Correspondence

Edited by Kiriakos Xenitidis and Colin Campbell

Contents

- Comment on: Neighbourhood greenness and depression among older adults: a risk assessment
- Authors' reply

1 Perrino T, Lombard J, Rundek T, Wang K, Dong C, Gutierrez CM, et al. Neighbourhood greenness and depression among older adults. *Br J Psychiatry* 2019; **215**: 476–80.

2 Zhu A, Yan L, Wu C, Ji JS. Residential greenness and frailty among older adults: a longitudinal cohort in China. *J Am Med Dir Assoc* 2019; **21**: 759–65e2.

3 de Keijzer C, Tonne C, Basagaña X, Valentín A, Singh-Manoux A, Alonso J, et al. Residential surrounding greenness and cognitive decline: a 10-year follow-up of the Whitehall II Cohort. *Environ Health Perspect* 2018; **126**: 077003.

4 Ji JS, Zhu A, Bai C, Wu CD, Yan L, Tang S, et al. Residential greenness and mortality in oldest-old women and men in China: a longitudinal cohort study. *Lancet Planet Health* 2019; **3**: e17–25.

Tomoyuki Kawada, Email: kawada@nms.ac.jp

Comment on: Neighbourhood greenness and depression among older adults: a risk assessment

The discussion about the risk of depression, frailty and cognitive impairment in elderly people is important. In their article, Perrino et al examined the relationship between neighbourhood greenness and depression among older adults, aged 65 years and older.[1] Adjusted odds ratios (ORs) of the middle and highest tertial of greenness against the lowest for depression were 0.92 (95% CI 0.88–0.96) and 0.84 (95% CI 0.79–0.88), respectively. I greatly appreciate for verifying host–environment relationship among older adults, which might lead to improve quality of life in later-life of people. I want to present some information regarding frailty in older adults.

First, Zhu et al conducted a prospective study with a 12-year follow-up to evaluate the effect of residential greenness on subsequent frailty in older adults aged ≥65 years.[2] They used the Normalized Difference Vegetation Index (NDVI) in the 500 m radius around participants' residence as the indicator of residential greenness, and the OR of the highest quartile of NDVI values for frailty was 0.86 (95% CI 0.77–0.97). In addition, the OR of each 0.1-unit increase in annual average NDVI for the improvement of frailty was 1.02 (95% CI 1.00–1.04). As they recognised that these significant relationships were stronger among urban residents; urbanisation indices might substitute for neighbourhood greenness to evaluate the relationship with depression.

Second, Perrino et al presented the dose–response relationship,[1] but Zhu et al could not identify a relationship between the level of NDVI and subsequent frailty, even in urban areas.[2] I suppose that several confounders might affect the relationship and risk assessment should be specified in further studies.

Third, de Keijzer et al conducted a 10-year prospective study to investigate the association between long-term residential surrounding greenness and subsequent cognitive decline in participants with a baseline age of 45- to 68-years-old.[3] An interquartile range of increase in NDVI was associated with an increase in the global cognition z-score of 0.020 (95% CI 0.003–0.037) in the 500 m radius and of 0.021 (95% CI 0.003–0.039) in the 1000 m radius. Although higher NDVI was associated with slower cognitive decline, especially in women, they handled a relatively younger population than Perrino et al's.[1] The effect of ageing on the relationship between neighbourhood greenness and depression should be evaluated.

Finally, there is a lowering effect of residential greenness on subsequent all-cause mortality in older individuals.[4] Hazard ratios of the highest quartile of NDVI values in the 250 m and 1250 m radius for mortality were 0.73 (95% CI 0.70–0.76) and 0.70 (95% CI 0.67–0.74), respectively. I suppose that the interrelationship among depression, frailty and cognitive would be related to life prognosis, and causality seems difficult to confirm. Comprehensive analysis is recommended to understand the relationship between neighbourhood greenness and depression in older adults.

