

## **Is education a demographic dividend? The role of cognitive reserve on dementia-related cognitive decline: a comparison of six longitudinal studies of ageing**

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### **Abstract**

**Background** Education, a marker for cognitive reserve, is thought to be associated with low risks of dementia, but less is known about its association with cognitive decline in preclinical stages of dementia. This study aimed to see whether higher education level could have a protective effect against faster cognitive decline in preclinical stages of dementia and if this protection is consistent across six different studies around the world.

**Methods** We assessed the association between education and change in Mini-Mental State Examination (MMSE) in people who developed dementia during the study period before the time of dementia diagnosis in six international studies of ageing: Newcastle 85+, UK; Three-City (3C), France; Leiden 85+ and Longitudinal Aging Study Amsterdam (LASA), the Netherlands; Octogenarian Twins (OCTO-Twin), Sweden; and Memory and Ageing Study (MAS), Australia. Using a coordinated analysis

approach, we used multilevel models to investigate the role of education on change in MMSE independently within each cohort, while controlling for common covariates such as age at baseline, sex, and time to dementia diagnosis from study entry within each cohort. Each individual's cognitive scores were aligned according to distance (years) to dementia diagnosis.

**Findings** High levels of education (> 12 years) were associated with steeper linear rates of decline in MMSE scores from the study entry to the time of dementia diagnosis in most cohorts—Three-City, Leiden 85+, LASA, OCTO-Twin, and MAS. However, in one cohort (Newcastle 85+), higher education was associated with a slow rate of decline in the preclinical stages of dementia ( $\beta=0.93$ , 95% CI 0.09–1.77) compared with lower education, suggesting perhaps a difference in the educational system between the UK and the rest of Europe or Australia during the early 1990s. A random-effects meta-analysis across data from all six studies showed a non-significant steeper cognitive decline with time for those with higher education ( $\beta=-0.08$ , 95% CI  $-0.17$  to  $0.003$ ; see appendix for forest plot).

**Interpretation** This coordinated approach analysis revealed no consistent protection for people with higher education in terms of lowering the rate of cognitive decline in the preclinical stages of dementia, which is a major public health burden. This work only partly supports the cognitive reserve hypothesis—ie, the clinical manifestation of dementia is delayed in people with higher education but that a steeper decline occurs once a certain threshold has been reached.

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### **Contributors**

DC ran the analyses and drafted the manuscript. AP and GMT contributed to the analyses. All authors contributed to the revision of the abstract.

### **Declaration of interests**

We declare no competing interests.

## Appendix

Figure 1

Forest plot of the associations between education and rates of decline from study entry to the time of dementia diagnosis (Education x Slope) in six international longitudinal studies of ageing

