Who gets less urban greenness: A case study of Sydney

Yunzheng Zhang[1], Fubin Luo[2,*]
[1] University of New South Wales, [2,*] City University of Hong Kong
[1] yunzheng.zhang@unsw.edu.au, [2,*] fubin.luo@my.cityu.edu.hk

Abstract
Inequalities in urban greenness have been investigated based on multi-source data. However, studies in Australia often overlook eye-level greenness - an important measure that captures human-perceived greenery. This study examines Sydney's eye-level greenness using Google Street View images and employs Geographically Weighted Regression (GWR) to analyse its association with neighbourhood socio-economic status. The findings reveal that older adults in central Sydney may experience inadequate greenness. Female, unmarried, non-English, indigenous, less-skilled, and unemployed individuals are more likely to face insufficient greenness outside the city centre. Additionally, foreign-born, low-income, carless, and less-educated individuals may experience greenery shortages in both central and suburban Sydney. This study explores Google-Street-View-derived urban greenness – a less employed data source in Australia, offering valuable insights for policymakers in mitigating green space inequalities.

Key words: Green inequality; Google Street View; Eye-level greenness; Australia

1. Introduction

Urban greenery provides substantial benefits to both urban environments and individuals, such as mitigating urban heat island effects and improving air quality (Luo, Zhang and Zhang, 2025), encouraging physical activity (Lu et al., 2019), and fostering social interactions (Enssle and Kabisch, 2020), thereby contributing to enhanced human well-being. However, urban greenery is often unevenly distributed in cities, particularly in the context of urban consolidation. In settings characterized by socio-spatial differentiation driven by market forces, socio-economically advantaged populations tend to enjoy greener urban environments, while disadvantaged groups are more likely to reside in areas with limited greenery. This disparity has led to concerns about green gentrification (Sharifi et al., 2021). Against this backdrop, green space inequality emerges as a critical issue within the discourse of environmental justice, highlighting the need to promote equity in the planning of urban greenness.

Like many other cities influenced by neoliberal urbanism, Australian cities are experiencing increasing socio-spatial differentiation under market forces, which channels populations of varying socio-economic status into distinct urban areas. This process has the potential to exacerbate inequalities in green space access, which requires further exploration. While several studies in the Australian context have examined green space inequalities using land use data (Mushangwe et al., 2021) or satellite imagery (Lin, Meyers and Barnett, 2015), these data sources predominantly capture urban greenness through aerial perspectives, failing to adequately represent the experiential quality of eye-level greenery that characterizes urban dwellers' daily visual environments. Recently, street-view imagery has gained traction in green space research for its ability to capture human-scale greenness. Nevertheless, studies employing this data source in Australia remain limited.

Drawing on data at Statistical Area Level 1 (SA1) from Sydney, this study addresses the following research questions:

(1)What is the spatial distribution of eye-level greenness in neighbourhoods across Sydney?

(2)How are neighbourhood socio-economic statuses associated with eye-level greenness?

To answer these questions, the study first employs machine learning techniques to extract eye-level greenness from Google Street View imagery and visualizes its spatial distribution. It then applies a Geographically Weighted Regression (GWR) model to examine the spatially varying relationship between neighbourhood socio-economic status and eye-level greenness.

The remainder of the paper is structured as follows: Section 2 reviews relevant literature on green space inequality and socio-economic status. Section 3 outlines the research methods. Section 4 presents the findings, followed by a discussion of implications and policy recommendations in Section 5. Section 6 concludes the paper.

2. Literature review: Green space inequality in relation to socio-economic status

Urban greenness provides significant environmental and health benefits, prompting growing scholarly interest in equitable green space planning. Existing green space studies have utilized green space data from various sources, with the most commonly used being parkland use data derived from online maps (Feltynowski et al., 2018)and urban green space management in particular, require proper data on urban green spaces. The potential of urban green spaces to provide benefits to urban inhabitants (ecosystem services or local statistical authorities (Zhang and Luo, 2024), as well as vegetation coverage extracted from satellite imagery such as Landsat (Zhang and Luo, 2025) and Sentinel (Aryal, Sitaula and Aryal, 2022). However, these data sources primarily offer a bird's-eye view of greenery and fail to adequately capture the green environments as perceived by individuals at the human scale, thereby motivating the exploration of alternative data sources.

In response, street view imagery has recently gained traction in green space research. This emerging data source captures eye-level greenness, offering a more human-centred perspective for assessing green space exposure (Zhang and Luo, 2025). Consequently, it has been increasingly adopted in the literature (Li, 2021; Liu et al., 2023; Zhang and Luo, 2025).

