School performance and hospital admissions due to self-inflicted injury: a Swedish national cohort study

Beata Jablonska,1* Lene Lindberg,1 Frank Lindblad,2,3 Finn Rasmussen,4 Viveca Östberg5 and Anders Hjern5,6

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Background Self-inflicted injury in youth has increased in many Western countries during recent decades. Education is the most influential societal determinant of living conditions in young people after early childhood. This study tested the hypothesis that school performance predicts self-inflicted injury.

Methods A national cohort of 447,929 children born during 1973–77 was followed prospectively in the National Patient Discharge Register from the end of their ninth and last year of compulsory school until 2001. Multivariate Cox analyses of proportional hazards were used to test hypotheses regarding grades in ninth grade as predictors of hospital admission due to self-inflicted injury.

Results The risk of hospital admission because of self-inflicted injury increased steeply in a step-wise manner with decreasing grade point average. Hazard ratios were 6.2 (95% confidence interval 5.5–7.0) in those with the lowest level of grade point average compared with the highest. The risks were similar for women and men. Adjustment for potential socio-economic confounders in a multivariate proportional hazards regression analysis attenuated this strong gradient only marginally.

Conclusion School performance is a strong factor for predicting future mental ill-health as expressed by self-inflicted injury.

Keywords Self-inflicted injury, school performance, register study, Sweden

Introduction

Registered self-inflicted injury among adolescents and young adults increased significantly in many Western countries during the last decade.1–3 In Sweden, hospitalizations due to self-inflicted injury increased by 50% between 1998 and 2004 in women aged 15–24 years and slightly less in men of the same age.4 This type of problem typically appears during adolescence.

* Corresponding author. Division of Applied Public Health, Department of Public Health Sciences, Karolinska Institutet, Box 17070, SE-104 62, Stockholm, Sweden. E-mail: Beata.Jablonska@ki.se

1 Division of Applied Public Health, Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden.
2 Department of Neuroscience, Child and Adolescent Psychiatry, Uppsala University, Uppsala, Sweden.
3 Stress Research Institute, Stockholm University, Stockholm, Sweden.
4 Child and Adolescent Public Health Epidemiology Group, Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden.
5 Centre for Health Equity Studies (CHESS), Stockholm University/Karolinska Institutet, Stockholm, Sweden.
6 Department of Children’s and Women’s Health, Uppsala University, Uppsala, Sweden.

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and young adulthood. In the years leading up to this phase, children spend thousands of hours in educational institutions. Leaving compulsory school with poor or incomplete qualifications may be one crucial risk factor for self-inflicted injury in the life course, positioned as it is between early childhood and the late teens.

Education is by far the greatest economic investment that a society makes in its children. Considering the potential impact of large economic investments in education upon health, it is surprising that the educational system is rarely evaluated in the public health perspective. Although previous studies lend some support to the association between poor school performance and self-inflicted injury, most focused on either self-inflicted injury ideation or completed suicide. With few exceptions, the cited investigations had several important limitations, such as small sample sizes and/or samples non-representative for the general population. Furthermore, the definitions of school performance varied and grades were hardly ever applied. To the best of our knowledge, there are no prospective or register studies that have analysed the association between school grades and self-inflicted injury.

The aim of this study was to test the hypothesis that school performance can predict self-inflicted injury. The study exploited a window in Swedish educational history when 95% of the children completed their 9 years of compulsory primary education in a uniform, state-funded school system with a grading system supervised through national examinations by The Swedish National Agency for Education.

Methods

This study was based on the data from national registers held by the Swedish National Board of Health and Welfare and Statistics Sweden. The key to these registers is the unique personal identification number, which was used to link data from the registers to each participant. The study was approved by the regional ethics committee in Stockholm, Sweden.

Study population

The study population consisted of the Swedish population born between 1973 and 1977 ($n = 491,258$), registered as residents in the Swedish Population and Housing Census of 1985. These are the first five birth cohorts in the National School Register—the Swedish national data source for information about school performance. Individuals were followed up in the National Hospital Discharge Register from the time of graduation and were censored at the date of death from the National Cause of Death Register, date of emigration from the Register of the Total Population or end of follow-up. Individuals who had been admitted to a hospital due to psychiatric disorder and/or self-inflicted injury before finishing ninth grade ($n = 1670$) were excluded. Their grade point average was 2.84 [standard deviation (SD) = 0.68], which was similar to those who had been admitted after leaving compulsory school, who had a grade point average of 2.87 (SD = 0.73). Individuals who had three or more incomplete courses ($n = 7062$) were excluded because of their unreliable grade point average, as were foreign-born children ($n = 34,597$) because of the negative influence of migration on school performance. In total, 447,929 persons comprised the study population.

