



School and Education

School performance and alcohol-related disorders in early adulthood: a Swedish national cohort study

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Abstract

Background Alcohol misuse is an important global health determinant and a major contributor to health inequalities. We aimed to investigate the association between school performance and alcohol-related disorders in early adulthood in a longitudinal register-based national cohort study.

Methods We followed a register-based national cohort of Swedish citizens born 1973–1984 ($N=948\,440$) from compulsory school graduation at age 15–16 to 2009. We divided the population into five groups: high school marks ($> \text{mean} + 1 \text{ SD}$); high average (between mean and mean + 1 SD); low average (between mean and mean – 1 SD); low ($< \text{mean} - 1 \text{ SD}$); and missing. Cox proportional hazard models were used to investigate the relation between school marks at time of graduation and hospital care for alcohol-related disorders in early adulthood.

Results There was a steep gradient in the risk of alcohol-related disorders related to school performance. In comparison with peers in the top category of school marks, students with low marks had adjusted hazard ratios of 8.02 [95% confidence interval (CI) 7.20 to 8.91], low average 3.02 (2.72 to 3.35) and high average 1.55 (1.39 to 1.73). The risk associated with low school marks was stronger in the male population and in the group from high socioeconomic background.

Conclusions The study demonstrated a strong graded relation between low school performance and alcohol-related disorders in young adulthood. School performance should be taken into account when developing prevention programmes/policies targeting alcohol misuse among teenagers and young adults, especially if the aim is to reach high-risk groups.

Key words: School performance, alcohol, social inequality, Sweden, longitudinal

Key Messages

- This national Swedish cohort study showed that poor school performance at the age of 15 was strongly associated with an increased risk of alcohol-related disorders in early adulthood.
- Increased vulnerability to alcohol is a possible mechanism: more education can provide individuals with a number of health-promoting resources with the potential to buffer against the negative effects of drinking.
- Confounding due to psychosocial problems such as heavy adolescent drinking, conduct disorders and bullying is another probable explanation.
- Once adjusted for school performance, the socioeconomic gradient with regard to alcohol-related disorders disappears. This indicates that schools have a great potential to reduce social inequalities in health.

Introduction

The contribution of alcohol-related disorders to the global burden of disease has increased in recent years and alcohol is now one of the top risk factors for morbidity and premature mortality.¹ In Sweden, the negative health effects of alcohol use remain a public health priority^{2,3} and a large number of studies have investigated the country-specific epidemiology of alcohol-related disorders.^{4–8} One study shows that not only is alcohol misuse adding to the general burden of disease, but it also is the single most important determinant of health inequalities in Sweden.⁹ One of the most common measures used in studies investigating alcohol-related health inequalities is education. Whereas some researchers investigate the importance of educational attainment (years spent in educational institutions and academic degrees),^{10–14} other studies focus on school performance (self-estimated or indicated by school marks),^{15–18} especially attainment is often used as a proxy for socioeconomic position (SEP) in adulthood. School performance is also linked to SEP, as well as to cognitive and psychological abilities such as self-regulation, variables that are strongly related to alcohol misuse.^{19,20} To identify, disentangle and discuss the impact of these kinds of early-life health determinants is an important first step in developing successful intervention strategies.

Much of the research on school performance and alcohol focuses on adolescent drinking and the reciprocal effects of school performance and alcohol consumption.^{21,22} There are also some studies with a longitudinal perspective on the association between school performance and alcohol-related disorders later in life,^{23–25} but those have mostly been done with small or mid size samples, relying on self-reported data. Our study contributes to this body of research by using register data for a large Swedish national cohort. The study aims to investigate the relationship between school performance at age 15–16 and diagnosed alcohol-related disorders in young

adulthood. In addition, it aims to investigate the extent to which this association depends on sex and SEP of the study subject.