Existing literature has extensively examined inequalities in the exposure, availability, accessibility, and use of green spaces across different socio-economic groups. For example, scholars have argued that women have historically been overlooked in urban planning processes, leading them to bear a disproportionate burden of social injustice (Walker, Frediani and Trani, 2013). However, a study in Iran suggests that gender justice in the use of green spaces is achievable, with both male and female residents having their needs adequately met (Rahimi et al., 2023). In the Chinese context, a study conducted in Guangzhou reveals that neighbourhoods with higher proportions of older adults are at greater risk of green space inequality (Yang, Yang and Zhou, 2022). Furthermore, family structure and marital status have also been identified as potential indicators of social vulnerability, which may lead to unequal access to green spaces (Rahman and Zhang, 2018). Ethnicity is another important dimension of green space inequality. For instance, a study across Sydney, Newcastle, and Wollongong found that individuals who do not speak English at home are more likely to face inadequate access to parkland and open grass areas. Similarly, those born in Italy, Lebanon, Vietnam, or China were found to be disproportionately affected by insufficient parkland provision (Mushangwe et al., 2021). In the Australasian context, indigenous people represent a structurally disadvantaged group. A study in New Zealand showed that indigenous communities are more likely to experience lower levels of green space availability and accessibility (Zhang et al., 2024). Moreover, neighbourhoods with more affluent residents such as those with higher incomes or car ownership may enjoy greater access to green space (Dai, 2011; Astell-Burt et al., 2014), while less affluent communities may experience limited green space availability. Educational attainment also plays an important role: a study in Germany demonstrated that urban greenery is unevenly distributed based on education levels (Wüstemann, Kalisch and Kolbe, 2017). Additionally, unskilled workers may be spatially segregated into disadvantaged neighbourhoods, which often lack basic amenities and infrastructure such as urban green spaces (Csomós et al., 2021). In relation to labour force status, a study in Shanghai found that subdistricts with higher unemployment rates exhibit lower levels of green space access (Shen, Sun and Che, 2017). Overall, green space inequality is intricately linked to socio-economic status, warranting continued and in-depth scholarly inquiry into these associations.

3. Research method

3.1 Study area and research framework

This study focuses on Sydney (Figure 1), a neoliberal city in Australia marked by pronounced socio-spatial differentiation driven by market forces, where urban greenery is unevenly distributed across different urban neighbourhoods. The analysis is conducted at the Statistical Area Level 1 (SA1), a geographic unit commonly used in neighbourhood-level research (Zhang and Luo, 2024, 2025). Each SA1 typically contains a population ranging from 200 to 800 individuals, with an average of approximately 400. To minimize potential bias in the calculation of proportional variables, we excluded SA1s with populations fewer than 20 and those without any street view sampling points. After this filtering process, 11,328 SA1s were retained for analysis.