Outcome variable

The outcome variable—hospital admission at least once due to ‘purposely self-inflicted poisoning or injury/suicide (attempted)’ [tenth revision of the International Classification of Diseases (ICD-10)]—was obtained through individual records linkage to the National Hospital Discharge Register from 1987 to 2001. Hospital admission involves staying at a hospital for ≥1 night. Self-inflicted injury was defined according to the World Health Organization (WHO) ICD-9 (intentional self-harm E950–959 and event of undetermined intent E980–989) during 1987–96 and ICD-10 (intentional self-harm X60–84 and event of undetermined intent Y10–34) during 1997–2001.

A suicide attempt is defined as a potentially self-injurious behaviour associated with at least some intent to die. The intent of an injury cannot be established in a register study of this kind. Thus, the term ‘self-inflicted injury’, applying to all cases of hospital-treated self-injuries irrespective of the intention, was used.

School performance

Data were collected from The National School Register on grade point averages and grades in specific subjects in five categories at the time of leaving compulsory school (usually at 16 years of age): (i) Swedish; (ii) natural science subjects—biology/physics/chemistry/technology (average); (iii) social science subjects—geography/history/civics (average); (iv) art-related subjects—arts/textiles/wood and metalwork/music (average); and (v) sports.

This register encompasses such information from all public schools since 1988 and also from all non-public schools (<5% of all Swedish schools) since 1993. Until 1996, a five-grade relative scale (5 being the highest) was used in the Swedish school system, supervised by the Swedish School Authority through national tests in core subjects. The data from the National School Register are of high quality and summary statistics are published regularly.

Grade point average for the sample ranged from a minimum of 1.0 to a maximum of 5.0 [mean (M) = 3.2, SD = 0.7]. This variation was used to create a four-category variable: high (>M + 1 SD),
high average (from $M + 1$ SD), low average (from $-1$ SD to $M$) and low (<$M - 1$ SD). The same procedure was applied for grades in specific subjects, using subject-specific mean and SD values.

**Socio-demographic variables**

Socio-demographic indicators were created through linkage to The Swedish Population and Housing Census in 1985: year of birth, sex, ethnicity, socio-economic status (SES) of the household, single-parent household, housing and geographical location of the residence (residency). Information about parental country of birth was used to create a three-category proxy for ethnicity: Swedish (both parents born in Sweden), immigrant (no parent born in Sweden) and mixed (one parent born in Sweden and one parent born in another country). SES was defined according to the classification used by the Statistics Sweden, which is based on occupation and considers the occupation’s required level of qualification, type of production and position of work of the head of the household. Six categories of SES were created: manual labour, skilled labour, lower white collar, medium white collar, higher white collar and others (i.e. self-employed, farmers, students, housewives, old age/sickness disability pensioners, long-term unemployed). Data on ‘maternal education’ were obtained from the Swedish Educational Register (if available from the register of 2001, otherwise from the registers of 1995 or 1990) categorized as short (≤11 years), medium (12–13 years), long (14–15 years) and very long (>16 years).

**Statistical methods**

Multivariate analyses were performed by Cox regression of proportional hazards of time to the event with ‘hospital admission at least once because of self-inflicted injury’ as the outcome variable. Time in the study was calculated with the entry date defined as the date of graduation and the exit date as the date of the first hospital admission, date of death from the National Cause of Death Register, date of emigration from the Register of the Total Population or end of follow-up (December 2001).

Model 1 was adjusted for year of birth and sex only. In Model 2, we added variables considered as socio-economic confounders: ethnicity, SES, maternal education, single-parent household, housing and residency. Year of birth was entered as a continuous variable into the regression models in accordance with the linear relation of this variable to the outcome. Other socio-demographic variables were entered as dichotomized variables into the models, and when necessary with the use of dummy variables. The SPSS software package, version 14.0 SPSS, Inc., Chicago, Illinois, was used in all statistical analyses.

**Results**

A total of 4798 individuals were hospitalized due to self-inflicted injury at least once during the study period. The majority (81%) had been categorized as intentional and the remaining 19% as events of undetermined intent. The most frequent method of injury was poisoning—86% of the cases categorized as ‘intentional injury’ and 69% of the cases categorized as the ‘event of undetermined intent’ (Table 1).

The admission rates due to self-inflicted injury increased gradually with decreasing grade point average, 0.5% at the highest level and 2.4% at the lowest level. In all levels of grade point average, crude rates of hospital admission due to self-inflicted injury were two to three times higher for women as compared with men (Table 2).

