Direct and indirect influences of childhood IQ on late life cognitive ability

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Background

Higher intelligence in late-life (LL-IQ) is protective against morbidity and mortality (e.g. Bassuk et al. 2000, Whalley & Deary 2001). Childhood intelligence (C-IQ) strongly predicts LL-IQ, however the mechanism underlying this relationship is not completely characterised. Here we test the hypothesis that C-IQ affects LL-IQ by altering the risk of hypertension in later life. Hypertension is a known risk factor for lower LL-IQ, and may act through promoting sub-clinical ischaemic brain damage (white matter hyperintensities [WMH]) (Deary et al. 2003).

Purpose

To investigate the direct and indirect influences on late life cognitive ability and model their relative contributions.

Methods

Participants
234 subjects from the Aberdeen 1936 birth cohort were recruited to this study aged 68.

MRI image acquisition
MRI was carried out on a 1.5T (GE NVi) scanner using T2 axial, FLAIR and 3D T1 sequences. Cerebrovascular disease (WMH) was assessed by an experienced rater using the Scheltens' scale (Scheltens et al 1993).

Cognitive ability and hypertensive history
Childhood IQ (CIQ) was measured at age 11, using the Moray House Test and aged 68, using four established tests (Raven's Standard Progressive Matrices, Auditory Verbal Learning Test, Digit Symbol and Uses for Common Objects). Hypertension (historic or current) was determined by questionnaire and measurement.

Statistical analysis
Structural equation models (SEM) were constructed a priori and analysed using AMOS 18.

Results

Figure 1 shows that hypertensive individuals have a significantly greater white matter burden than hypo- or normo-tensives. **Figure 2** shows the significant association between lower C-IQ and greater WMH burden in later life. **Figure 3** summarises the results of the SEM analysis. Reduced C-IQ did not affect later-life hypertension, but did significantly contribute to increased brain WMH burden. Hypertension acted to increase WMH burden. Increased WMH burden significantly reduced LL-IQ. The model produced an excellent fit to the data (chi squared 7.71, df 6, NFI 0.962, RMSEA 0.000).

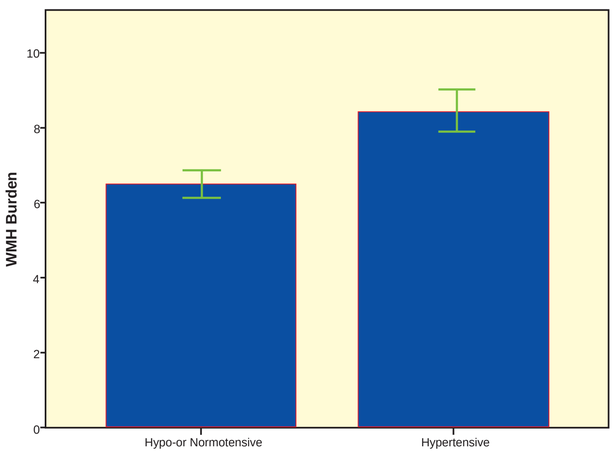

Figure 1. Graph demonstrating greater WMH burden in people with current or historic hypertension. Data are means +/- SEM.

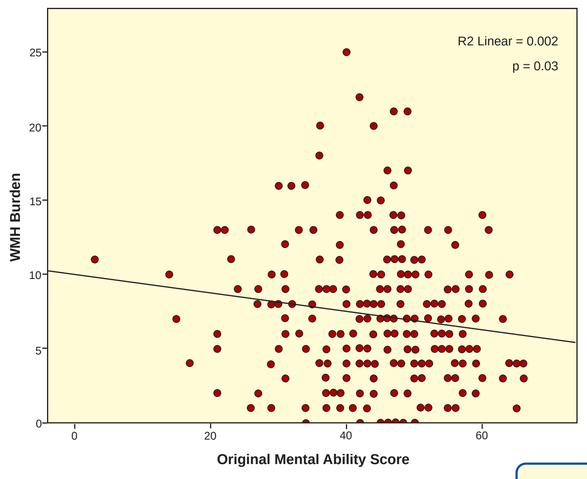

Figure 2. Scatter plot and linear regression of the relationship between age 11 mental ability and brain WMH burden at 68y.

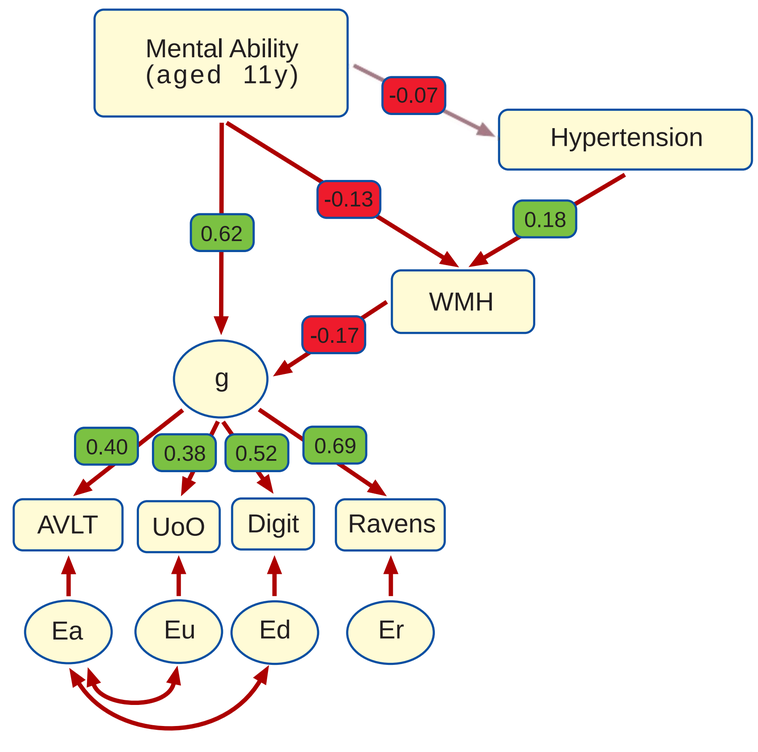

Figure 3. Structural Equation Model of the major determinants of intelligence at age 68. Positive standardised regression weights shown in green, negative in red. Arrow shaded light red are non-significant (p>0.05).

Discussion

Childhood and late-life IQ are directly and indirectly linked. These data demonstrate that lower childhood intelligence is a risk factor for increased WMH in later life. Our original hypothesis was that this effect would be mediated via increased hypertension, with the rationale that lower cognition is associated with greater exposure to vascular risk factors through life. Our data do not support this hypothesis but suggest that CIQ influences WMH by another mechanism and that those with lower CIQ are at greater risk of the negative cognitive effects of WMH.

Conclusions

- WMH have a negative influence on late life fluid intelligence.
- Hypertension promotes the burden of WMH.
- Childhood intelligence does influence WMH burden, but not by affecting hypertension.
- An as yet unknown mechanism contributes to the risk lower childhood intelligence confers on developing late life cerebrovascular disease.

References

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