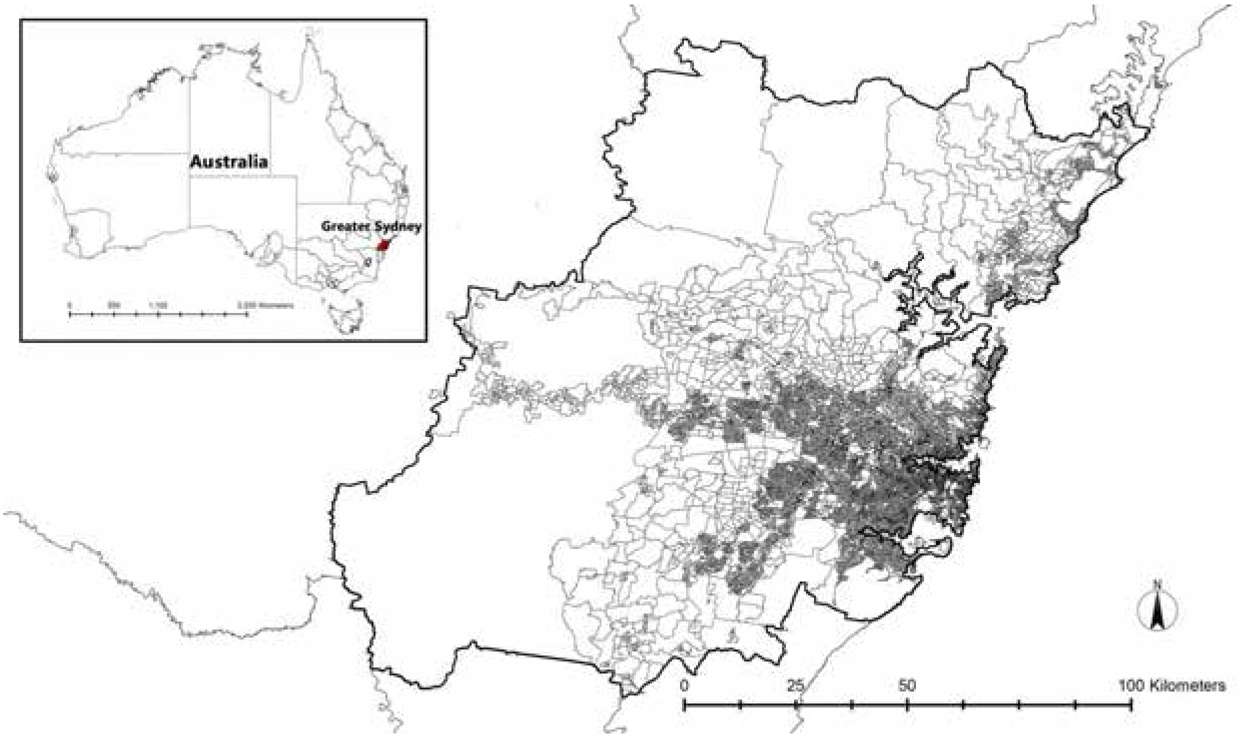

Figure 1. The location of Sydney.

As outlined in the research framework (Figure 2), this study first maps the eye-level greenness of neighbourhoods in Sydney and subsequently employs a Geographically Weighted Regression (GWR) model to examine its spatially varying association with neighbourhood socio-economic status.

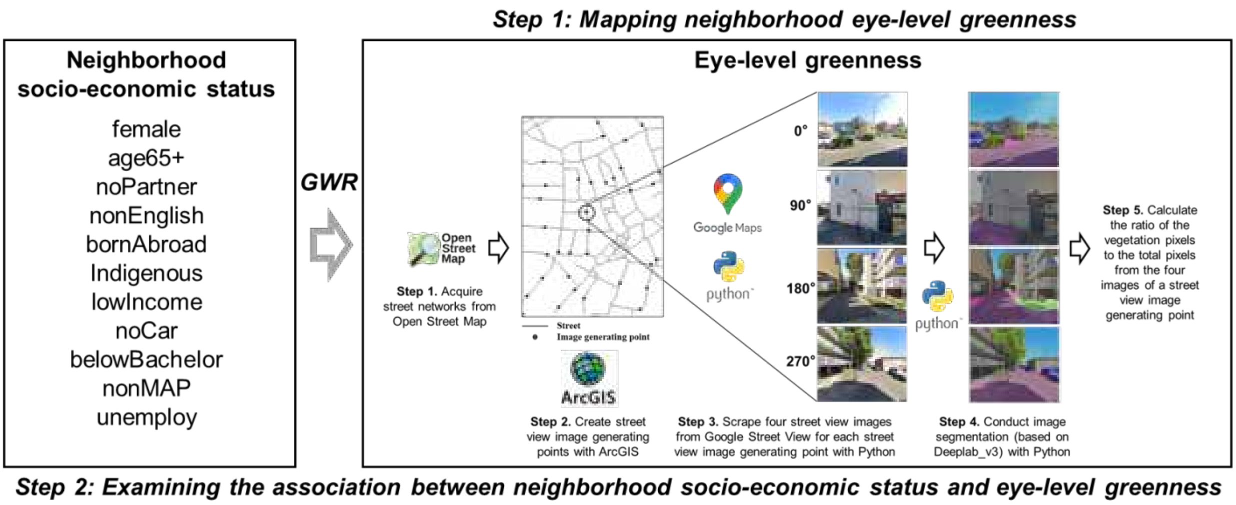

Figure 2. Research framework.

3.2 Data

This study draws on two primary data sources. Eye-level greenness was calculated using Google Street View imagery, while socio-economic variables at the SA1 level were obtained from the 2021 Australian Census released by the Australian Bureau of Statistics (ABS). The variables used in the analysis were derived from these sources, with further explanations and descriptive statistics provided in Sections 3.2.1 and 3.2.2, as well as in Table 1.

3.2.1 Dependent variable: eye-level greenness

As shown in Fig. 2, the calculation of eye-level greenness includes the following steps: First, the road network data in Sydney was acquired from OpenStreetMap. Second, 199,090 image-generating points with 100 m intervals were created using ArcGIS. Third, the coordinates of these points were fed into a Python-based crawler to download four Google Street View (GSV) images per point, with headings of 0°, 90°, 180°, and 270°, each with a 90-degree field of view. After removing points with invalid or missing imagery, we retained 144,850 valid points, which includes a total of 579,400 street-view images. Fourth, we used the Deeplab_v3 image segmentation algorithm, trained on the Cityscapes dataset (https://www.cityscapes-dataset.com/), to extract the street view greenness from each image using Python. Fifth, the ratio of vegetation pixels to the total number of pixels across the four images for each point was calculated, yielding the Street View Greenness (SVG) indicator for that location.

$$SVG\_singlepoint = \frac{Vegetation\ pixels\ of\ four\ images}{Total\ pixels\ of\ four\ images} \qquad (1)$$

After that, the average SVG of sampling points within each SA1 was calculated as the eye-level greenness of that SA1.

