Can Education Override DNA? The Impact of Longer Schooling on Genetic Inequality in Mental Health

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Background I

- There is a social gradient in health meaning that socially disadvantaged individuals experience worse health outcomes.
- Finns from lower socioeconomic status (SES) are over-proportionally diagnosed with a mental illness (Hakulinen et al., 2023; Vaalavuo et al., 2022).
- Higher education protects against mental illness?
- No (Dahmann & Schnitzlein, 2019),
- weak causal evidence (Dobewall et al., 2023; Haas & Fosse, 2008; Kuuppelomäki, 2021; Viinikainen et al., 2018),
- only for a part of the population (Böckerman et al., 2021; Laaksonen et al., 2026).

Background II

- The Finnish compulsory school reform of the 70s as a natural experiment, relying on novel molecular genetic instruments.
- The reform resulted in 3 years longer comprehensive schooling and better access to upper-secondary degrees and higher education institutions (Pekkarinen, 2008).
- Before the reform many children — especially from rural areas or lower-SES families — dropped out early or followed the shorter folk school track.
- Focus on psychiatric diagnoses due to the growing concern about mental illness and its individual and societal costs.

Previous Research

- We follow-up Barcellos et al. (2018) pioneering UK study, which found that additional years of schooling reduced the gap in unhealthy body size between those at high versus low genetic predisposition of obesity.
- A recent Swedish register- based study (Ahlskog et al., 2024), however, examining the heterogeneous effects of an educational reform across 20 outcomes including health for individuals with different genetic predispositions but only 2 out of 105 pre-registered tests were statistically significant.
- Example: ”among females from high-SES families, the reform had a relatively larger effect on earnings for those with a lower genetic propensity for educational attainment”
- Finnish data already utilized to study education-linked genes (Lahtinen et al., 2023)
- Example: “the genetic prediction of education was stronger after the reform by one-third among men and those coming from low-educated families”

Research Questions

- Do additional years of compulsory schooling reduce the association between genetic predisposition and mental illness (gene-environment GxE interaction)?

- Do some social groups, defined by gender and parental SES, benefit more / less from the educational reform than others (heterogeneous effects)?

Data & Methods

- INVEST genetically-informed register data – cohorts born between 1957 and 1970 (n= 10.480, 54.5% female).

- Sample split into those affected by the Finnish compulsory school reform (58.7%) and those who went to school before the change in obligatory years of schooling took place.

- We used the Stata areg command to run the difference-in-differences models taking advantage of municipality and birth cohort variation (for details, see Böckerman et al., 2021; Lahtinen et al., 2023).

