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General and Specific Factors of Environmental Stress and their Associations with Brain Structure

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Introduction: The child's environment consists of broad factors which interact in complex ways to impact the developing brain (1) and has important implications for the onset of psychopathology (2). Environmental stressors encompass neglect, abuse, resource availability governed by income, physical environmental attributes such as urban living and pollution, and interpersonal factors such as the availability of supportive relationships (3). A unifying model that captures the common and specific contributions of these environmental stressors and which accounts for the high co-occurrence among various stressors is needed to uncover the influence of the child's environment on brain development. To this aim, the current study capitalized upon a large sample of 11,878 children aged 9 to 10 years from the Adolescent Brain Cognitive Development (ABCD) Study to identify general and specific factors of environmental stress and test their associations with brain structure.

Methods: Exploratory structural equation modeling and bifactor modeling were used to delineate a general factor of environmental stress that represents the shared variance across various stressors as well as specific subfactors that explain the unique variance. The associations between these factors and gray matter volume (GMV), cortical thickness, and psychopathology dimensions were examined.

Results: Exploratory structural equation modeling and bifactor modeling identified general and specific factors of environmental stress: familial risk, interpersonal support, neighborhood deprivation, and urbanicity. The general stressor factor was associated with globally smaller cortical and subcortical GMV, as well as thinner cortices in frontal, temporal, and parietal regions. The specific factor of neighborhood deprivation was associated with smaller GMV in key subcortical regions and smaller cortical GMV and thinner cortices in frontotemporal regions. The specific factor of urbanicity was associated with globally larger cortical and subcortical GMV, as well as thicker cortices in frontotemporal regions, indicating that the unique variance of urbanicity may reflect the positive aspects of urban living (4). Furthermore, the environmental stressor factors were related to psychopathology dimensions, with greater general environmental stress, familial risk, and neighborhood deprivation associated with a wide variety of psychopathology symptoms. Greater interpersonal support and urbanicity predicted lower psychopathology symptoms.

Discussion: The current study demonstrates that environmental stress factors are reliable predictors of structural deficits and psychopathology dimensions in children. The convergent findings of globally smaller brain volumes associated with both the general environmental stress factor and the general psychopathology factor in the ABCD Study sample (5) suggest an important link between environmental risk factors, psychopathology, and brain structure. The current findings on the adverse effects of environmental stressors on the developing brain call for early intervention at systemic levels.

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