Title:

Does 15-Minute Green Space Accessibility Affect Mental Health in UK Cities?

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Abstract (368/400 words):

In recent years, multiple studies have analysed accessibility through the lens of the '15-minute city' framework. This study aims to contribute to such studies by testing the associations between the 15-minute accessibility to green spaces and the self-reported wellbeing in England using spatial "big data" and GeoAI. To do so, we utilise the street networks from OpenStreetMap (OSM), NASA MODIS satellite images on land cover (*MOD44B*), governmental demographics from Office for National Statistics (ONS), and the mental health and wellbeing data from the Department of Health and Social Care. We study green space accessibility within the 15-minute (a well-known threshold in urban studies) by walking or driving from the centroid of each *local authorities (LAs) and clinic commissioning groups (CCGs)*. Using machine learning models (ML), we investigate the relationhsips between access to different types of green surfaces and self-reported, wellbeing indicators, including "anxiety", "feeling life is worthwhile", "happiness", and "life satisfaction", while accounting for demographic factors such as age, gender, and income.

To achieve this, first we retrieve the satellite images of green surfaces and construct spatial weight matrices (SWM) to calculate 15-minute accessibility for each study area, this can be a local district or a clinic commissioning group. The SWMs conceptualise accessibility based on "zone of indifference". In this respect, they have a flat (100%) utility for areas within the fixed distance band of 15-minute walking (0-800m) and cascading linear utilities -equal to reverse metric distances- for the rest of the area within 15-minutes driving distance with 30km speed (800-7,500m). Using SWM and satellite images, we calculate three types of 15-minute green accessibilities for each *study area*: (1) access to tree-covered green surfaces, (2) access to non-tree-covered green surfaces, (3) access to both green surfaces combined.

Second, we retrieve the four self-reported, well-being statistics for each *study area* and collect five types of control variables on: (a) gender composition of population; (b) presence of different age groups; (c) disposable income; (d) immigration status; (e) percentage of residents with physical disabilities or illness.

Third, we conduct and compare the performances of three ML models,Decision Tree, Xgboost, Random Forest- in terms of RMSE (Root Mean Squared Error). We select the best performing model to illustrate the association between the green spaceaccessibility and the self-reported wellbeing using SHAP's (*SHapley Additive exPlanations*) partial dependence plots, visualising the expected values of the green spaceaccessibility against every possible wellbeing value.

Key words:

15-minute cities, wellbeing, , ,green space accessibility, GeoAI, machine learning, spatial statistics