Methods

Swedish population registers (administered by national government agencies) include a large number of social, educational and health-related indicators. They provide researchers in social epidemiology with excellent data for longitudinal population-based studies. Every Swedish resident is given a unique personal identification number (PIN) at the time of birth or immigration. The PINs enable record linking, which makes it possible to follow a person from birth to death in all population registers. For confidentiality, the PINs are anonymized when used in research. The study has been approved by the regional ethics committee in the Stockholm region.

Study population

The study cohort was identified in the National Medical Birth Register and included all men and women born in Sweden between 1973 and 1984 who were alive and registered as residents of Sweden at 15 years of age ($n = 948\,440$). Due to limited register data on migrants' circumstances in childhood, residents not born in Sweden were excluded from the cohort. Due to the risk of reverse causality, the small group with register entries of alcohol-related disorders before the age of 16 were also excluded ($n = 78$). The individuals in the study population were linked to their parents via the Multi-Generation Register.

Predictors

Data on school marks average at the time of leaving compulsory school (around age 15–16) were collected from the

National School Register. These marks summarize performance in the final school year and are used as qualifications for entry into further secondary level education programmes. The cohort was divided into five categories of school marks: high ($> \text{mean} + 1 \text{ SD}$); high average (from mean to $+ 1 \text{ SD}$); low average (from mean to $- 1 \text{ SD}$); low ($< \text{mean} - 1 \text{ SD}$); and missing. The small group with missing school marks, consisting of 2.44% of the cohort, is a heterogeneous category. Some children in this group attended schools for students with special needs and did not receive school marks, or their marks were not reported to the register agency. Some of the older cohort members who attended private schools are also included in this category, as marks from these schools were not reported to the National School Register before 1993.²⁶ To become eligible for further secondary schooling, a student must pass the 'core subjects': Swedish, English and mathematics. Those ineligible for further secondary schooling were listed as a separate group. This population largely overlaps with the low and missing mark categories.

Outcome

In this study, alcohol-related disorders were defined as a binary outcome (yes/no) and were indicated by at least one entry in registers on alcohol-related medical care and alcohol-related mortality.

Alcohol-related medical care included data from the National Patient Register²⁷ on alcohol-related hospitalizations (1973–2009) and outpatient care (2002–09). Alcohol-related diagnoses that did not necessarily imply long-term alcohol misuse (such as accidental alcohol intoxication) were excluded from the outcome measure. Records on alcohol-related mortality were collected from the National Cause of Death register (1973–2008).

Co-variables

The national censuses and the Register of the Total Population provided a number of socio-demographic co-variables including year of birth, sex, childhood household socioeconomic position, area of residency, maternal country of birth and parental civil status. Previous studies have shown that these variables are associated with alcohol-related disorders in different ways.^{28–32} The study also takes a number of parental factors into account. Indicators for parental psychosocial problems including parental alcohol and/or illicit drug-related disorder, parental psychiatric disorder and parental criminality were collected from the Cause of Death register, the National Patient register and the National Register of Criminal Convictions. Parental alcohol- and/or drug-related disorders were indicated by any entry of alcohol and/or drug-related death or

hospital care. Parental psychiatric disorders were indicated by medical care or death records with a diagnosis related to psychiatric illness and/or self-inflicted injuries. Parental criminality was indicated by any record of a criminal conviction leading to a sentence to prison, probation or forensic psychiatric care (excluding fines, community service and suspended sentences). All parental factors were analysed separately for mothers and fathers and treated as binary variables (yes/no).

Statistical analysis

The analyses in this study were conducted using Cox proportional hazard models. Person-time was calculated from graduation (15–16 years of age) from ninth grade, until first indication of alcohol-related disorders, death, record of emigration or end of follow-up in 2009.

