ENVIRONMENTAL DETERMINANTS OF BRAIN STRUCTURE DEVELOPMENT USING MAGNETIC RESONANCE IMAGING AMONG CHILDREN IN GHANA

ABSTRACT

This development is greatly influenced by both genes and environmental factors such as nutrition, social relationships, and sensory stimuli. However, the interconnections between the quality of early life nutrition on one hand, the home environment and language exposure on the other, and structural brain development among children in Ghana has not been investigated. This study investigated the relationship between environmental determinants and structural brain development of children aged 9-11 years in Ghana. Magnetic Resonance Imaging brain data was collected from 231 participants aged 9 to 11 years (51.6% males and 49.4% females) to be included in this study. Whole-brain vertex-wise general linear model at a threshold of 3.0 and Family-wise error (FWE) rate correction of $p < 0.05$ for multiple comparisons in Freesurfer imaging suite v.7.2.0. was used to test for associations between the environmental determinants (nutrition and home environment) and brain structure indices (cortical grey matter thickness and volume). Linear regression analysis was performed using Stata v.15.0 at 95% CI, $p < 0.05$. The Benjamini-Hochberg correction $p \leq 0.05$ was used to correct for multiple comparisons in selected regions of interest and brain structure indices (cortical grey matter thickness, volume and subcortical volume). Nutrition was found not to be significantly associated with any brain structure metric of any brain region in the whole-brain analysis. However, before correcting for multiple comparison, nutrition was found to be positively associated with thickness of caudal anterior cingulate cortex (ACC) and negatively associated with volume of rostral ACC at 9-11 years in the linear regression analysis. Home environment at 5 years was positively associated with right insula ($p=0.03$) cortical thickness and negatively with left inferior parietal ($P=0.006$) cortical thickness. Home environment at 10 years was negatively associated with cortical thickness of the left pericalcarine ($p=0.026$) and right rostral middle frontal ($p=0.049$). Lastly, multilingualism was marginally positively associated with thicker cortex of left pars opercularis cortex ($p=0.06$). Early and middle child home environment in addition to multilingualism influence development of cortical thickness in regions associated with cognition, socioemotional control and language processing among children.

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