Hospital admission because of self-inflicted injury was more common in youth of mixed ethnicity, who lived in households with low SES, short maternal education, a single parent and rented apartments. The same groups also had lower grade point averages. Men had lower grade point average than women (Table 3).

Table 4 presents Cox regression models of grade point average and hospital admission due to self-inflicted injury. In Model 1, adjusted for year of birth and sex only, hazard ratios (HRs) increased stepwise with a 6-fold elevated risk of self-inflicted injury for those with the lowest grade point average, compared with those with the highest level of grade point average. When socio-economic factors were adjusted for in Model 2, these associations were only marginally attenuated. The pattern of results was similar when analysed separately for men and women.

Table 5 presents Cox regressions of grades divided into five school subject categories and hospital admission due to self-inflicted injury. The HRs were highest

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**Table 1** Methods of self-inflicted injury in intentional and undetermined cases

<table>
<thead>
<tr>
<th></th>
<th>Intentional self-inflicted injury $n$ (%)</th>
<th>Event of undetermined intent $n$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poisoning</td>
<td>3329 (85.8)</td>
<td>631 (68.8)</td>
</tr>
<tr>
<td>Poisoning by and exposure to alcohol</td>
<td>64 (1.6)</td>
<td>16 (1.7)</td>
</tr>
<tr>
<td>Sharp object</td>
<td>221 (5.7)</td>
<td>36 (3.9)</td>
</tr>
<tr>
<td>Hanging, strangulation, suffocation</td>
<td>43 (1.1)</td>
<td></td>
</tr>
<tr>
<td>Jumping from high place</td>
<td>57 (1.5)</td>
<td></td>
</tr>
<tr>
<td>Smoke, fire, flames, steam, hot vapours</td>
<td>16 (0.4)</td>
<td>101 (11.1)</td>
</tr>
<tr>
<td>Other/unspecified means</td>
<td>151 (3.9)</td>
<td>133 (14.5)</td>
</tr>
<tr>
<td>All</td>
<td>3881</td>
<td>917</td>
</tr>
</tbody>
</table>
### Table 2
Number of cases and crude rates of hospital admission due to self-inflicted injury by grade point average (n = 4798)

<table>
<thead>
<tr>
<th>Grade point average</th>
<th>Total n</th>
<th>All n (%)</th>
<th>Women n (%)</th>
<th>Men n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High&lt;sup&gt;a&lt;/sup&gt;</td>
<td>63894</td>
<td>337 (0.5)</td>
<td>266 (0.7)</td>
<td>70 (0.3)</td>
</tr>
<tr>
<td>High average&lt;sup&gt;b&lt;/sup&gt;</td>
<td>161795</td>
<td>1148 (0.7)</td>
<td>868 (1.0)</td>
<td>277 (0.4)</td>
</tr>
<tr>
<td>Low average&lt;sup&gt;c&lt;/sup&gt;</td>
<td>159686</td>
<td>1793 (1.1)</td>
<td>1238 (1.8)</td>
<td>559 (0.6)</td>
</tr>
<tr>
<td>Low&lt;sup&gt;d&lt;/sup&gt;</td>
<td>62554</td>
<td>1520 (2.4)</td>
<td>777 (3.9)</td>
<td>743 (1.7)</td>
</tr>
<tr>
<td>All</td>
<td>447929</td>
<td>4798 (1.1)</td>
<td>3149 (1.4)</td>
<td>1649 (0.7)</td>
</tr>
</tbody>
</table>

<sup>a</sup>M +1 SD.
<sup>b</sup>from M to +1 SD.
<sup>c</sup>from −1 SD to M.
<sup>d</sup><M −1 SD.

### Table 3
Hospital admission due to self-inflicted injury from graduation 1989–93 to 2001 and school performance by sex and socio-economic indicators