3.2.2 Independent variables: socio-economic status

Eleven variables that capture neighbourhood socio-economic disadvantages at the SA1 scale were selected as dependent variables for their potential relevance to green space inequality (as shown in the literature review): the proportion of females, the proportion of individuals aged 65 and older, the proportion of individuals without partners, the proportion of individuals who speak English not well or not at all, the proportion of populations born abroad, the proportion of indigenous populations, the proportion of low-income (weekly income < AUD 800) households, the proportion of dwellings without cars, the proportion of populations whose educational levels are below bachelor, the proportion of populations whose occupations are not in the manager, administrator, and professional categories, and the proportion of unemployed individuals. The VIF values of all the selected independent variables are smaller than 5, indicating no multi-collinearity.

Table 1. Descriptive statistics of dependent and independent variables.

	Mean	S.D	Min.	Max.
Dependent				
Eye-level greenness	0.282	0.129	0.000	0.840
Independent				
female	0.506	0.035	0.000	0.986
age65+	0.156	0.097	0.000	1.000
noPartner	0.126	0.060	0.000	0.708
nonEnglish	0.061	0.067	0.000	0.642
bornAbroad	0.415	0.170	0.000	1.000
indigenous	0.018	0.028	0.000	0.745

lowIncome	0.068	0.051	0.000	0.388
noCar	0.078	0.082	0.000	1.333
belowBachelor	0.458	0.110	0.000	0.950
nonMAP	0.733	0.109	0.314	1.000
unemploy	0.052	0.039	0.000	0.500

3.3 Geographically Weighted Regression (GWR)

To explore the equity issue in urban greenness, we employed the Geographically Weighted Regression (GWR) model to examine the associations between neighbourhood socio-economic status and eye-level greenness. Compared to frequently used linear regression models such as the ordinary least squares (OLS) regression which yields constant coefficients across the whole sample, the GWR model allows the coefficients of explanatory variables to vary across geographic locations, thereby capturing the spatial heterogeneity of these relationships (Kang et al., 2021). The GWR model is specified as follows:

$$y_i = \beta_0(u_i, v_i) + \sum_k \beta_k(u_i, v_i)X_{ik} + \varepsilon_i \qquad (2)$$

Where y_i is the eye-level greenness at SA1 *i*; $\beta_0(u_i, v_i)$ represents the intercept at SA1 *i*; $\beta_k(u_i, v_i)$ is the coefficient (weight) of the *k*th independent variable estimated for each SA1 *i*; ε_i is a random error.

4. Results

4.1 The spatial pattern of neighbourhood eye-level greenness in Sydney

Figure 3 illustrates the spatial pattern of neighbourhood eye-level greenness in Sydney. A general trend is observed whereby eye-level greenness increases from the central urban area toward the suburban regions. Specifically, neighbourhoods in the southern and western parts of the city exhibit relatively lower levels of eye-level greenness compared to those in the north. Notably, the southwestern region of Sydney is recognized for its concentration of socio-economic disadvantage. Accordingly, it is essential to further investigate the relationship between neighbourhood socio-economic status and eye-level greenness. Such analysis can deepen the understanding of green space inequality and offer valuable insights for advancing environmental justice through urban planning and design policies.