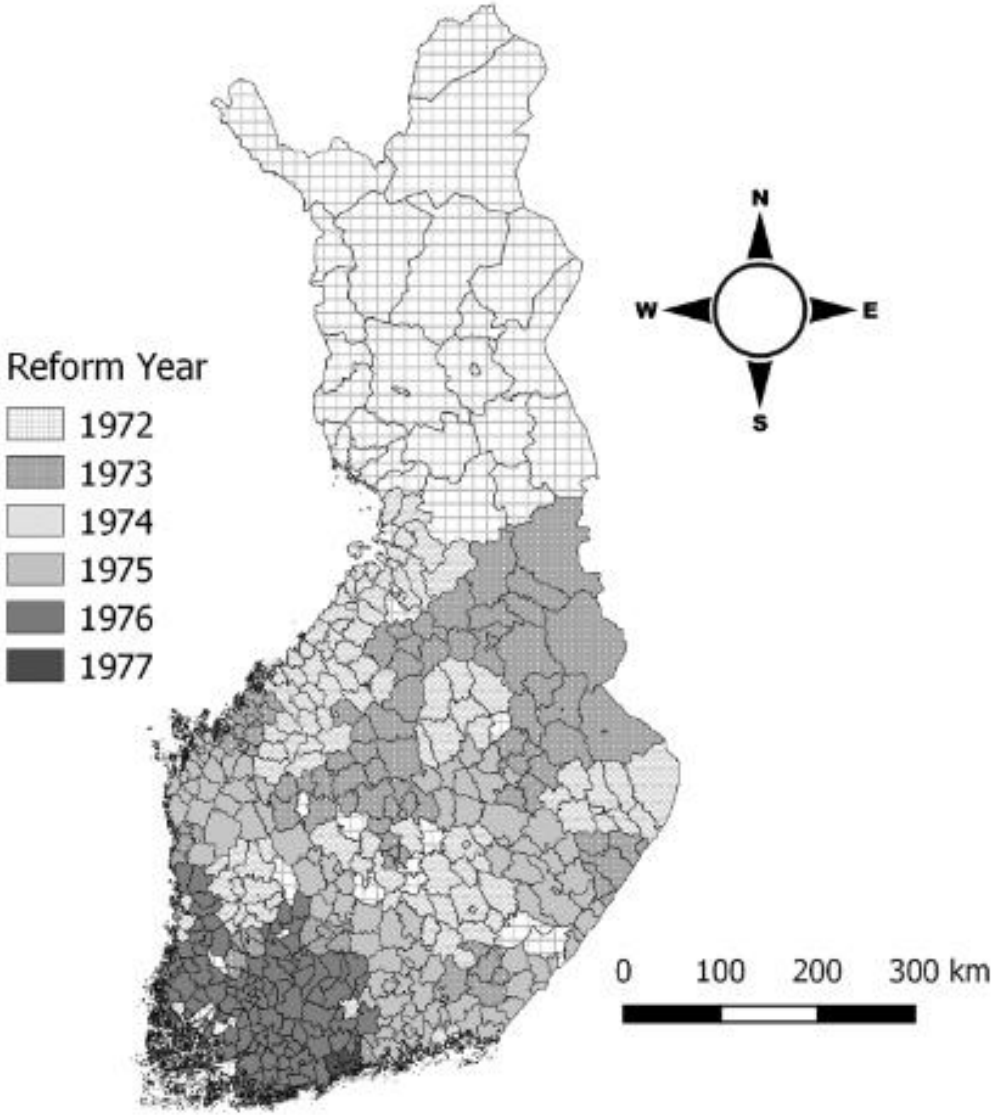

Figure 1. Rolling out of the educational reform during the period 1972–77

Measures

- Minimum years of schooling were measured as exogenous education variable, as cohorts were affected differently by the school reform dependent on municipality of residency at age 11.
- Outcomes. Mental illness diagnoses based on ICD-10 classification (inpatient 1970-; outpatient 1998-) and reimbursement costs for psychotropic medication.
- Heterogeneity. Men versus women and individuals with less educated versus more educated parents were compared.

Polygenic Scores (PGS) & Mental Illness

- We followed closely the preregistration plan of Ahlskog et al. (2024).
- Tested GxE interactions if PGS if explained > 0.5% of the variance.

Polygenic Scores	Mental health diagnoses ICD-10
• ADHD PGS	• F9 Emotional behavioral disorders with onset in youth
• Bipolar disorder PGS	• F3 Bipolar
• PT stress disorder PGS	• F4 Anxiety disorders
• Neuroticism PGS	• F3 Mood disorders / Depression
• Drug addiction PGS	• F1 Substance abuse
• Schizophrenia PGS	• Any; F2 Psychosis / Schizophrenia; Medication costs
• Depression PGS	• Any; F2 Psychosis / Schizophrenia; F3 Mood disorders / Depression ; F4 Anxiety disorders
• Mood disorder spectrum PGS	• Any; F3 Mood disorders / Depression ; F4 Anxiety disorders; Medication costs

(Null-) Results

- PGS were somewhat stronger associated with diagnoses before the reform, but the difference was minimal; A few exceptions (e.g., Neuroticism and Mood PGS).
- No robust evidence that the educational reform reduced the genetic effect on mental illness diagnoses or medication use (no GxE).
- A few signals for heterogeneous effects were observed, like a p<.1 in the higher SES group for bipolar disorder diagnosis and bipolar disorder PGS.
- No association would survive correction for multiple testing.
- The results are consistent with previous Swedish study showing few significant effects of educational reforms.

Conclusions

- This study was designed to challenge the notion of genetic determinism and to provide evidence that social policy can overcome social differences in health risks set at conception.
- The statistical power of this study might have been insufficient to show if the comprehensive school reform reduce social differences in mental health related to genetic predisposition.

Framing & methods

- Study is invited to be submitted to *Comparative Sociology*
- Exiting to write up the story that non-replication should not be interpreted as cultural differences (Eisenberg & Hayes, 2011; Kim et al., 2011; Chiao & Blizinsky, 2010).

- **Experience with using xtlogit models?** To consider the clustering in municipalities and birth cohorts since areg command is less useful for binary outcomes.

Thank you for your attention!

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