THE JOURNAL OF PEDIATRICS • www.jpeds.com

ORIGINAL ARTICLES

# The Population Impact of Childhood Health Conditions on Dropout from Upper-Secondary Education

Janne Mikkonen, MSocSc[1], Heta Moustgaard, PhD[1], Hanna Remes, PhD[1], and Pekka Martikainen, PhD[1,2,3]

**Objectives** To quantify how large a part of educational dropout is due to adverse childhood health conditions and to estimate the risk of dropout across various physical and mental health conditions.

**Study design** A registry-based cohort study was conducted on a 20% random sample of Finns born in 1988-1995 (n = 101 284) followed for school dropout at ages 17 and 21. Four broad groups of health conditions (any, somatic, mental, and injury) and 25 specific health conditions were assessed from inpatient and outpatient care records at ages 10-16 years. We estimated the immediate and more persistent risks of dropout due to health conditions and calculated population-attributable fractions to quantify the population impact of childhood health on educational dropout, while accounting for a wide array of sociodemographic confounders and comorbidity.

**Results** Children with any health condition requiring inpatient or outpatient care at ages 10-16 years were more likely to be dropouts at ages 17 years (risk ratio 1.71, 95% CI 1.61-1.81) and 21 years (1.46, 1.37-1.54) following adjustment for individual and family sociodemographic factors. A total of 30% of school dropout was attributable to health conditions at age 17 years and 21% at age 21 years. Mental disorders alone had an attributable fraction of 11% at age 21 years, compared with 5% for both somatic conditions and injuries. Adjusting for the presence of mental disorders reduced the effects of somatic conditions.

**Conclusions** More than one fifth of educational dropout is attributable to childhood health conditions. Early-onset mental disorders emerge as key targets in reducing dropout. *(J Pediatr 2018;■■:■■-■■).*

Adolescents with no postcompulsory education are at particular risk of cumulative disadvantage through poor health, poverty, and unemployment later in life.[1-4] Early-life health is a key determinant of educational attainment,[1,5-7] but the contribution of health on school dropout at the population level is unknown. It has been suggested that poor health could disturb educational careers by delaying cognitive development, shifting focus away from long-term goals such as education and employment, and disengaging children from their school and peers through increased negative interactions, stigmatization, and missed school days.[5,8-10]

Previous research has found health conditions to predict worse educational outcomes, particularly for mental disorders,[11-22] whereas evidence on specific somatic conditions is mixed.[23-40] Overall, the scarce comparable evidence indicates mental disorders to be more significant than physical conditions in explaining educational disparities.[41-43] Despite their high prevalence, childhood injuries have been largely neglected in studies of educational outcomes.[44,45] Relying mostly on limited, typically self-reported health measures,[7,46] or on clinical samples, previous studies have been unable to combine a wider perspective of health to assessment of specific conditions, or to account for comorbidity.[7,47,48] According to systematic reviews, most previous results are from the US, which makes their applicability to other educational and welfare systems uncertain.[7,49] Most importantly, with small, nonrepresentative samples, it has been impossible to evaluate how much of dropout is attributable to health conditions at the population level.

This study uses large, population-based cohort data to assess the immediate (age 17 years) and more persistent (age 21 years) consequences of childhood health conditions on dropout from upper-secondary education. Using administrative data on inpatient and outpatient care, we estimate whether having any condition, a somatic condition, a mental disorder, or an injury at ages 10-16 years predicts educational dropout and quantify the population impact of these conditions by calculating population-attributable fractions (PAFs). We also assess the effects of 25 specific conditions while accounting for their comorbidity. Given that both poor childhood health and weak educational achievement are overrepresented in socially disadvantaged families[6,50,51] we control for a large number of sociodemographic confounders.

| | |
|---|---|
| PAF | Population-attributable fraction |
| RR | Risk ratio |

From the [1]Population Research Unit, Faculty of Social Sciences, University of Helsinki, Helsinki, Finland; [2]Center for Health Equity Studies (CHESS), Department of Public Health Sciences, Stockholm University, Stockholm, Sweden; and [3]The Max Planck Institute for Demographic Research, Rostock, Germany

Supported by the Academy of Finland (294861) and the Strategic Research Council of Finland (303615). The authors declare no conflicts of interest.

Portions of this study were presented as a poster at the European Consortium for Sociological Research, August 31-September 2, 2017, Milan, Italy.


https://doi.org10.1016/j.jpeds.2018.01.034

## Methods

We used a nationally representative 20% random sample of households in mainland Finland with at least 1 child aged 0-14 at the end of 2000. This sample comprised annual, individual-level measurements from several national registers covering all household members spanning the years 1987-2012. Statistics Finland combined the data from different registers with the personal identification numbers assigned to all residents in Finland (permission TK-53-525-11). We included children born between 1988 and 1995 (n = 102 998), excluding those who had received treatment for intellectual disabilities (*International Statistical Classification of Diseases and Related Health Problems, 10th edition*, codes F70-F79). We also excluded children who had emigrated or died by age 17 years (n = 952), after which the final study sample consisted of 101 284 children. Because 2012 was the last available measurement year, we used a subsample of these children to analyze schooling status at age 21 years (birth cohorts 1988-1991, n = 50 327).

