

Association between Greenness and Cardio-Ankle Vascular Index: A Longitudinal Cohort Study

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Extended Abstract

Epidemiological studies suggest that exposure to more greenery may improve cardiovascular health [1]. The cardio-ankle vascular index (CAVI), a novel non-invasive measure of arterial stiffness, may be beneficial as a long-term predictor of cardiovascular risk [2]. High CAVI was associated with coronary artery disease and cerebral artery disease [3]. However, no study has investigated the association between greenness and the progression of CAVI. We examined the association between long-term exposure to greenness and CAVI in employees of the Electricity Generating Authority of Thailand (EGAT) in the Bangkok Metropolitan Region (BMR), Thailand [4].

In this longitudinal cohort study of 1,215 employees (aged 57-76 years at the baseline), the subjects were followed for 10 years from 2007 to 2017. CAVI was measured in 2007, 2012, and 2017. Each individual received two sets of CAVI measurements, which were taken on the right and left ankles. The left- and right-side measures' averages were utilized for CAVI [2,5]. Greenness was assessed using the satellite-derived Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI), with a spatial resolution of 250 m. The NDVI and EVI have no unit with the values ranging from -1.0 to 1.0. Lower values represent areas with a low concentration of vegetation, whereas higher numbers represent areas with a high concentration of greenery. The NDVI and EVI of the BMR and areas of Thailand have been documented elsewhere [6,7]. Long-term exposure to greenness of each subject's sub-district was defined as 1-year average concentrations prior to the subject's follow-up date in 2007, 2012, and 2017 [7]. Linear mixed models were used to examine the association between greenness and CAVI. Each subject was assigned as a random intercept in our models to control the autocorrelation of repeated measurements for the same subject. The results of CAVI were presented as a percentage change for each interquartile range (IQR) increase in NDVI (IQR = 0.07) and EVI (IQR = 0.05). R statistics project (version 4.1.3) was used to conduct all statistical analyses. Statistics were deemed significant at $P < 0.05$.

During the follow-up period, subjects' average exposure to NDVI and EVI at the sub-district level was 0.4 (Range = 0.16–0.7) and 0.26 (Range = 0.1–0.45), respectively. After full adjustments (i.e., age, sex, body mass index, smoking status, alcohol consumption, education level, income, and prevalence and treatment of hypertension, diabetes, and hypercholesterolemia), we found that decreases in CAVI were associated with NDVI [-4.7% (95% confidence interval (CI): -10.3, 0.9)] and EVI [-4.8% (95% CI: -10.9, 1.3)], but the results were not statistically significant. The associations between NDVI and EVI with right- or left-side CAVI were essentially unchanged.

Although not statistically significant, long-term exposure to greenness was associated with lower CAVI in the subjects of the EGAT cohort study. Our findings need to be confirmed by further studies in other settings and populations. Exposure to greenness may promote cardiovascular health. We advocate for the importance of supporting the development of green spaces.

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