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
<th>Grade point average mean (SD)</th>
<th>Hospital admission due to self-inflicted injury (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>230275 (51.4)</td>
<td>3.11 (0.68)</td>
<td>0.7</td>
</tr>
<tr>
<td>Women</td>
<td>217654 (48.6)</td>
<td>3.38 (0.65)</td>
<td>1.4</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swedish</td>
<td>391067 (87.3)</td>
<td>3.25 (0.67)</td>
<td>1.0</td>
</tr>
<tr>
<td>Immigrants</td>
<td>25641 (5.7)</td>
<td>3.18 (0.68)</td>
<td>1.4</td>
</tr>
<tr>
<td>Mixed</td>
<td>31221 (7.0)</td>
<td>3.19 (0.70)</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>SES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>65302 (14.6)</td>
<td>3.10 (0.67)</td>
<td>1.3</td>
</tr>
<tr>
<td>Manual labour</td>
<td>63808 (14.2)</td>
<td>2.93 (0.66)</td>
<td>1.5</td>
</tr>
<tr>
<td>Skilled labour</td>
<td>72217 (16.1)</td>
<td>3.04 (0.64)</td>
<td>1.2</td>
</tr>
<tr>
<td>White collar I</td>
<td>56814 (12.7)</td>
<td>3.20 (0.64)</td>
<td>1.0</td>
</tr>
<tr>
<td>White collar II</td>
<td>102967 (23.0)</td>
<td>3.37 (0.62)</td>
<td>0.9</td>
</tr>
<tr>
<td>White collar III</td>
<td>86821 (19.4)</td>
<td>3.58 (0.61)</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Maternal education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short</td>
<td>158570 (35.4)</td>
<td>3.04 (0.66)</td>
<td>1.2</td>
</tr>
<tr>
<td>Medium</td>
<td>139474 (31.1)</td>
<td>3.15 (0.64)</td>
<td>1.2</td>
</tr>
<tr>
<td>Long</td>
<td>95713 (21.4)</td>
<td>3.44 (0.62)</td>
<td>0.8</td>
</tr>
<tr>
<td>Very long</td>
<td>54172 (12.1)</td>
<td>3.70 (0.58)</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Single-parent household</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>73853 (16.6)</td>
<td>3.06 (0.70)</td>
<td>1.9</td>
</tr>
<tr>
<td>No</td>
<td>371175 (83.4)</td>
<td>3.28 (0.66)</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rents apartments</td>
<td>86727 (19.6)</td>
<td>3.03 (0.70)</td>
<td>1.8</td>
</tr>
<tr>
<td>Owns apartments</td>
<td>32078 (7.2)</td>
<td>3.20 (0.68)</td>
<td>1.3</td>
</tr>
<tr>
<td>Own house</td>
<td>324286 (73.2)</td>
<td>3.30 (0.66)</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Residency</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stockholm, Malmö, Gothenburg</td>
<td>114833 (25.6)</td>
<td>3.31 (0.68)</td>
<td>1.2</td>
</tr>
<tr>
<td>Other city</td>
<td>233697 (52.2)</td>
<td>3.23 (0.67)</td>
<td>1.1</td>
</tr>
<tr>
<td>Rural</td>
<td>99346 (22.2)</td>
<td>3.19 (0.67)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<sup>a</sup>For all pair-wise comparisons of means within each variable, P < 0.000, except for Ethnicity ‘Immigrants’ vs ‘Mixed’ (P < 0.03).
for low grades in natural science subjects, followed by
low grades in art-related subjects.

**Discussion**

In this register study in a cohort of half a million Swedish youth, the risk of hospitalization due to self-inflicted injury, up to 24–28 years of age, increased steeply with decreasing grade point average from the last year of compulsory school. This gradient was similar in all school subjects, in men and women, and only marginally attenuated when multiple socio-economic confounders were adjusted for.

Our results highlight that school grades are not only important measures of academic achievement but also the significant predictors of future mental ill-health as expressed by self-inflicted injury. There is a high probability that this relation between educational and mental health development depends on a variety of factors and may not be a causal one. It is plausible that the association observed is to a certain extent explained by shared risk factors that influence school performance as well as the risk of self-inflicted injury. For instance, psychiatric conditions, such as anxiety disorder\(^{12-14}\) and AD/HD (Attention-Deficit/ Hyperactivity Disorder) Combined Type,\(^{15}\) socially deviant behaviours\(^{16-18}\) and low cognitive competence\(^{19}\) are associated with both the phenomena.

The register design of this study did not allow for control of these conditions since these usually do not lead to inpatient care, which means that such symptoms cannot be identified in a valid way in available national registers. Thus, it cannot be ruled out that school performance is more of a marker for self-injury predisposing factors, than a cause itself.
It may also contribute to self-inflicted injuries by mediating—or aggravating—the effects of various risk factors. For example, school performance may affect vulnerability/resiliency in a child with depressive traits through its impact on self-esteem, thereby increasing or decreasing the risk of suicidal actions. Similarly, cognitive competence may be improved or impaired depending on how one performs in school and may hypothetically interact with the development of ill-health as a component of the ability to cope with stressors and/or as an important basis for the capacity to attain higher education levels.