### Measures

Finnish children attend a compulsory 9-year comprehensive school that usually begins in the year the child turns 7 and ends in the year he or she turns 16. Virtually all children (>99.5%) receive a comprehensive-school certificate during their compulsory education.[52] Most school-leavers continue to the upper-secondary level that divides into an academic and a vocational track and lasts 2-4 years after comprehensive school, although some enroll for voluntary additional basic education or preparatory courses for upper-secondary education, both lasting 12 months at the most.[53] We chose the age of 17 years as the earliest measurement point for dropout because at that age even those with 1 gap year or prolonged compulsory schooling ought to have begun their upper-secondary studies. Meanwhile, we chose age 21 years as the final measurement point because obtaining an upper-secondary diploma becomes increasingly unlikely after this age.[54]

We used information provided by Statistics Finland to form the outcome variable of the study, ie, dropout from upper-secondary education, and defined a "dropout" dummy that took the value 1 if the person was not enrolled in any institution offering upper-secondary education at the given age, did not receive student financial aid during that year, and had not obtained an upper-secondary diploma by that age. Thus measured, the proportion of dropouts increases by age as some people start upper-secondary education but never finish.

Health indicators were based on visits to inpatient hospital care (1995-2011) and outpatient specialized services (1998-2011), derived from the Finnish Hospital Discharge Register. We formed indicators of health conditions expressing whether the person had at least 1 inpatient or outpatient visit with a corresponding primary *International Statistical Classification of Diseases and Related Health Problems, 10th edition*, code at ages 10-16 years. The use of a 7-year age span reduces both random and systematic (eg, due to differences in treatment seeking) variation in the detection of health conditions. Moreover, ages 10-16 years capture a salient stage of life with respect to educational careers and precede the measurement of dropout at ages 17 and 21 years.

**Table I** (available at www.jpeds.com) gives the complete list of the diagnostic codes included in the study. First, we identified 3 broad groups of health conditions, ie, somatic, mental, and injury, as well as a general group of any condition, which included all of these groups. Second, based on population prevalence and previous significance in the previous literature, we identified 14 specific somatic conditions, 9 mental disorders, and 2 types of injuries. Within somatic conditions, we included allergy, asthma, cancer, cerebral palsy, celiac disease, congenital heart disease, dorsopathy, epilepsy, inflammatory bowel disease, migraine and other headache syndromes, rheumatoid arthritis, severe infection (ie, pneumonia, meningitis, and sepsis), visual or hearing impairment, and type 1 diabetes. The mental disorders included attention deficit-hyperactivity disorder, anxiety, conduct disorder, eating disorders, pervasive developmental disorders (eg, autism), specific developmental disorders (eg, of speech and language), unipolar depression, psychosis, and substance abuse disorder. Of the injuries, we examined fractures and intracranial injuries separately.

We controlled for individual-level factors (sex, birth year, birth quarter, and maternal age at birth) that might be associated with both the risk of health conditions (or seeking treatment for them) and the risk of school dropout. We also adjusted for several family background–related factors (household income quintile, highest parental education, family type, immigrant status, number of children <18 years living in the same household, persons per room excluding kitchen). Furthermore, we controlled for region of residence and type of municipality to take account of any regional differences in the prevalence of illnesses, access to treatment, and educational opportunities. All control variables were derived from the longitudinal population data file of Statistics Finland. We measured the family- and regional-level characteristics at ages 10-15 years because virtually all Finnish children in this age range still live with a parent or a guardian.[55] We treated these measurements as 6-year averages/modes to control for annual fluctuations. **Table II** (available at www.jpeds.com) shows the classifications and distributions of all the control variables.

### Statistical Analyses

We ran Poisson regression models with robust SEs to estimate risk ratios (RR) of dropout between children with and without adverse health conditions at ages 10-16 years.[56] We took family-level clustering into account by using generalized estimating equations and an exchangeable working correlation structure.[57] We chose the robust Poisson method instead of log-binomial regression, given the convergence issues with the latter.[57] In addition, we calculated PAFs to quantify the contribution of different health conditions at the population level. Different formulas yield the crude and adjusted PAFs:

$$Crude\ PAF = P_T(RR_C - 1)/(1 + P_T(RR_C - 1))$$



FLA 5.5.0 DTD ■ YMPD9740_proof ■ March 14, 2018