The effect of school performance on alcohol-related disorders in early adulthood was examined in a regression analysis including four models. Model 1 adjusts for sex and year of birth only. Model 2 additionally controls for childhood SEP. Model 3 additionally includes area of residency, maternal country of birth and single parenthood. The final model shows the results adjusted for all of the above and also parental psychosocial problems. The regression analysis shows the combined outcome measure for alcohol-related medical care and death. We also conducted two multiplicative interaction analyses on school performance and sex as well as school performance and childhood SEP. In order to account for reverse causality, we conducted additional analyses including wash-out periods of 5 and 10 years. These analyses are available as [Supplementary data](#) at *IJE* online and showed only slightly weaker associations between the predictors and the outcome.

Proportionality hazards assumption

The assumption of proportional hazards is central in the Cox regression model. A test of this assumption indicated that our model included non-proportional hazards ($p < 0.01$). Although the estimates including non-proportional hazards could be interpreted as the average effect of the predictor, a number of measures may be taken for further verification and to provide more accurate results.³³ In this study we allowed for non-proportional hazards by using a time-predictor interaction term. We also compared our results with negative binomial regressions and Poisson regressions with robust standard errors.

Attrition

Attrition in the register data-based variables was negligible. For 0.14% of the study population, we had no

Table 1. Study population stratified by school performance ($N=948\,440$)

	Total	School marks					Ineligible for further secondary school
		High	High average	Low average	Low	Missing	
Total		14.5%	34.6%	34.2%	14.3%	2.4%	14.8%
Sex							
Female	48.1%	64.2%	54.0%	41.9%	33.0%	43.2%	33.3%
Male	51.9%	35.8%	46.0%	58.1%	67.0%	56.8%	66.6%
Childhood socioeconomic position							
High non-manual	14.1%	30.7%	17.2%	8.9%	3.7%	13.6%	4.2%
Mid non-manual	23.0%	31.2%	27.7%	19.8%	11.7%	17.4%	11.8%
Low non-manual	14.7%	12.0%	15.3%	15.9%	13.5%	11.1%	13.4%
Skilled manual	17.8%	9.7%	15.5%	21.0%	23.9%	16.6%	23.6%
Unskilled manual	20.2%	8.8%	15.2%	24.0%	33.9%	27.0%	33.6%
Other	10.8%	7.6%	9.1%	11.0%	13.3%	14.3%	13.5%
Area of residency							
Rural	21.1%	18.5%	20.8%	22.1%	23.0%	16.4%	23.0%
City	28.9%	33.7%	29.1%	27.5%	25.2%	38.8%	26.1%
Town	49.1%	47.1%	49.4%	49.5%	50.5%	43.1%	50.9%
Maternal nationality							
Swedish	91.6%	92.6%	92.3%	91.6%	89.8%	86.8%	89.6%
Nordic	4.8%	3.8%	4.3%	4.9%	6.5%	6.4%	6.5%
European	2.7%	2.7%	2.6%	2.6%	3.0%	5.3%	3.0%
Non-European	0.9%	0.9%	0.8%	0.9%	0.8%	1.6%	0.9%
Single parent household							
Yes	10.4%	6.8%	8.2%	11.1%	16.8%	16.7%	17.0%
Parental psychosocial problems							
Maternal alcohol/drug disorder	2.0%	0.8%	1.3%	2.2%	4.2%	4.3%	4.2%
Maternal mental health problems	6.8%	4.7%	5.4%	7.1%	10.8%	12.6%	11.0%
Maternal criminality	1.1%	0.3%	0.6%	1.1%	2.7%	3.2%	2.8%
Paternal alcohol/drug disorder	5.0%	2.4%	3.5%	5.4%	9.5%	9.1%	9.6%
Paternal mental health problems	6.2%	4.1%	5.0%	6.5%	9.9%	10.7%	10.0%
Paternal criminality	7.5%	3.3%	4.9%	8.3%	15.2%	15.6%	15.4%

Discrepancies from 100% are due to rounding error.

information on the study outcome; and for the co-variables, the attrition ranged from 0 to 0.89%. In the regression models, the total loss of cases due to attrition was 1.2%.

