park Availability and Quality in a Major Southern Metropolitan Region," International Journal of Environmental Research and Public Health, vol. 21, no. 2, p. 204, 2024.

[9] G. W. Evans, "The Built Environment and Mental Health," Journal of Urban Health: Bulletin of the New York Academy of Medicine, vol. 80, no. 4, pp. 536–555, Dec. 2003, doi: 10.1093/jurban/jtg063.

[10] T. H. Moore et al., "The effects of changes to the built environment on the mental health and well-being of adults: Systematic review," Health & place, vol. 53, pp. 237–257, 2018.

[11] I. O. Sokale, S. H. Conway, and D. I. Douphrate, "Built environment and its association with depression among older adults: A systematic review," The Open Public Health Journal, vol. 15, no. 1, 2022, Accessed: May 04, 2025. [Online]. Available: https://www.openpublichealthjournal.com/VOLUME/15/ELOCATOR/e187494452202030/FULLTEXT/

[12] J. Pellizzari, F. H. Shariati, and A. T. Kaczynski, "The Relationship Between Park Access and Quality and Various Health Metrics in a Metropolitan Area in South Carolina Using the CDC PLACES Dataset," Journal of Preventive Medicine and Public Health, vol. 58, no. 2, p. 208, 2025.

[13] E. Warner, D. Nadouri, H. Orpana, and J. Wang, "A Scoping Review of the Definition of Walkability and its Relationship with Depression and Anxiety Symptoms," Canadian Journal of Community Mental Health, vol. 41, no. 2, pp. 46–67, Apr. 2022, doi: 10.7870/cjcmh-2022-014.

[14] Y. Guo, S. S. Chang, C. H. Chan, Q. Chang, C.-Y. Hsu, and P. S. Yip, "Association of neighbourhood social and physical attributes with depression in older adults in Hong Kong: a multilevel analysis," J Epidemiol Community Health, vol. 74, no. 2, pp. 120–129, 2020.

[15] A. Baobeid, M. Koç, and S. G. Al-Ghamdi, "Walkability and its relationships with health, sustainability, and livability: elements of physical environment and evaluation frameworks," Frontiers in Built Environment, vol. 7, p. 721218, 2021.

[16] M. Wen, X. Zhang, C. D. Harris, J. B. Holt, and J. B. Croft, "Spatial Disparities in the Distribution of Parks and Green Spaces in the USA," Ann Behav Med, vol. 45, no. Suppl 1, pp. 18–27, Feb. 2013, doi: 10.1007/s12160-012-9426-x.

[17] X. Zhu, Z. Lu, C.-Y. Yu, C. Lee, and G. Mann, "Walkable communities: Impacts on residents' physical and social health: Researchers from Texas A&M University studied residents in a newly developed 'walkable community'in

Austin, Texas to see how it changed their habits for physical activity and whether it increased social interaction and cohesion in the community," World Health Design, vol. 6, no. 3, p. 68, 2013.

[18] X. Zhu, Z. Lu, C.-Y. Yu, C. Lee, and G. Mann, "Walkable communities: Impacts on residents' physical and social health: Researchers from Texas A&M University studied residents in a newly developed 'walkable community'in Austin, Texas to see how it changed their habits for physical activity and whether it increased social interaction and cohesion in the community," World Health Design, vol. 6, no. 3, p. 68, 2013.

[19] S. T. Child et al., "'We need a safe, walkable way to connect our sisters and brothers': a qualitative study of opportunities and challenges for neighborhood-based physical activity among residents of low-income African-American communities," Ethnicity & Health, vol. 24, no. 4, pp. 353–364, May 2019, doi: 10.1080/13557858.2017.1351923.

[20] A. Mahindru, P. Patil, and V. Agrawal, "Role of physical activity on mental health and well-being: A review," Cureus, vol. 15, no. 1, 2023, Accessed: May 04, 2025. [Online]. Available: https://www.cureus.com/articles/121652-role-of-physical-activity-on-mental-health-and-well-being-a-review.pdf

[21] A. L. Chupak, S. H. Hallum, F. H. Shariati, E. Looney, and A. T. Kaczynski, "Identifying disparities in the relationship between neighborhood walkability and active transportation safety within South Carolina," Journal of Transport & Health, vol. 41, p. 101960, 2025.

[22] M. I. Creatore et al., "Association of neighborhood walkability with change in overweight, obesity, and diabetes," Jama, vol. 315, no. 20, pp. 2211–2220, 2016.

[23] S. A. Carlson, E. N. Ussery, K. B. Watson, K. A. Cornett, and J. E. Fulton, "Perceived importance of physical activity and walkable neighborhoods among US adults, 2017," Preventing Chronic Disease, vol. 17, p. E168, 2020.

[24] E. M. Berke, L. M. Gottlieb, A. V. Moudon, and E. B. Larson, "Protective Association Between Neighborhood Walkability and Depression in Older Men," *J American Geriatrics Society*, vol. 55, no. 4, pp. 526–533, Apr. 2007, doi: 10.1111/j.1532-5415.2007.01108.x.

[25] O. US EPA, "National Walkability Index User Guide and Methodology." Accessed: May 04, 2025. [Online]. Available: https://www.epa.gov/smartgrowth/national-walkability-index-user-guide-and-methodology

[26] R. Ewing and R. Cervero, "Travel and the Built Environment: A Meta-Analysis," *Journal of the American Planning Association*, vol. 76, no. 3, pp. 265–294, Jun. 2010, doi: 10.1080/01944361003766766.

[27] CDC, "PLACES: Local Data for Better Health," PLACES: Local Data for Better Health. Accessed: May 04, 2025. [Online]. Available: https://www.cdc.gov/places/index.html

[28] Census Bureau, "Census Bureau Data." Accessed: Sep. 06, 2024. [Online]. Available: https://data.census.gov/

[29] C. E. Anderson, S. T. Broyles, M. E. Wallace, L. A. Bazzano, and J. Gustat, "Association of the neighborhood built environment with incident and prevalent depression in the rural south," *Preventing Chronic Disease*, vol. 18, p. E67, 2021.

[30] A. Barnett, C. J. Zhang, J. M. Johnston, and E. Cerin, "Relationships between the neighborhood environment and depression in older adults: a systematic review and meta-analysis," *International psychogeriatrics*, vol. 30, no. 8, pp. 1153–1176, 2018.

[31] E. M. Berke, L. M. Gottlieb, A. V. Moudon, and E. B. Larson, "Protective Association Between Neighborhood Walkability and Depression in Older Men," *J American Geriatrics Society*, vol. 55, no. 4, pp. 526–533, Apr. 2007, doi: 10.1111/j.1532-5415.2007.01108.x.

[32] J. de A. Siqueira Junior *et al.*, "Neighbourhood walkability and mental health in older adults: A cross-sectional analysis from EpiFloripa Aging Study," *Frontiers in aging*, vol. 3, p. 915292, 2022.

[33] E. Warner, D. Nadouri, H. Orpana, and J. Wang, "A Scoping Review of the Definition of Walkability and its Relationship with Depression and Anxiety Symptoms," *Canadian Journal of Community Mental Health*, vol. 41, no. 2, pp. 46–67, Apr. 2022, doi: 10.7870/cjcmh-2022-014.