Even in the absence of underlying factors, experiencing academic problems might be expected to cause psychological distress through the negative influence on self-esteem and sense of mastery, which in turn may contribute to mental health problems, including self-inflicted injury. Furthermore, school performance in the ninth grade in Sweden is the most important determinant for studies at upper secondary school level and for choice of educational programme, which in turn strongly influence the socio-economic context of the phases of life in the focus of this study. The homogenous pattern of associations observed in this study between school performance and self-inflicted injury for all combinations of grade levels and gender provides some support to the hypothesis of an influential role of poor school performance on the risk of self-inflicted injury.

Low grades not only in natural science but also in other subjects—most marked for art-related subjects—predicted self-inflicted injury equally in this study, suggesting that not only cognition but also adjustment problems contributed to school performance. This highlights that school performance not only reflects cognitive prerequisites but also contextual characteristics like—inter alia—social relations, and school environment, which are related to suicidal behaviours as well. For example, bullying and bully-victimization are associated with low academic performance and increased risk of suicidal behaviour. School performance may not only serve as a marker of a variety of such stressors and complicated social relations, but also as a trigger of these phenomena.

The results observed at the individual level may, at least partly, be influenced by the processes independent of students’ abilities. Studies suggest that school itself may add to the students’ academic and health outcomes, above and beyond student’s individual resources. Evaluating the independent effects of the school environment on self-inflicted injury would necessitate a different study design, e.g. a multilevel approach.

The study findings also point to the importance of socio-economic factors. Our data indicate, for example, a higher prevalence of self-inflicted injury in youth of mixed ethnicity and in immigrant youth. This is consistent with a recent Swedish study demonstrating an increased risk of self-inflicted injury among these groups compared with the majority population. Interestingly, the study also revealed that whereas socio-economic disadvantage seemed to be the main explanation for the increased risk of self-inflicted injury in youth with an immigrant background, the same conclusion could not be reached for the youth of mixed ethnicity. Future studies may consider that individuals of mixed ethnicity are not a homogeneous group. This approach would allow it to be addressed whether the association between mixed ethnicity and self-injury is universal, e.g. due to feelings of ambiguity over one’s own ethnic identity, or restricted only to certain mixed ethnicity populations.

Other socio-economic factors that emerged as being related to self-inflicted injury were low-SES households and single-parent families. Although beyond the scope of this study, if and how the influence of these factors on self-inflicted injury may be mediated or/and moderated by the school performance is worthy of further investigation.

Research based on register data on hospital discharge is restricted to the medical diagnoses made by the responsible physician at the time of discharge and does not include any psychological or subjective information. Studies based on other data sources, e.g. questionnaires, have shown that, for example, experiences of abuse, poor relationships with parents or friends and minority sexual orientation may put the young at risk of self-inflicted injury. Thus, the role of school performance in self-inflicted injury in the context of these circumstances would be of interest for future studies.

**Limitations**

We cannot rule out the possibility that low performers may seek help in other ways than high performers. Along the same line, criteria for hospital care may hypothetically be applied differently by professionals in these two groups. Hospital admissions because of self-inflicted injury, however, are often medical emergencies because of poisoning, which limits bias of these kinds. This also illustrates that our selection procedure most probably implies an overrepresentation of more severe cases. It could not be taken for granted that the associations with grades are similar in —probably—less severe cases of self-inflicted injury that do not lead to hospitalizations.

**Implications**

Poor school performance should be considered as a warning sign for increased risk of self-inflicted injury among young people. Ensuring that students are provided with appropriate academic support and assistance during their school years might have the potential to reduce self-injury behaviour. The large economic investment made in the educational system creates considerable opportunities for the primary prevention of self-inflicted injury through the
modification of educational methods and structures. Secondary prevention of self-inflicted injury should be considered in educational environments where adolescents with poor grades tend to cluster.

Conclusion
In summary, a strong association between school performance and self-inflicted injury has been demonstrated in this study. The study design does not allow us to draw conclusions about the mechanisms linking both the phenomena. Subsequent studies are needed to test the hypothesis of a causal link between poor school performance and self-inflicted injury.

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Conflict of interest: None declared.

KEY MESSAGES
- The risk of self-inflicted injury up to the age of 24–28 years increased steeply with decreasing grade point average from the last year of compulsory school.
- This gradient was similar in all school subjects, in men and women, and only marginally attenuated when multiple socio-economic confounders were adjusted for.
- Poor school performance should be considered as a warning sign for increased risk of self-inflicted injury among young people.

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SCHOOL PERFORMANCE AND SELF-INFLICTED INJURY

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