A multimodal neuroimaging investigation of normal brain aging in younger and older adulthood

by

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Abstract

In many regions worldwide, older adults now form the fastest growing portion of the population. As such, aging research has seen tremendous growth in recent years, with a focus on identifying early biomarkers of age-related disease. However, crucial to understanding age-related disease is to identify what constitutes normal brain aging, and the life-course factors associated with positive outcomes in later life. In support of this goal, the current dissertation is comprised of three manuscripts that aim to investigate the functional and structural correlates of normal aging in a sample of community-dwelling younger and older adults, from both a multimodal and multi-analysis perspective. Study 1: The first study examined how cumulative cardiovascular risk and self-reported levels of physical, social, and cognitive activity are associated with differences in hippocampal volumes in early and later adulthood. Results indicated that greater cumulative cardiovascular risk was associated with smaller hippocampal volumes across age cohorts. Moreover, a negative association found between frequency of social activities and bilateral hippocampal volumes in older adults, suggesting that social activities with a low cognitive load may not be beneficial to structural brain outcomes in older age. Study 2: This study employed novel advances in functional magnetic resonance imaging (fMRI) to study fluctuations in the blood-oxygen-level dependent (BOLD) signal in relation to age and markers of brain health. Specifically, the study examined the relationship between resting-state BOLD variability and markers of both vascular health and lifestyle activity levels. Results indicated that resting-state BOLD variability is increased in older relative to younger adults. The findings also suggest that the association between BOLD variability and lifestyle activity levels may differ depending on age. Study 3: The final study aimed to further investigate the origins of the BOLD variability signal by examining the feasibility of combining functional near infrared spectroscopy (fNIRS) with fMRI brain signal fluctuation data. In addition to providing proof of concept of combining fNIRS hemoglobin metrics with fMRI BOLD variability maps, the
results of this study also indicate that the patterns of regional association between resting hemoglobin concentrations and BOLD fluctuations may vary according to age cohort. Together, the three studies comprising this dissertation illustrate the value of adopting a multimodal, life-course perspective in the study of normal aging. These findings also support increasing evidence of a relationship between the BOLD variability signal and age. Given the limitations of cross-sectional designs for demonstrating change over time, longitudinal investigations with larger sample sizes across multiple age groups are needed to further the development of public health measures aimed at promoting successful aging from early adulthood.