

## Title: Does education explain the terminal decline in the oldest-old? Evidence from two longitudinal studies of ageing: Newcastle 85+, UK and OCTO-Twin, Sweden

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### Background

Cognitive performance shows a marked deterioration in close proximity to death, as postulated by terminal decline hypothesis. However, the association between education and terminal decline remains highly controversial. This study investigated the role of education on terminal decline in healthy and incident dementia cases from two European longitudinal studies of oldest-old.

### Method

Participants were from the Newcastle 85+, UK (N= 702) and from OCTO-Twin, Sweden (N= 845). They were assessed biannually over 3 and 5 consecutive waves respectively. In a coordinated analysis, multilevel models were employed to examine terminal decline in Mini-Mental State Examination (MMSE), controlling for education, age at baseline, dementia incidence, sex, and time to death from the study entry within each cohort. Cognitive change was modeled as a linear function of time to death in both cohorts and as a quadratic function in the OCTO-Twin study. Education was used as a continuous measure (ranging 6-20yrs in Newcastle 85+ and 0-23yrs in OCTO-Twin).

### Results

The results suggest that a typical British man, aged 85 at baseline, with 10 years education, entered the terminal phase at around 2.5 years before death, and the rate of decline was -1.04 (0.25),  $p < 0.001$  with each year closer to the time of death. In contrast, a Swedish man, aged 83, with an average of 7 years education, entered the study at around 8 years from death, after which the rate of cognitive decline steepened by -1.70 (SE=0.20),  $p < 0.001$  and accelerated by -0.11 (0.01)  $p < 0.001$  points per year closer to the time of death. Incident dementia cases experienced a steeper decline compared to healthy individuals in both studies with (-2.70 (SE=0.21) and (-0.13 (SE=0.02) acceleration),  $p < 0.001$  units in OCTO-Twin and -1.73 (SE=0.33),  $p < 0.001$  in Newcastle 85+). Education was positively associated with the estimated MMSE scores prior to the time of death in OCTO (0.43 (SE=0.15)  $p < 0.005$ ), but not in the Newcastle 85+ and did not attenuate the rate of terminal decline in either of the two cohorts investigated.

### Conclusions

As postulated by terminal decline hypothesis, decline and acceleration of this decline were detectable in both of these studies prior to death, with steeper rates of decline observed in the Swedish cohort. However, this process was not lessened by education itself. It will be useful to extend these analyses in studies with longer follow-ups periods, in order to allow a better understanding of the transition from the subtle cognitive changes accompanying age decline to those of neurological substance.