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PREVENTION (NONPHARMACOLOGICAL)

Disadvantaged neighbourhoods, modifiable risk factors, and cerebral small vessel disease in healthy midlife adults: the PREVENT Dementia study

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Abstract

Background: Individuals living in socioeconomically disadvantaged areas are disproportionately affected by dementia. However, the pathway leading from neighbourhood deprivation to cognitive symptoms is not well understood. To test our hypothesis that this relationship is associated with cerebral small vessel disease (SVD), we examined (1) whether neighbourhood deprivation related to midlife SVD burden and cognition, and (2) whether these links can be explained by modifiable lifestyle risk factors.

Method: In this multi-centre cross-sectional study, 514 cognitively healthy midlife participants aged 40-59 years (median 52 years, 64.6% female) underwent clinical assessment and 3T MRI. Postcode data were used to obtain national indices of neighbourhood deprivation. To quantify SVD, we assessed white matter hyperintensities (WMH), perivascular spaces, cerebral microbleeds, and lacunes. Cognition was assessed using the Computerized Assessment of Information Processing (COGNITO) battery. Lifestyle risk factors were evaluated based on clinical data. Using multivariate statistics like structural equation modelling (SEM) and canonical correlation analysis (CCA), we examined associations between these constructs both globally and at the item-level (i.e., distinction between domains of cognition/deprivation), to shed light on specific domains that could inform targeted prevention strategies.

Result: Neighbourhood deprivation related to greater prevalence of lifestyle risk factors ($r = 0.36$, $p < .001$), greater SVD burden (b=0.18, $p = .01$; Figure 1), and greater cognitive impairment ($r = 0.36$, $p < .001$), independent of educational attainment, sex, and age. These links with neighbourhood deprivation were largely driven by lifestyle factors relating to vascular health (sleep, physical activity, obesity, hypertension) (Figure 2), and cognitive deficits consistent with SVD (processing speed, visuospatial) (Figure 3). Residents of deprived neighbourhoods displayed greater prevalence of lifestyle risk factors, except alcohol consumption. Lower cognitive scores were most closely associated with deprivation domains of Crime and Living Environment (Figure 3). The *DEPRIVATION→SVD* path was mediated by lifestyle risk factors (z=2.57, $p = .010$), and the *DEPRIVATION→COGNITION* path was mediated by SVD (z=-2.14, $p = .032$) (global SVD & hypertensive subtype, but not CAA-SVD).

Conclusion: The pathway linking neighbourhood disadvantage to cognitive impairment at midlife is influenced by vascular risk factors and cerebrovascular burden. Tailored strategies could promote resilience against dementia by promoting health behaviours aligned with the community's unique needs.