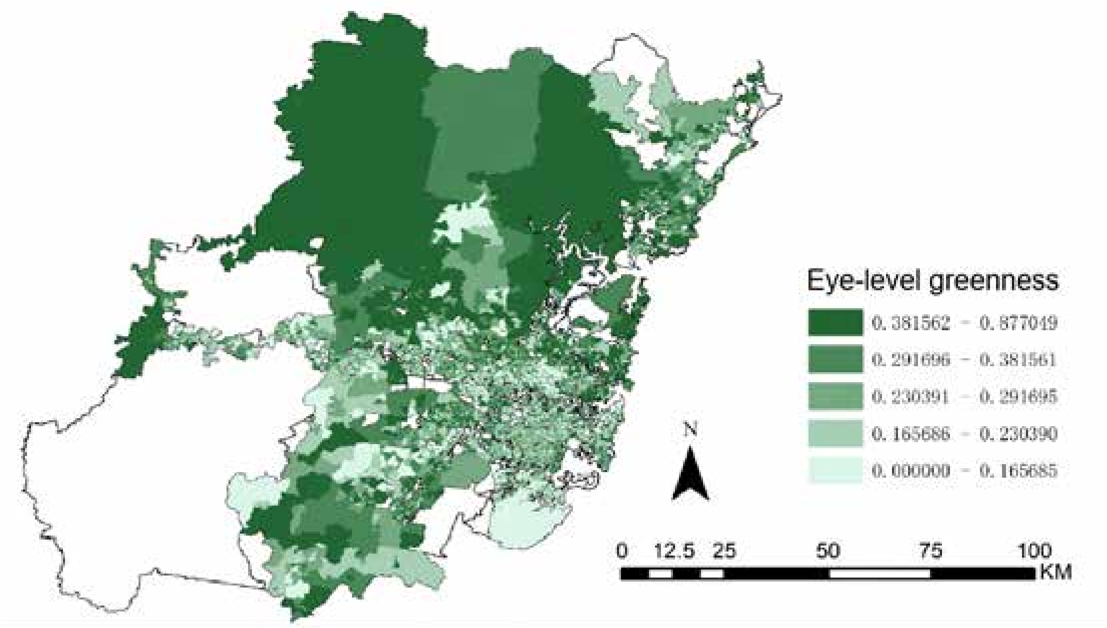

Figure 3. The spatial pattern of neighbourhood eye-level greenness in Sydney.

4.2 Association between neighbourhood socio-economic status and eye-level greenness

Table 2 shows the regression result summary of both the OLS model and the GWR model. The OLS model suggests that the higher proportions of females, individuals without partners, foreign-born, carless, less-educated, and less-skilled people are significantly associated with insufficient eye-level greenness. The adjusted R^2 values of the OLS and the GWR models are 0.206 and 0.465 respectively, indicating that the GWR has better performance than the OLS and spatial heterogeneity exists in the association between neighbourhood socio-economic status and eye-level greenness.

Table 2. Regression result summary of the OLS and the GWR models. (All coefficients are standardized.)

	OLS		GWR	
	Coef.	**Sig.**	**Coef.(median)**	**Coef.(mean)**
female	-0.068	0.000	-0.028	-0.038
age65+	0.304	0.000	0.148	0.150
noPartner	-0.053	0.000	-0.014	-0.013
nonEnglish	0.013	0.409	0.013	-0.055
bornAbroad	-0.312	0.000	-0.213	-0.230
indigenous	-0.011	0.313	0.025	0.017
lowIncome	-0.015	0.209	-0.016	-0.011
noCar	-0.095	0.000	-0.026	-0.038
belowBachelor	-0.195	0.000	-0.138	-0.112
nonMAP	-0.100	0.000	-0.070	-0.075
unemploy	0.068	0.000	0.056	0.062
R^2	0.207		0.473	
Adjusted R^2	0.206		0.465	

Since GWR has better performance compared to OLS, we further explain the associations between the selected socio-economic variables and eye-level greenness based on the results of the GWR model. Figure 4 presents the results of the GWR model, reflecting the spatially varying relationships between neighbourhood socio-economic status and eye-level greenness in Sydney. Neighbourhoods highlighted in red indicate a negative association between the examined socio-economic disadvantages and eye-level greenness, whereas those highlighted in blue indicate a positive association.

