



Extant Cohorts and Geographical Information Systems (EXCoGIS) Initiative

BECRP

Behaviour, Environment and Cognition Research Program

Key Investigators

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Background

Cognitive health promotion aims to maintain cognitive function in healthy individuals and minimise cognitive decline in those with cognitive impairment by targeting relevant modifiable risk factors. Among these, environmental factors are particularly important as they have been identified as major determinants of health that can potentially influence entire populations. However, empirical evidence on environmental factors affecting cognitive health is lacking because most research in the field has focused on individual-level factors, such as lifestyle behaviours (e.g., physical activity and diet) and biomarkers (e.g., high blood pressure), while environmental factors (e.g., neighbourhood attributes) have been largely neglected. Utilising a broad ecological model of health emphasising the importance of environment-individual interactions, the ExCoGIS initiative aims to address this knowledge gap in the field of cognitive health by adding environmental data to extant large-scale cohort studies on cognitive function.

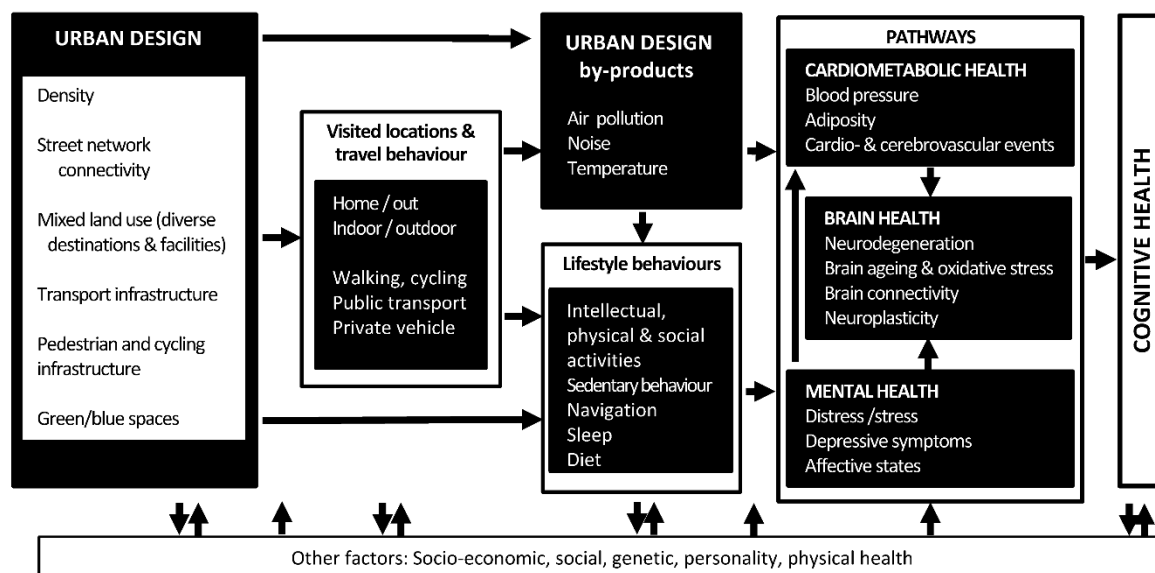


Figure 1: Ecological model of cognitive health. Depicts the pathways through which the urban environment affects cognitive health.

Aims

The aim of the ExCoGIS initiative is to add spatial environmental data to existent international cohorts with cognitive health (i.e., cognitive function) assessments to evaluate aspects of a proposed ecological model of the effects of urban environments on cognitive health.

Methods

Several cohorts that have been established to study individual-level determinants of cognitive health or collected cognitive function data have joined the ExCoGIS initiative from its inception (January 2018). These include: the Australian Imaging, Biomarkers and Lifestyle (AIBL) on ageing study; the Personality And Total Health (PATH) through life project; the Sydney Memory and Ageing Study (Sydney MAS); the Australian Diabetes, Obesity & Lifestyle Study (AusDiab); and the Alzheimer and Families (ALFA) project. Each of these cohorts has specific methodological features and geographical settings that uniquely contribute to achieving the aims of this initiative. Collectively, analyses across cohorts will enable assessment of the generalizability of findings.

