

Are Campus Environments Associated with Emotional Well-Being? Evidence from a Large Sample of Chinese University Students

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Abstract: While anxiety and depression have been extensively studied in relation to individual-level factors, the role of environmental determinants remains less understood. Using a campus livability framework, this study organized environmental indicators into convenience, health, and amenity domains and examined their associations with anxiety and depression among Chinese university students. Based on questionnaire data from 73,193 students across 31 universities, LightGBM models were selected based on model fit performance and applied to examine the nonlinear associations between environmental exposures and emotional health, with a SHAP-weighted campus livability index constructed to summarize overall environmental quality. Most indicators showed nonlinear associations, with similar patterns for anxiety and depression. Shopping and healthcare facilities were associated with lower distress, whereas food facilities and, particularly for anxiety, transportation facilities were associated with higher distress at higher concentrations. Nonlinear associations were observed between emotional distress and the Nighttime Light Intensity, Land Surface Temperature, and Air Quality Indexes, with turning points at approximately $40 \text{ nWatts}\cdot\text{cm}^{-2}\cdot\text{sr}^{-1}$, 13–16 °C, and 40, respectively. Furthermore, green and blue spaces showed threshold-dependent associations with emotional distress. The composite campus livability index was negatively associated with both anxiety and depression, indicating that higher overall campus livability was linked to lower predicted emotional distress. These findings highlight the need to consider the varying importance and threshold-dependent effects of specific environmental factors in campus planning and environmental management.

Keywords: Anxiety; Depression; Livability; LightGBM; Chinese university students