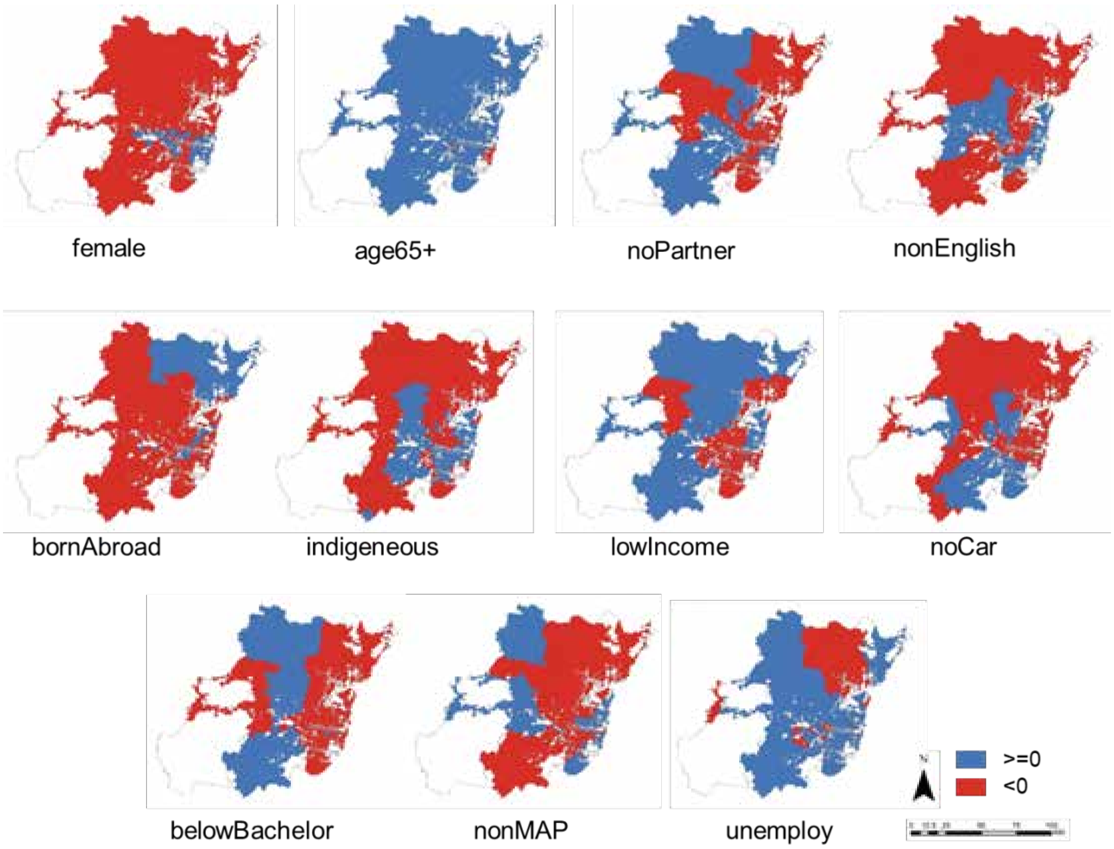

Figure 4. Associations between neighbourhood socio-economic status and eye-level greenness. (All coefficients are standardized.)

Female
In areas near the city centre and the western transport corridor, neighbourhoods with a higher proportion of female residents are associated with greater street-view greenness, whereas those outside these regions exhibit lower eye-level greenness.

Age65+
Neighbourhoods with higher proportions of older adults (65+) in the eastern city centre exhibit lower eye-level greenness, whereas this association is positive in most other regions of Sydney.

NoPartner
In many eastern and some western regions, neighbourhoods with higher proportions of individuals without partners tend to have lower eye-level greenness. Conversely, in the eastern city centre as well as some northwestern and southwestern areas, the association is positive.

NonEnglish
Most northern and southern neighbourhoods show a negative association between higher proportions of non-English speakers and eye-level greenness. In contrast, neighbourhoods in the eastern centre and some western suburban areas exhibit a positive association.

BornAbroad
Neighbourhoods with higher proportions of foreign-born residents generally have lower eye-level greenness, except for some suburban neighbourhoods in the north.

Indigenous
In suburban Sydney, neighbourhoods with higher proportions of indigenous residents tend to have lower eye-level greenness, whereas those in the eastern city centre or some western suburbs exhibit higher levels of human-perceived greenness.

LowIncome
Neighbourhoods with higher proportions of low-income households in eastern regions and some western fringes are associated with lower eye-level greenness. In contrast, such neighbourhoods in western suburbs and some northeastern areas show higher levels of greenness.

NoCar
In many suburban and eastern central areas, neighbourhoods with higher proportions of carless households have lower eye-level greenness. However, in some northwestern and southern areas, the association is positive.

BelowBachelor
Neighbourhoods with higher proportions of less-educated individuals in eastern and some western regions display lower eye-level greenness, while those in northwestern and southwestern suburbs show higher greenness.

NonMAP
Across suburban regions, neighbourhoods with higher proportions of low-skill workers tend to have lower eye-level greenness. However, in some areas near the city centre or peripheral zones, these neighbourhoods exhibit higher greenness.

Unemploy
In most regions of Sydney, neighbourhoods with higher unemployment rates are associated with higher eye-level greenness. However, some southwestern and northern neighbourhoods with higher employment rates are characterized by lower levels of greenness.

5. Discussion and policy implications

5.1 Discussion

The case of Sydney demonstrates a decline in eye-level greenness alongside urbanization, with central areas exhibiting higher eye-level greenness while suburban neighbourhoods are significantly greener. This spatial pattern aligns with observations in other global cities, such as Shanghai (Wu et al., 2019), New York (Li, 2021), and London (Pan, Bardhan and Jin, 2021), as urban centres are dominated by built-up areas, with limited space left for urban greenery.