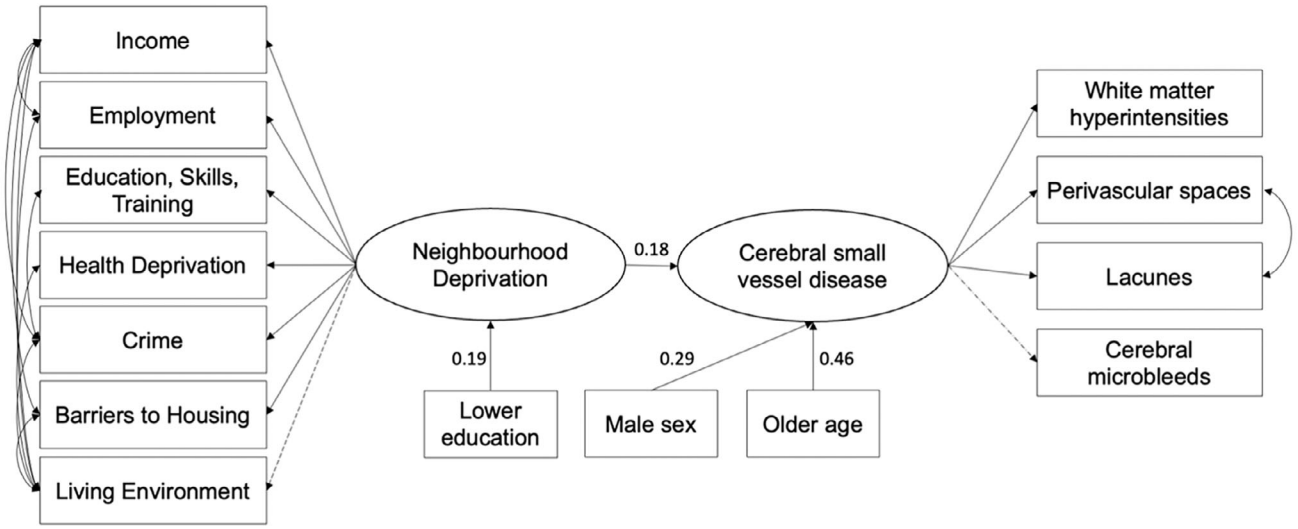

Figure 1. Structural equation modelling of neighbourhood deprivation and cerebral small vessel disease. *The full structural model assesses the associations between the latent variables of neighbourhood deprivation and cerebral small vessel disease, accounting for years of education, sex, and age. Rectangles represent observed variables; ovals represent latent variables. Values represent standardised beta coefficients. Straight lines represent paths, while double-arrowed curved lines represent covariance. Solid lines indicate statistically significant associations; dashed lines indicate non-significant paths.*

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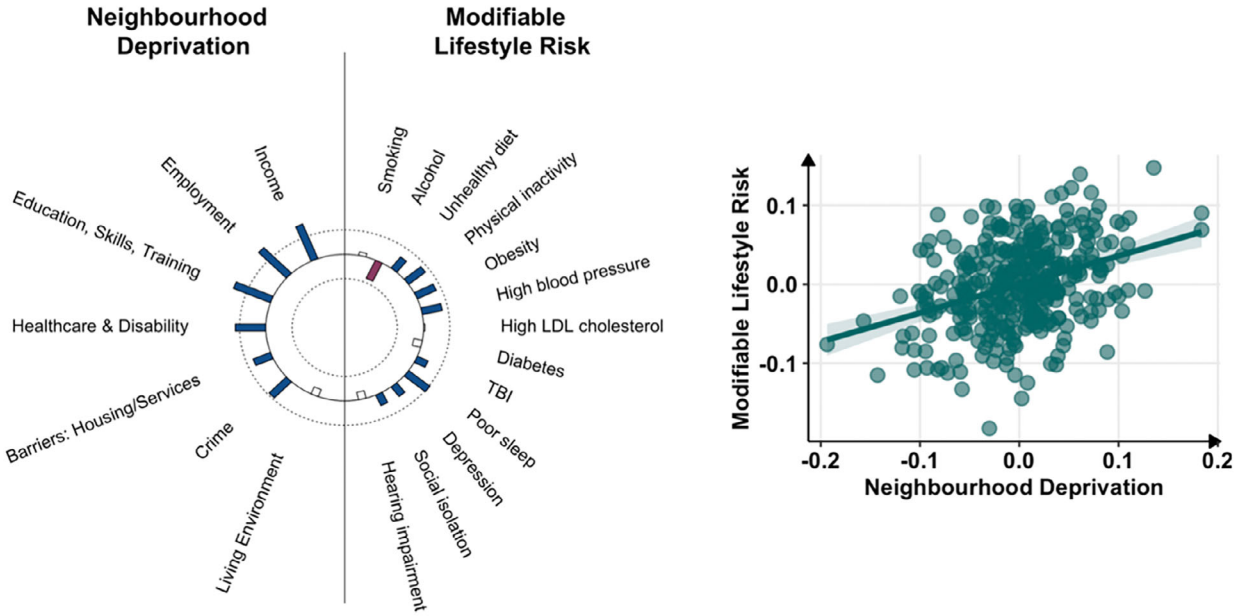

