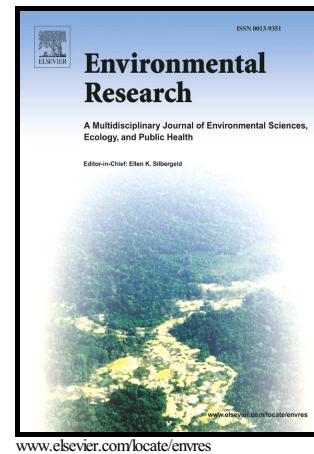


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Cardiovascular diseases in middle aged and older adults in China: the joint effects and mediation of different types of physical exercise and neighborhood greenness and walkability

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ABSTRACT

Background:

Both physical exercise and the built environment are associated with cardiovascular diseases (CVDs). Yet, the influence of the multiple dimensions of the built environment and different types of physical exercise on CVDs is not well understood. Further, little is known about the joint effects of physical exercise and the built environment, nor whether one mediates the effect of the other on the risk of CVDs. We aim to investigate the risk of CVDs on middle aged and older Chinese adult populations by analyzing the independent effects, as well as potential interactions and mediation effects of different types of physical exercise and two dimensions of the built environment; namely, greenness and walkability.

Methods:

Data were collected from a community-based cross-sectional study (n =1,944). The study participants, aged 40 years or older, came from 32 communities across urban, suburban, and rural areas in Longzihu district of Bengbu, a typical second-tier city in eastern China. Physical exercise data were obtained from the International Physical Activity Questionnaire (IPAQ) question survey. We used a satellite-based Normalized Difference Vegetation Index (NDVI) score to assess greenness exposure. We used both the Walk Score index and the Neighborhood Environment Walkability Scale (NEWS) to assess walkability. Multilevel logistic regression, also known as mixed-effects logistic regression, was used to estimate the associations between physical exercise and the built environment (greenness and walkability) on CVD outcomes while accounting for within-community and within-subdistrict correlations. We followed Baron and Kenny's framework and used bootstrapping to quantify the mediation of physical exercise between built environment and CVD outcomes. Stratified analysis was conducted by age (middle aged and older adults) and gender.

Results:

Compared to the reference group with little to low physical activities, we found a significantly reduced risk of hypertension (about 20-45% reduction) and coronary heart disease (about 35-55% reduction) among those with moderate to high activities in walking/square dancing or morning exercising/Tai Chi, and a significantly reduced risk of stroke (about 25% reduction) among those with moderate to high activities in walking/square dancing. Compared to the reference group with low NDVI-based greenness exposure, we found a significant reduction in risk of hypertension (about 55-85% reduction), coronary heart disease (about 75% reduction) and stroke (about 45% reduction) among those with moderate to high levels of exposure. Compared to the reference groups with low walkability, we observed about 30-60% lower risk of hypertension and coronary heart disease associated with moderate to high levels of Walk score, and about 20-30% lower risk of hypertension and stroke associated with moderate to high levels of NEWS-based walkability. We found no interactions between physical exercise and the built environment. The associations of greenness and walkability with CVDs were partially explained by physical exercise (up to 55% of the total effect).

Conclusions:

Both physical exercise and built environment factors were associated with the risk of CVDs. Our observed association between CVDs and neighborhood greenness exposure and walkability was explained, in part, by physical exercises. Such a role, if confirmed in future studies, could have

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