



**“**  
POLY<sub>EDU</sub> has a direct effect on reproductive fitness that is independent of the amount of education received **”**

Epidemiological studies have estimated that genetics can account for up to 40% of the variance in educational attainment (the highest level of schooling reached by an individual). Furthermore, a recent study of the US population suggested that the genetic propensity for increased educational attainment is associated with reduced fertility. Now, a larger study of the Icelandic genealogical database that covers a greater time span confirms a steady decline in the frequency of genetic variants that are associated with greater educational attainment, in keeping with the idea that the population average is decreasing over time.

To provide increased statistical power, a polygenic score for educational attainment (POLY<sub>EDU</sub>) of the Icelandic population born after 1910 was constructed based on the weightings of 620,000 markers from a recent genome-wide association study (GWAS). When applied to 46,079 Icelanders, the POLY<sub>EDU</sub> was found to explain 3.74% of the trait variance.

Focusing on 109,120 individuals born between 1910 and 1975, the authors showed that, for women, an increase of 1 standard unit (SU) of POLY<sub>EDU</sub> corresponded to an average

decrease of 0.084 in terms of number of children. This effect was mainly a result of delayed reproduction, with the age at first child and average age at child birth increasing by 0.59 years and 0.46 years, respectively, for 1 SU of POLY<sub>EDU</sub>. Similar, but slightly weaker, results were obtained for men, and the effects could also be seen for individual genetic variants.

Looking at a subset of individuals for whom information about their actual educational attainment level was available, the estimated effect of POLY<sub>EDU</sub> on number of children, although somewhat reduced, remained highly significant when adjusted for actual educational attainment level. Thus, importantly, POLY<sub>EDU</sub> has a direct effect on reproductive fitness that is independent of the amount of education received. The authors therefore propose that the POLY<sub>EDU</sub> score partially captures not only cognitive ability but also the propensity for long-term planning and delayed gratification.

For 129,808 individuals born between 1910 and 1990, the authors observed a highly significant decline in POLY<sub>EDU</sub> (sampled between 1998 and 2014) with increased year of birth. To negate the association

between increased POLY<sub>EDU</sub> and increased survival as a source of bias, they used individuals born after 1940 to estimate the rate of decline in POLY<sub>EDU</sub> as 0.0122 SU per decade. Based on the estimated effect of POLY<sub>EDU</sub> on the intelligence quotient (IQ) and the fact that POLY<sub>EDU</sub> only captures a fraction of the overall genetic propensity, the authors estimated that the change of the gene pool by itself would lead to a decline of 0.30 IQ points per decade.

The authors conclude that as POLY<sub>EDU</sub> is only a fraction of the full genetic component of educational attainment, this trend could have a marked effect on IQ if it persists over the course of several centuries. Notably, however, IQ scores are known to have increased by 13.8 points between 1932 and 1978 (known as the Flynn effect), which suggests that changes in the socioeconomic and technological environment may mask a decreased genetic propensity for IQ.

Kirsty Minton, Senior Editor,  
Nature Reviews Immunology

**ORIGINAL ARTICLE** Kong, A. et al. Selection against variants in the genome associated with educational attainment. *Proc. Natl Acad. Sci. USA* <http://dx.doi.org/10.1073/pnas.1612113114> (2017)