Creation of spatial environmental variables to be added to extant cohort datasets.

Objective GIS-based data on urban design characteristics of residential neighbourhoods will be linked to each cohort included in the ExCoGIS initiative. These will include median household income, dwelling density, street intersection density, land use mix, and number and distance to public transport stops, parks, public open spaces, health-related destinations, community services (e.g., libraries), general services (e.g., post offices), food outlets and retail, and community-level socio-economic status. We will also quantify the amount of live green vegetation (Normalized Difference Vegetation Index) which is obtained via remote sensing, the concentration of air pollutants linked to cognitive ill-health ($PM_{2.5}$, PM_{10} and NO_2) and traffic-related noise. Traffic related noise will be modelled using the TRAffic Noise Exposure (TRANEX) model. All the above variables will be created for participants' residential addresses and, if applicable, workplace addresses. Neighbourhood areas will be operationalized as 0.5km and 1km standards (whole surface) and sausage-shaped street-network buffers surrounding residential and work addresses. (Distances ranging 0.5km-1km are considered walkable for adults and older adults). Data on pedestrian and cycling infrastructure will be collected using the online version of the Microscale Audit of Pedestrian Streetscapes (MAPS) Global. Using images from Google Earth Street-View, trained observes will use MAPS Global to collect information on traffic safety, quality of footpaths and amenities for pedestrians and cyclists along the route that connects a residential/workplace address to the nearest commercial area.

Cohort-specific data analyses addressing research questions focusing on specific aspects of the proposed ecological model of the effects of urban environments on cognitive health

The aims of the ExCoGIS initiative revolve around the estimation of associations between levels of, and changes in, urban environmental factors, lifestyle behaviours, blood and brain imaging biomarkers and cognitive health. Generalized Additive Models (GAMs) and 2-level Generalized Additive Mixed Models (GAMMs) with random intercepts (accounting for spatial clustering arising from the adopted sampling strategy) will be employed to estimate the shape and strength of the cross-sectional associations between attributes of the urban environment, cognitive function and related lifestyle behaviours and biological mechanisms using cohorts with cross-sectional data.

For cohorts with multiple assessments of cognitive function across time (but no spatial sampling), several analytical approaches will be adopted depending on the data available. For example, we will use 2-level GAMMs with random intercepts and slopes accounting, respectively, for the dependence of repeated measures on the same individuals and individual-differences in exposure effects. We will also examine associations of baseline and total (cumulative) environmental exposures with trajectories of and average magnitude of changes in cognitive function across time. Categories of trajectories of cognitive function will be identified using group-trajectory modelling accounting for non-random participant attrition (drop out due to death or ill health). Mediation analyses will be conducted to quantify the environmental effects on cognitive function mediated by lifestyle behaviours and biological mechanisms. Moderating effects of personality, genotype and other factors will be estimated by adding appropriate interaction terms to the main effect models described above.

Missing data (for time points prior to a participants' withdrawal from a study) will be imputed using Multiple Imputations by Chained Equations and analyses will be conducted on 100 imputed datasets. Directed Acyclic Graphs will be employed to select confounders to be included in the regression models.

Synthesis of findings providing an overview of the validity of the proposed ecological model of the effects of urban environments on cognitive health

After the publications of findings from Stage 2, we will provide an overview of the validity of the proposed ecological model of the effects of urban

environments on cognitive health based on our findings and an updated systematic review of the literature.

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Publications

Cerin E, Barnett A, Shaw JE, Martino E, Knibbs LD, Tham R, Wheeler AJ, Anstey KJ. (2021). From urban neighbourhood environments to cognitive health: a cross-sectional analysis of the role of physical activity and sedentary behaviours. *BMC Public Health*, 21(1), 2320. doi: [10.1186/s12889-021-12375-3](https://doi.org/10.1186/s12889-021-12375-3).

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