Green space inequality is evident in less socio-economically advantaged neighbourhoods. In Sydney, older adults in the eastern central areas are more likely to experience lower eye-level greenness. This negative association can also be observed in other urban contexts, such as in Guangzhou, China (Yang, Yang and Zhou, 2022). A possible explanation is that those residing in the city centre are long-term residents, and they age alongside the densification of urban cores over time. Females, unmarried individuals, non-English speakers, indigenous people, low-skilled workers, and unemployed individuals face greater insufficiency of greenness outside the city centre. These populations may concentrate within certain socio-economically disadvantaged suburban neighbourhoods, wherein green resources are limited. Furthermore, other less-advantaged populations, such as overseas-born individuals, those with lower incomes, those without car ownership, and those with lower educational attainment tend to experience lower human-perceived greenness in both central and suburban areas. These associations are supported by evidence in existing literature (Dai, 2011; Astell-Burt et al., 2014; Wüstemann, Kalisch and Kolbe, 2017; Mushangwe et al., 2021).

5.2 Policy implications

To mitigate green space inequalities across socio-economically stratified neighbourhoods, tailored urban greening interventions should be differentially implemented according to distinct spatial and demographic characteristics. In the city centre where urban consolidation limits available space for traditional greening, vertical greenery, such as green façades on buildings, could enhance eye-level greenness and should be implemented in dense urban environments. In suburban areas where socio-economically disadvantaged groups (including higher proportions of females, unmarried individuals, non-English speakers, indigenous people, low-skilled workers, and unemployed individuals) reside, maintaining sufficient tree coverage is crucial. This requires the local government to scientifically and systematically consider green space planning during suburban development. Furthermore, the institutional coupling of subsidized housing initiatives with green infrastructure development emerges as a demonstrably effective policy mechanism for advancing environmental justice, ensuring socioeconomically disadvantaged groups gain equitable access to green urban environments.

6. Conclusion

Guided by the environmental justice discourse, this study examines equity in urban greenery by investigating the associations between neighbourhood socio-economic status and eye-level greenness in Sydney, Australia. The findings reveal that older adults residing in the eastern central areas of Sydney are more likely to experience lower levels of eye-level greenness, while females, unmarried individuals, non-English speakers, indigenous people, less-skilled workers, and unemployed individuals tend to encounter insufficient greenness outside the city centre. Furthermore, foreign-born, low-income, carless, and less-educated individuals are generally exposed to less eye-level greenness greenery in both central and suburban areas.

Drawing upon these findings, the study proposes a differentiated urban greening framework that accounts for distinct spatial contexts. Specifically, implementing green façades in the city centre may help enhance eye-level greenness. In socio-economically disadvantaged suburban neighbourhoods characterized by higher proportions of the aforementioned vulnerable groups, it is crucial to maintain adequate tree canopy coverage and to integrate green space planning with the development of affordable housing projects.

A key limitation of this study is its reliance on cross-sectional data, which precludes the identification of causal relationships between socio-economic status and eye-level greenness. Future research should incorporate longitudinal data by regularly collecting street-view imagery to facilitate deeper insights into the causal dynamics of green space inequality.

Despite this limitation, by leveraging street-view imagery, a data source underutilized in Australian green space research, this study contributes novel insights into spatial inequality in urban greenery. It elucidates how socio-economic disadvantage correlates with eye-level greenness and extends the environmental justice discourse with an Australian case study, thereby supporting future international comparative research.

Declaration of generative AI in scientific writing

During the preparation of this work the authors used ChatGPT in order to proofread the sentences. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

References

Aryal, J., Sitaula, C. and Aryal, S. (2022) 'NDVI threshold-based urban green space mapping from Sentinel-2A at the Local Governmental Area (LGA) level of Victoria, Australia', Land, 11, p. 351. Available at: https://doi.org/10.3390/land11030351.

Astell-Burt, T. et al. (2014) 'Do low-income neighbourhoods have the least green space? A cross-sectional study of Australia's most populous cities', BMC Public Health, 14(1), pp. 19–21. doi:10.1186/1471-2458-14-292.

Csomós, G. et al. (2021) 'Measuring socio-economic disparities in green space availability in post-socialist cities', Habitat International, 117. doi:10.1016/j.habitatint.2021.102434.

Dai, D. (2011) 'Racial/ethnic and socioeconomic disparities in urban green space accessibility: Where to intervene?', Landscape and Urban Planning, 102(4), pp. 234–244. doi:10.1016/j.landurbplan.2011.05.002.

Enssle, F. and Kabisch, N. (2020) 'Urban green spaces for the social interaction, health and well-being of older people— An integrated view of urban ecosystem services and socio-environmental justice', Environmental Science and Policy, 109(March), pp. 36–44. doi:10.1016/j.envsci.2020.04.008.

Feltynowski, M. et al. (2018) 'Challenges of urban green space management in the face of using inadequate data', Urban Forestry and Urban Greening, 31(July 2017), pp. 56–66. doi:10.1016/j.ufug.2017.12.003.