Results

Table 1 presents the study population stratified by school performance. The cohort was distributed in stable school mark categories following the division based on standard deviations. However, some differences in school performance became apparent when looking at population subgroups ($p < 0.01$). High school marks were more common among females and among cohort members from high socioeconomic background and urban areas. Low and missing school marks were more common in males and

particularly prevalent in groups growing up with parents having psychosocial problems. Consequently it was also more common that these groups were ineligible for further secondary school. Table 2 presents the prevalence of alcohol-related disorders in men and women, respectively. A total of 10 978 persons (1.16%) had a record of alcohol-related medical care or death. The outcome was more prevalent in the male population, but among both men and women, low or missing school marks were associated with higher rates of death or hospital care.

Effect of school performance

Table 3 shows a clear gradient in the risk for developing alcohol-related disorders in early adulthood depending on school marks. The gradients were similar for alcohol-related medical care and mortality and the table shows the

Table 2. Alcohol-related disorders in the population

	Total		Any indication of alcohol-related disorder		Alcohol-related death		Alcohol-related medical care	
	Men	Women	Men	Women	Men	Women	Men	Women
Total	491 692	455 442	1.5% (n = 7 500)	0.8% (n = 3 478)	0.07% (n = 342)	0.02% (n = 69)	1.5% (n = 7 205)	0.8% (n = 3422)
School marks								
High school marks	10.0%	19.5%	0.4%	0.3%	0.01%	<0.01%	0.4%	0.3%
High average school marks	30.6%	38.8%	0.6%	0.4%	0.03%	0.01%	0.6%	0.4%
Low average school marks	38.2%	29.8%	1.3%	0.9%	0.07%	0.03%	1.2%	0.9%
Low school marks	18.4%	9.8%	3.9%	2.5%	0.16%	0.03%	3.7%	2.5%
Missing school marks	2.5%	2.1%	4.9%	2.2%	0.19%	0.02%	4.7%	2.2%
Eligible for further secondary school								
No	19.0%	10.2%	4.0%	2.6%	0.16%	0.03%	3.8%	2.5%

Table 3. Hazard ratios for alcohol-related disorders

	Model 1 HR (95% CI)	Model 2 HR (95% CI)	Model 3 HR (95% CI)	Model 4 HR (95% CI)
Sex				
Female	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Male	1.52 (1.46–1.58)	1.53 (1.47–1.59)	1.55 (1.49–1.61)	1.60 (1.53–1.66)
School marks				
High school marks	1 (ref)	1 (ref)	1 (ref)	1 (ref)
High average school marks	1.61 (1.44–1.80)	1.57 (1.41–1.75)	1.57 (1.41–1.76)	1.55 (1.39–1.73)
Low average school marks	3.42 (3.09–3.80)	3.23 (2.91–3.59)	3.19 (2.87–3.54)	3.02 (2.72–3.35)
Low school marks	10.56 (9.53–11.71)	9.72 (8.75–10.78)	9.33 (8.39–10.36)	8.02 (7.20–8.91)
Missing school marks	12.38 (10.99–13.96)	11.65 (10.32–13.14)	10.67 (9.44–12.06)	8.94 (7.91–10.11)
Eligible for further secondary school				
Yes	1 (ref)	1 (ref)	1 (ref)	1 (ref)
No	4.69 (4.51–4.88)	4.38 (4.20–4.56)	4.21 (4.04–4.39)	3.71 (3.56–3.87)

Model 1: adjusted for year of birth.

Model 2: additionally adjusted for childhood SEP.

Model 3: additionally adjusted for area of residency, maternal country of birth, single parenthood.

