Influence of young adult cognitive ability on the association between lifetime education and later-life cognitive function – a study in Danish twins

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BACKGROUND AND AIM

- Educational attainment is a modifiable risk factor known to be associated with later-life cognitive function.
- However, one outstanding question is whether a higher lifetime educational attainment merely reflects the consequences of greater cognitive ability or if it conveys an advantage of its own.
- To explore this as well as the influence of other lifestyle factors that might contribute to later-life cognitive function, we aimed at investigating the influence of young adult cognitive ability on the association between lifetime educational attainment and later-life cognitive function using a sample of 2294 male, Danish twins.

RESULTS

- A significant association was found between lifetime educational attainment and later-life cognitive function.
- The effect attenuated when adjusting for young adult educational attainment and became non-significant when adjusting for young adult cognitive ability.
- The association between young adult cognitive ability and later-life cognitive function was found to be significant, also when restricting the analysis to individuals with the modal level of young adult educational attainment.
- In all models, age, engagement in cognitive-intellectual activities, and occupational complexity were significantly associated with later-life cognitive function, but to a lesser extend than young adult cognitive ability.

CONCLUSION

- The results of our study suggest that the association between lifetime educational attainment and later-life cognitive function is mainly driven by young adult cognitive ability. This is consistent with prior research findings.
- This pattern seems to persists even when restricting to individuals with the same level of young adult educational attainment.
- Age at later-life cognitive testing, engagement in cognitive-intellectual activities, and occupational complexity appears to significantly affect later-life cognitive function, independent of young adult cognitive ability. However, young adult cognitive ability is clearly the strongest predictor.

	Model 1			Model 2			Model 3			Model 4		
	Beta	**P**	**95% CI**	**Beta**	**P**	**95% CI**	**Beta**	**P**	**95% CI**	**Beta**	**P**	**95% CI**
Lifetime education	0.59	<0.001	0.42;0.75	0.30	0.001	0.11;0.48	0.06	0.432	-0.09;0.22	0.17	0.162	-0.07;0.42
Young adult education	-	-	-	1.00	<0.001	0.70;1.29	-	-	-	-	-	-
Young adult cognitive ability	-	-	-	-	-	-	4.41	<0.001	4.00;4.82	4.18	<0.001	3.64;4.73
Age	-0.46	<0.001	-0.53;-0.38	-0.41	<0.001	-0.49;-0.34	-0.38	<0.001	-0.44;-0.31	-0.34	<0.001	-0.42;-0.25
Cognitive-intellectual activity	2.19	<0.001	1.79;2.59	1.98	<0.001	1.58;2.39	1.10	<0.001	0.72;1.48	1.11	<0.001	0.62;1.60
Physical activity	-0.46	0.011	-0.81;-0.11	-0.43	0.017	-0.78;-0.08	-0.14	0.407	-0.46;0.19	-0.09	0.676	-0.33;0.51
Physical health	-0.53	<0.001	-0.80;-0.26	-0.49	<0.001	-0.76;-0.22	-0.31	0.014	-0.56;-0.06	-0.26	0.119	-0.58;-0.07
Occupational complexity	2.68	<0.001	1.72;3.65	2.42	<0.001	1.46;3.38	1.33	0.004	0.44;2.23	1.61	0.005	0.49;2.73
Parental education	0.24	0.013	0.05;0.43	0.17	0.089	-0.03;0.36	0.13	0.146	-0.05;0.31	0.08	0.480	-0.14;0.30
Parental occupation	-0.13	0.088	-0.28;0.02	-0.07	0.352	-0.22;0.08	0.003	0.968	-0.13;0.14	0.006	0.941	-0.16;0.17

Table 1. Results of mixed-effects linear regression models investigating the association between lifetime education and later-life cognitive function. Model 1 adjusts for age, parental socioeconomic status (parental education and parental occupation), occupational complexity, engagement in cognitive-intellectual activities (cognitive-intellectual activity), physical activity, and physical health. Model 2 adjusts for the Model 1 covariates as well as young adult educational attainment (young adult education). Model 3 adjusts for the Model 1 covariates as well as young adult cognitive ability. Model 4 is identical to Model 3, but the analysis is restricted to individuals with the modal level of young adult educational attainment (10 years). P-values are uncorrected.

MATERIALS AND METHODS

Study Population: The study population consisted of 2294 male twins born from 1939-1959 with data on young adult (mean age = 19.9 years) variables available from the Danish Conscription Database and data on later-life (mean age = 61.3 years) variables available from surveys conducted by the Danish Twin Registry from 2008 to 2011.
Variables: Later-life cognitive function was evaluated by a cognitive composite score aggregated from the scores of six cognitive tests (verbal fluency, immediate word recall, delayed word recall test, digits forward, digits backward, and symbol-digit replacement). Lifetime educational attainment was assessed as years of education derived from the highest lifetime level of education. Young adult educational attainment was assessed as years of education at the time of conscription. Young adult cognitive function was evaluated by the Børge Priens Prøve, which is a score ranging from 0 to 78 testing letter matrices, verbal analogies, number series, and geometric figures. Age at later-life cognitive testing was calculated from survey date and birth date. Parental socioeconomic status was assessed by parental education (years of primary and secondary education) and parental occupation (evaluated using the International Standard Classification of Occupations 2008 (ISCO-08)). Occupational complexity was assessed using the Occupational Cognitive Requirements Score (OCRS), a composite measure of 10 items that assess the cognitive demands of occupations on a 0 to 7 scale . Engagement in cognitive-intellectual activities and physical activity were calculated by summing the score of questions related to cognitive or cultural activities in non-work settings (e.g., reading, writing, attending a play, or visiting a museum) and physical exercise or movement in non-work settings (e.g., walking, running, or stretching), respectively. Physical health was evaluated by a Cumulative Illness Rating Scale (CIRS) assessing the presence or absence of 13 disease domains. The cognitive composite score was standardized to a mean of 50 and a standard deviation of 10 using the means and standard deviations of twins aged 46-50 years, while the score for engagement in cognitive-intellectual activities, physical activity, and young adult cognitive ability were standardized to a mean of 0 and a standard deviation of 1.
Statistical Analysis: The association between lifetime education and later-life cognitive function was investigated using mixed-effects linear regression models with twin pair id as a random effect and including age, parental socioeconomic status, occupational complexity, engagement in cognitive-intellectual activities, physical activity, and physical health as covariates in the baseline model (Model 1), and either young adult education (Model 2) or cognitive ability (Model 3) in additional models. In addition, an analysis identical to Model 3 but restricting to individuals with the modal level of young adult educational attainment (10 years) was performed (Model 4).

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