Figure 2. Canonical correlation analysis between neighbourhood deprivation and modifiable lifestyle risk. *Left: Heliograph of canonical variate loadings. Blue bars extending outwards indicate positive weights; red bars extending inwards indicate negative weights; uncoloured bars indicate |r| < 0.2; length indicates strength of structural correlations (loadings). Half-maximum strength of correlation is indicated by the innermost (r = -0.5) and outermost (r = 0.5) circles. Right: Bivariate correlation plots of canonical correlations. Abbreviations: LDL = low-density lipoprotein; TBI = traumatic brain injury.*

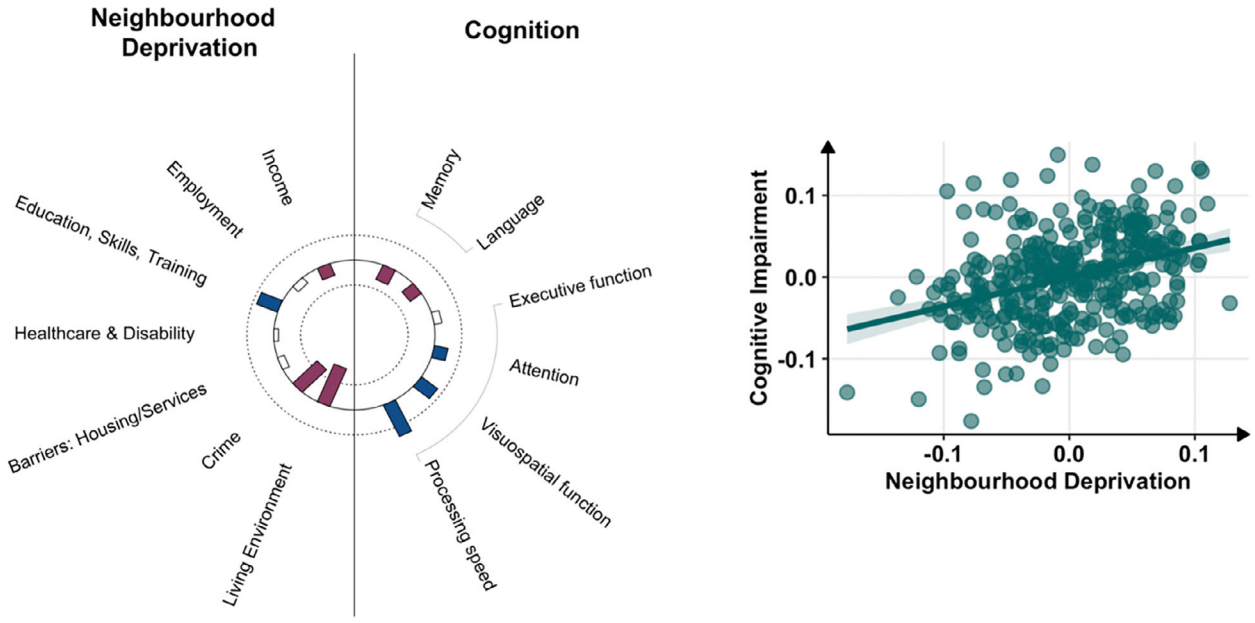

Figure 3. Canonical correlation analysis between neighbourhood deprivation and cognition. *Left: Heliograph of canonical variate loadings. Blue bars extending outwards indicate positive weights; purple bars extending inwards indicate negative weights; uncoloured bars indicate |r| < 0.2; length indicates strength of structural correlations (loadings). Half-maximum strength of correlation is indicated by the innermost (r = -0.5) and outermost (r = 0.5) circles. Right: Bivariate correlation plots of canonical correlations between neighbourhood deprivation and cognitive impairment.*