Model 4: additionally adjusted for parental psychosocial problems.

combined measure (the separate analyses are available as [Supplementary data](#) at *IJE* online). The moderately elevated risk in the groups with high average [hazard ratio (HR): 1.61, 95% confidence interval (CI) 1.44 to 1.80] and low average (HR: 3.42, 95% CI 3.09 to 3.80) school marks was contrasted by the much stronger risk increase in the groups with low (HR: 10.56, 95% CI 9.53 to 11.71) and missing (HR: 12.38, 95% CI 10.99 to 13.96) school marks. The gradient remained unchanged also after omitting the heterogeneous category 'missing school marks'. Comparing the groups eligible and ineligible for further secondary schooling, the latter showed a considerably increased risk (HR: 4.69, 95% CI 4.51 to 4.88) compared with the former.

Given the violation of the proportional hazards assumption, these results can be interpreted as average effects.³³ We accounted for the non-proportional hazards in an additional model including a time-predictor interaction term. This additional analysis suggested that the gradient related to school performance was slightly stronger in the population with a person-time of 11 years or less. This includes the individuals with early events of alcohol-related disorders as well as the youngest cohort members, together adding up to 9% of the entire population. The results from the Cox regression were highly similar to the results of the negative binomial regressions and the Poisson regressions that were conducted for verification purposes (the separate analyses are available as [Supplementary data](#) at *IJE* online).

Effect of co-variables

Adjusting for co-variables only led to a moderate attenuation of the gradient demonstrated in model 1. In the fully adjusted model, the group with low school marks still had an 8-fold higher risk of developing alcohol-related disorders in young adulthood compared with the reference group. The group ineligible for further secondary school were almost four times more likely to develop alcohol-related disorders compared with the rest of the population. The increased risk in the male population remained stable in all models.

Interaction analyses

An interaction analysis of sex and school performance found that the risk related to low or missing school marks was slightly higher in the male compared with the female population ($p < 0.01$). However, this interaction effect was weaker when omitting the ambiguous category 'missing school marks' ($p = 0.06$). The pattern was reversed for SEP and school performance: the interaction effect between these variables was stronger when omitting the 'missing school marks' category and showed that low school marks and being ineligible for further secondary school implied a particularly high risk in the population with high SEP ($p < 0.01$). The interaction effect of sex and school performance was very modest, but the strong interaction effects of school performance and childhood SEP are illustrated by the stratified regression results in Table 4.

Discussion

In this longitudinal register study of almost 950 000 Swedish men and women, the risk of alcohol-related disorders in young adulthood increased steeply with decreasing school marks at age 15–16. In the fully adjusted model, low school marks ($< \text{mean} - 1\text{SD}$) indicated an eight times

higher risk for alcohol-related disorders in early adulthood compared with the reference group ($> \text{mean} + 1\text{SD}$). The interaction analysis suggested a moderating effect of childhood SEP. It showed that low school performance was more strongly associated with the outcome in the group growing up in a high SEP household.

Education is one of the most important social determinants of health and a strong predictor of adult SEP, which has been showed to be associated with alcohol-related disorders.³⁴ As discussed in a previous study on this cohort, the elevated risk for alcohol-related disorders in low SEP groups in Sweden does not seem to reflect large socioeconomic differences in alcohol consumption, but rather differences in vulnerability to alcohol exposure.^{28,35,36} High school performance and a subsequent high level of education may provide people with the kind of health-promoting capital that compensates for high alcohol consumption later in life. This hypothesis is strengthened by research looking at drinking and its consequences in young adults with high levels of education, such as college students. Several studies identify relatively high drinking levels in these groups, but the risk for developing alcohol-related disorders is generally lower than in peers with no college education.³⁷