Authors' reply

Authors' reply: We thank Dr Kawada for his interest in our study.[1] We are particularly interested in the findings cited by Kawada on the relationship of greenness to all-cause mortality.[2] In our own work we have found that among US Medicare beneficiaries over 65 years of age living in Miami-Dade County, Florida, USA, greenness was associated with a broad range of chronic diseases that have the potential to contribute to all-cause mortality. Specifically, an increase in mean block-level Normalized Difference Vegetation Index (NDVI) greenness scores from –1 s.d. below to +1 s.d. above the mean was associated with reductions of 10% in hyperlipidaemia, 13% in hypertension and 14% in diabetes diagnoses.[3] These findings have a remarkable population-level impact on health, equivalent to 49 fewer chronic conditions per 1000 individuals – or, the equivalent of a population who is 3 years younger at +1 s.d. NDVI when compared with –1 s.d. NDVI, even when controlling in all of these analyses by individual age, gender, race/ethnicity and neighbourhood income.[3] Notably, these results are 50% stronger for the lowest income blocks, suggesting that for the people with the least resources, block-level greenness is so much more protective, possibly because of their inability to afford or have access to other types of healthy environments.[3] Moreover, in follow-up analyses, our findings revealed that the same increase in mean-level greenness was also associated with 18% reductions in Alzheimer's disease,[4] 19% reductions in heart disease[5] and 20% reductions in stroke (details available from the authors on request).

It is also of interest that the greenness-to-health relationships appears to be robust across different ways of defining the variable, ranging from the block as in our case, to 250 m and 1250 m as in the work of Ji et al.[2] Urbanisation may play an important role in understanding greenness' relationship to depression.

Longitudinal studies such as Ji et al[2] are important for assertions of causality. Indeed, our team currently is working on prospective longitudinal studies to evaluate the longitudinal impact of greenness including tree planting on health outcomes. The addition of randomised controlled studies and examination of place-based interventions is important for identifying and designing the most appropriate greening strategies for promoting the health of populations.

In summary, we agree that the findings from these and other research groups highlight potential approaches to improving the quality of life and health of older adults, as well as identifying mechanisms through which greenness may lead to better outcomes and inform interventions.

Funding

Declaration of interest

References

1 Perrino T, Lombard J, Rundek T, Wang K, Dong C, Gutierrez CM, et al. Neighbourhood greenness and depression among older adults. *Br J Psychiatry* 2019; **215**: 476–80.

2 Ji JS, Zhu A, Bai C, Wu CD, Yan L, Tang S, et al. Residential greenness and mortality in oldest-old women and men in China: a longitudinal cohort study. *Lancet Planet Health* 2019; **3**: e17–25.

3 Brown SC, Lombard J, Wang K, Byrne MM, Toro M, Plater-Zyberk E, et al. Neighborhood greenness and chronic health conditions in Medicare beneficiaries. *Am J Prev Med* 2016; **51**: 78–89.

4 Brown SC, Perrino T, Lombard J, Wang K, Toro M, Rundek T, et al. Health disparities in the relationship of neighborhood greenness to mental health outcomes in 249,405 US Medicare beneficiaries. *Int J Environ Res Public Health* 2018; **15**: 430.

5 Wang K, Lombard J, Rundek T, Dong C, Marinovic Gutierrez C, Byrne MM, et al. Relationship of neighborhood greenness to heart disease in 249 405 US Medicare beneficiaries. *J Am Heart Assoc* 2019; **8**: e010258.

Scott Brown, University of Miami Miller School of Medicine, USA; and University of Miami Miller School of Architecture, USA; **Tatiana Perrino**, University of Miller School of Medicine, USA; **Joanna Lombard**, University of Miami Miller School of Medicine, USA; and University of Miami School of Architecture, USA; **José Szapocznik**, University of Miami Miller School of Medicine, USA; and University of Miami Miller School of Architecture, USA