Kang, Y. et al. (2021) 'Understanding house price appreciation using multi-source big geo-data and machine learning', Land Use Policy, 111(September 2019), p. 104919. doi:10.1016/j.landusepol.2020.104919.

Li, X. (2021) 'Examining the spatial distribution and temporal change of the green view index in New York City using Google Street View images and deep learning', Environment and Planning B: Urban Analytics and City Science, 48(7), pp. 2039–2054. doi:10.1177/2399808320962511.

Lin, B., Meyers, J. and Barnett, G. (2015) 'Understanding the potential loss and inequities of green space distribution with urban densification', Urban Forestry and Urban Greening, 14(4), pp. 952–958. doi:10.1016/j.ufug.2015.09.003.

Liu, Y. et al. (2023) 'Does the quality of street greenspace matter? Examining the associations between multiple greenspace exposures and chronic health conditions of urban residents in a rapidly urbanising Chinese city', Environmental Research, 222, p. 115344. doi:10.1016/j.envres.2023.115344.

Lu, Y. et al. (2019) 'Associations between overhead-view and eye-level urban greenness and cycling behaviors', Cities, 88, pp. 10–18. doi:10.1016/j.cities.2019.01.003.

Luo, F., Zhang, Y. and Zhang, L. (2025) 'Transcending the urban–rural dichotomy: inequality in urban green space availability among urban neighbourhoods, urban villages and rural villages in Guangzhou, China', Journal of Asian Architecture and Building Engineering, 00(00), pp. 1–20. doi:10.1080/13467581.2025.2455022.

Mushangwe, S. et al. (2021) 'Ethnic inequalities in green space availability: Evidence from Australia', Urban Forestry and Urban Greening, 64, p. 127235. doi:10.1016/j.ufug.2021.127235.

Pan, J., Bardhan, R. and Jin, Y. (2021) 'Spatial distributive effects of public green space and COVID-19 infection in London', Urban Forestry and Urban Greening, 62(February), p. 127182. doi:10.1016/j.ufug.2021.127182.

Rahimi, A. et al. (2023) 'Gender justice in green space use in relation to different socio-economic conditions in Tabriz, Iran', Sustainable Cities and Society, 99, p. 104973. doi:10.1016/j.scs.2023.104973.

Rahman, K.M.A. and Zhang, D. (2018) 'Analyzing the level of accessibility of public urban green spaces to different socially vulnerable groups of people', Sustainability (Switzerland), 10(11). doi:10.3390/su10113917.

Sharifi, F. et al. (2021) 'Green gentrification or gentrified greening: Metropolitan Melbourne', Land Use Policy, 108, p. 105577. doi:10.1016/j.landusepol.2021.105577.

Shen, Y., Sun, F. and Che, Y. (2017) 'Public green spaces and human wellbeing: Mapping the spatial inequity and mismatching status of public green space in the Central City of Shanghai', Urban Forestry and Urban Greening, 27, pp. 59–68. doi:10.1016/j.ufug.2017.06.018.

Walker, J., Frediani, A.A. and Trani, J.F. (2013) 'Gender, difference and urban change: Implications for the promotion of well-being?', Environment and Urbanization, 25(1), pp. 111–124. doi:10.1177/0956247812468996.

Wu, Z. et al. (2019) 'Changing urban green spaces in Shanghai: trends, drivers and policy implications', Land Use Policy, 87(June). doi:10.1016/j.landusepol.2019.104080.

Wüstemann, H., Kalisch, D. and Kolbe, J. (2017) 'Access to urban green space and environmental inequalities in Germany', Landscape and Urban Planning, 164, pp. 124–131. doi:10.1016/j.landurbplan.2017.04.002.

Yang, W., Yang, R. and Zhou, S. (2022) 'The spatial heterogeneity of urban green space inequity from a perspective of the vulnerable: A case study of Guangzhou, China', Cities, 130(September 2021), p. 103855. doi:10.1016/j.cities.2022.103855.

Zhang, Y. et al. (2024) 'Inequalities in urban green space distribution across priority population groups: Evidence from Tāmaki Makaurau Auckland, Aotearoa New Zealand', Cities, 149(September 2022), p. 104972. doi:10.1016/j.cities.2024.104972.

Zhang, Y. and Luo, F. (2024) 'Linkages among socio-economic status , green space accessibility , and health outcomes : An environmental justice perspective in Australia', Sustainable Cities and Society, 114(April), p. 105784. doi:10.1016/j.scs.2024.105784.

Zhang, Y. and Luo, F. (2025) 'How are green spaces associated with chronic disease incidence in Australia? Direct health benefits and interactive effects with socioeconomic status based on multiple green space indicators', Sustainable Cities and Society, 121, p. 106229. doi:10.1016/j.scs.2025.106229.