Using a life-course terminology, school performance is an important mechanism on the pathway between childhood factors and alcohol-related disorders later in life.³⁸ Education promotes social mobility and good school performance may compensate for early socioeconomic disadvantages. This potential of education became particularly clear when school performance was taken into account in the study on childhood SEP and alcohol-related disorders in early adulthood.²⁸ The socioeconomic gradient was completely attenuated once adjusted for school performance. Our results showed that good school marks were more common among children from high socioeconomic background. However, the interaction analysis also demonstrated that lower school marks were a stronger risk factor for this group compared with their peers growing up in low SEP households. This could indicate that the children who do not do well in school in spite of the learning-promoting environment associated with their parents' high SEP share other risk factors making them vulnerable for alcohol-related disorders later in life. Attention deficit/hyperactivity disorder, conduct disorders, lack of self-regulation or bullying and social exclusion could be potential psychosocial mechanisms behind both poor school performance and alcohol-related disorders in adult age.^{39–41}

Strengths and Limitations

The combination of a national cohort design and register data used in this study has advantages compared with

Table 4. Hazard ratios for alcohol-related disorders stratified by SEP (fully adjusted regression)

	High SEP HR (95% CI)	Low SEP HR (95% CI)
School marks		
High school marks	1 (ref)	1 (ref)
High average school marks	2.08 (1.66–2.61)	1.14 (0.86–1.53)
Low average school marks	4.27 (3.40–5.36)	2.10 (1.60–2.76)
Low school marks	12.25 (9.52–15.75)	5.38 (4.10–7.06)
Eligible for further secondary school		
Yes	1 (ref)	1 (ref)
No	5.20 (4.38–6.18)	3.11 (2.88–3.36)

many other studies in this field. The most obvious benefit is the considerable size of the study cohort, enabling multi-variable analyses with a great number of co-variables. The Swedish registers made it possible to deliver clear results using both a relative and a more absolute measure of school performance: school marks and eligibility for further secondary school. The register follow-up also minimizes attrition and self-report bias, which is a significant problem in other studies on alcohol-related disorders.

A concern in studies of alcohol-related disorders based on data from hospital care is the validity of the outcome at population level. The proportions of hidden alcohol misuse and its subsequent disorders are likely to be high, potentially even more so in specific population groups. Unlike studies based on survey data, we were not able to include information on consumption patterns of alcohol that potentially also could explain differences in alcohol-related disorders. Especially heavy drinking during adolescence, but also psychosocial problems of the cohort members, would be important confounders to consider. Our study is limited to native Swedish citizens and is therefore not representative of all Swedish residents given the significant migrant population. Also, the specific context of the Swedish educational and political systems should be considered before generalizing these results to other contexts. Finally, the National School Register provides ninth grade school marks for the large majority of the study population. For a small proportion (2.4%), no school marks were reported. The ambiguity of this category (children with special needs, but also children from private schools) suggests that interpretations related to this group should be made with caution.

Implications for research, policy and practice

Given our observational cohort design, we had limited possibilities of isolating the effect of school performance from other factors. This makes it difficult for us to claim with absolute certainty that improving school performance would lead to decreased alcohol-related disorders later in life. However, we think that the remarkably high risks connected with poor school performance, as well as the fact that the socioeconomic gradient found in a previous study completely disappeared once adjusted for school performance, both deserve attention. The compensating potential of schools should be considered, especially given the fact that the divergence in school performance of children from different socioeconomic backgrounds has increased in Sweden in recent years.^{42,43} Increasing social and health-related inequality in adult life is likely to be one of the consequences, alcohol-related disorders being one of the likely contributors. The school has a great potential to prevent

not only poor health in general but also health inequalities. It may however also be a significant arena for the reproduction of social inequality and a generator of early marginalization, leading to increased risks of exclusion later in life. The strong connection between school performance and alcohol-related disorders and its interaction with socioeconomic circumstances should be investigated further. This large study, in combination with research using material that allows for more detailed controlling of potential confounders, build a strong base for informing social and public health policy.

Supplementary Data

Supplementary data are available at *IJE* online.

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Contributors

The study was conceived by A.H., who also designed the study in collaboration with K.G. K.G. conducted all statistical analyses under supervision of A.H. K.G. wrote the first draft of the manuscript and all authors interpreted the data, contributed to the writing of the subsequent versions of the manuscript and approved the final version.

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