Education Level Moderates the Effect of Brain Atrophy on Cognition in Multiple Sclerosis

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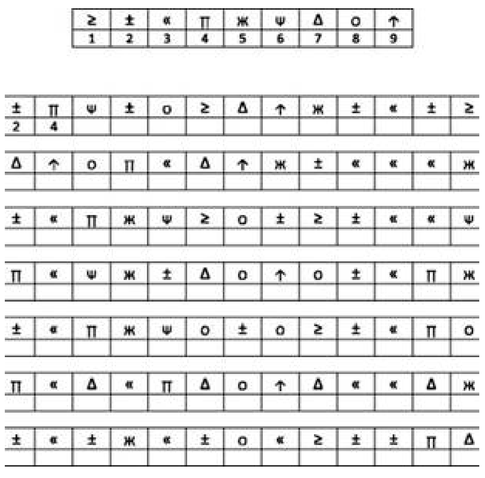
Introduction

Multiple sclerosis (MS) is a disease involving the demyelination of nerve fibers in the brain and spinal cord, interrupting communication between the central nervous system and the rest of the body. A common result of MS is cognitive dysfunction. The cognitive reserve theory refers to how clinical manifestations of brain pathology are affected by the brain's ability to use preexisting cognitive processes to cope with and adapt to neurological insult or damage.[1] Studies suggest that greater intellectual ability leading to greater educational attainment may attenuate the negative cognitive effects of brain atrophy by increasing cognitive reserve, protecting against cognitive impairment.[2,3] Based on this theory, we hypothesized that education level moderates the effect of brain atrophy, measured by third ventricle width (TVW), on cognition in multiple sclerosis. If found to be significant, this would support other findings that educational attainment has a protective effect on cognition and may suggest its use as a predictor of neuropathological manifestation in patients with multiple sclerosis.

Methods

The study included 84 participants with MS. 81% of the participants were female. The highest level of education ranged from 9 – 20 years (mean = 14.63 ± 2.823 years). The age of the participants ranged from 19 – 71 years (mean = 46.71 ± 12.487 years). Disease duration ranged from 2 – 466 months (mean = 129.69 ± 114.670 months). The level of education was measured as the number of fully completed years of schooling.



Cognitive ability was assessed using the Symbol Digits Modalities Test (SDMT), which measures information processing speed. A t-score was determined for the SDMT based on norms provided by the test makers. In addition, participants provided their most recent clinical MRI scans, which were used to measure the TVW by hand using the FreeSurfer software. The axial slice with the longest segment of the third ventricle was chosen, and a vertical line was drawn along the length. The length of the segment was then measured and divided in half. A horizontal line was drawn halfway down, and its length represented the TVW.

Brain MRI of Third Ventricle in MS Patient

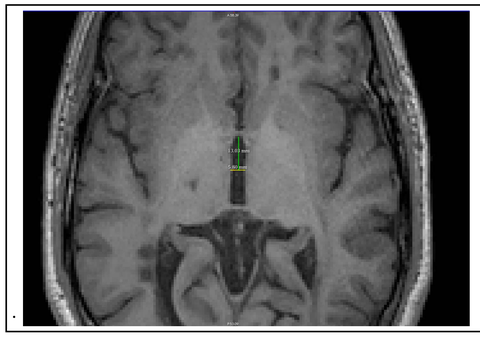


Figure 1. MRI of the third ventricle, demonstrating how the third ventricle width (TVW) was measured.

Educational Attainment vs. Third Ventricle Width

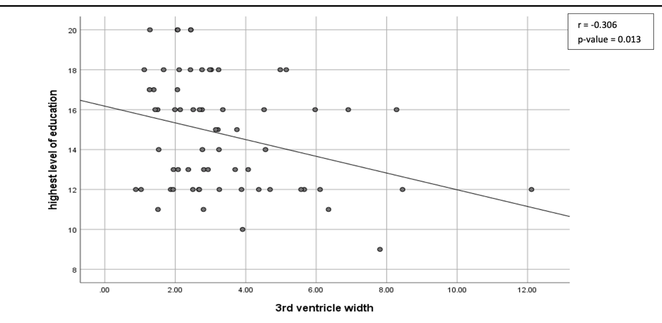


Figure 2. Negative correlation between the highest level of education and TVW, signifying that higher educational attainment corresponded with a smaller TVW. Results were significant with a p-value of 0.013.

Educational Attainment vs. Baseline SDMT

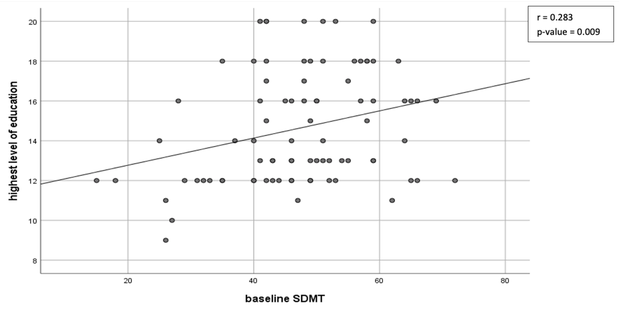


Figure 3. Positive correlation between the highest level of education and baseline SDMT, signifying that higher educational attainment corresponded with a higher SDMT score. Results were significant with a p-value of 0.009.

Third Ventricle Width vs. Baseline SDMT

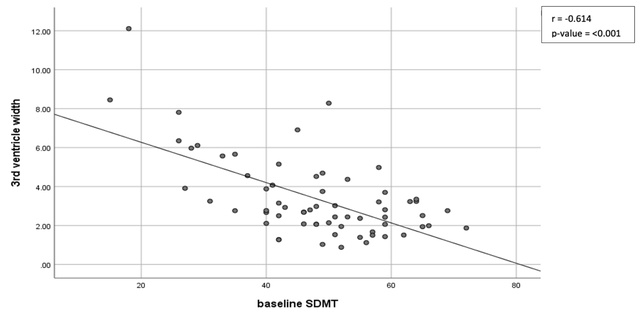


Figure 4. Negative correlation between TVW and baseline SDMT, signifying that a lower TVW corresponded with a higher SDMT score. Results were significant with a p-value of <0.001.

Results

The results from the 3 parameters (highest level of education, baseline SDMT, and third ventricle width) were all significant. After a Bonferroni correction for multiple comparisons resulted in a p-value needed of <0.017, all 3 correlations remained significant. Higher educational attainment correlated with better scores on the Symbol Digits Modalities Test and lower third ventricle width, signifying less brain atrophy.

Conclusion and Future Direction

The results supported the hypothesis that education level moderates the effect of brain atrophy on cognition in multiple sclerosis. This suggests the use of education as a predictor of neuropathological manifestation in multiple sclerosis. There is reason to research if this protective effect extends to other neurocognitive diseases too.

References

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