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Published in:
Scandinavian Journal of Public Health

DOI:
10.1177/1403494818799873

Publication date:
2019

Document version
Accepted manuscript

Citation for published version (APA):
School and class level variation in self-harm, suicide ideation and suicide attempts in Danish high schools

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Word count: 3,617

Keywords: clustering, school level variation, self-harm, suicide ideation, suicide attempt, youth,

Acknowledgement: KH is a National Institute for Health Research Senior Investigator and is also support by Oxford Health NHS Foundation Trust.

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Abstract

**Purpose:** Strong associations have been found between being exposed to self-harm in family and friends and own self-harm in adolescence. Therefore, self-harm and suicide behaviour might tend to cluster within school and school classes. The aim of this study was to describe the prevalence, frequency and type of self-harm, suicide ideation and suicide attempts within Danish high schools and to test whether self-harm and suicide behaviour cluster in schools and school classes.

**Methods:** Data came from the Danish National Youth Study 2014, a national survey. The respective study included 66,284 high school students nested in 117 schools and 3,146 school classes. The prevalence and clustering of self-harm behaviour, ever and within the last year, type of self-harm e.g. cutting, burning, scratching and hitting and suicide ideation and suicide attempts were investigated. Multi-level logistic regression was applied to quantify clustering among participants within the same class and school.

**Results:** In total, 12,960 (20%) reported self-harm ever and 5,706 (8.6%) within the last year. Prevalence was higher among girls than boys. Among girls, cutting (15%) and scratching (13%) was the most common type of self-harm, whereas among boys, hitting (6.7%) was most prevalent. The degree of clustering of self-harm and suicide behaviour was low, with school level intra-class correlation coefficients (ICC) ranging from 0.8-1.8 percent and school class level ICC’s from 4.3-6.8 percent.

**Conclusion:** This study shows that self-harm was common, especially in girls. The degree of clustering of self-harm and suicide behaviour in school and school classes was low.
Introduction

Self-harm and suicide are major public health problems in adolescence and young adulthood, with high rates of self-harm and suicide being the second most common cause of death in young people worldwide (1, 2). International community-based studies show that around 5-20% of adolescents, with considerable more girls than boys, report having self-harmed and attempted suicide (3-8), and hospital records show that the prevalence is rising (9, 10). Young people who self-harm have also been found to have higher rates of suicide attempts and are more likely to die from suicide (8, 11-14). Knowledge about risk factors and mechanisms in self-harm and suicide behaviour is important to be able to identify possible preventive interventions that can reduce the rates of self-harm and suicide behaviour among adolescents. Several individual risk factors for self-harm, suicide ideation and suicide attempt in the transitional life-stage of adolescence have already been identified, including sociodemographic factors, such as low socioeconomic status, mental health problems, substance abuse, impulsivity and risk taking (15-17), homo- and bisexuality (18), but also negative life events such as bullying, parental divorce, parental death (by suicide) (15, 17), physical or sexual abuse (17), are all important predictors (2, 16). However, a more in-depth knowledge of the social mechanisms for the development and dissemination of the phenomena is still lacking.

Suicide tends to cluster (19-22) and anecdotal studies have reported ‘epidemics’ of self-harm in residential treatment settings (23). Strong associations have been found between being exposed to self-harm in family and friends and self-harm in adolescence (2, 7, 24, 25). The school constitutes one of the most important settings influencing the development of health behaviors and wellbeing among adolescents (26). This is where adolescents spend most of their time, establish friendships and meet social norms and academic expectations. The school and school class may constitute important environmental and contextual influences on the risk of self-harm and suicide behaviour. Therefore self-harm and suicide behaviour might cluster within schools and school
classes and even small effects at the contextual level may be of public health importance, given the high prevalence of self-harm. Different theories of why self-harm and suicide might cluster has been suggested. One theory is that of clustering of risk factors where risk factors for self-harm and suicidal behaviour might cluster and thereby also the risk of self-harm and suicidal behaviour (2, 19). Another theory is that of social contagion based on the theory of social learning (27), where self-harm and suicide behaviour of others provides a behavioural model for vulnerable individuals and thereby increases their likelihood of imitating the behaviour (19). However, few studies have investigated the clustering of self-harm, suicide ideation and suicide attempts in high schools, and these studies have found the clustering effect to be minimal (4, 7, 28). To our knowledge, no previous studies have assessed the impact of the school class in self-harm, suicide ideation and suicide attempts. The theories are not mutually exclusive but represent different explanation of the phenomenon of clustering. While school level clustering may reflect clustering of local conditions, such as neighbourhood socio-economy in line with the theory of clustering of risk factors, variation in school classes may represent factors associated with social dynamics and norms between students at the micro-level, more in line with the theory of social contagion. Clustering on different levels could therefore be a result of different mechanisms and it is important to investigate if clustering at the school class level exists.

The aim of this study was to describe the prevalence, frequency and type of self-harm, suicide ideation and suicide attempts within Danish high schools and to test the hypothesis that self-harm and suicide behaviour cluster in schools and school classes.
Method

The Danish National Youth Study 2014

The data for this study came from the Danish National Youth Study 2014, a national survey of 75,853 high school and vocational school students. The Danish National Youth Study was conducted with the aim of investigating health, health behaviour and mental health among young people in secondary education in Denmark. A thorough description of the study design and population characteristics of the Danish National Youth Study 2014 have been provided elsewhere (29). The respective study includes high school students. All general high schools in Denmark were invited to participate. Eighty-seven percent of all high schools in Denmark participated in the survey and 85% of high school students in participating schools participated (supplementary material, figure 1). After excluding two pilot schools (n=1,661) without the question on frequency of self-harm and those with missing information on self-harm (n=2,729), the study included 66,284 participants nested in 117 schools and 3,146 school classes.

Measures

Self-harm and suicidal behaviours

Self-harm

Participants were asked if they “had ever deliberately hurt themselves e.g. cutting, scratching, burning, or hitting?” The possible answers were “Yes” and “No”. Participants who answered “yes” were also asked what they did e.g. cutting, scratching, burning, or hitting, with the option of more than one answer, and how frequently they had self-harmed, with the possible answers “Not within the last year”, “monthly or rarer”, “weekly” or “daily or almost daily”. Based on the frequency and type of self-harm questions, variables were coded for self-harm (all types) within the last year,
cutting within the last year, burning within the last year, scratching within the last year, and hitting within the last year.

Suicidal ideation
Participants were asked if they “ever have considered suicide”. The possible answers were “Yes”, “No”, and “Do not want to answer”. Those who answered they did not want to answer (N= 4,564) were coded as missing.

Suicide attempts
Participants, who had considered suicide, were also asked if they “ever have attempted suicide”. The possible answers were “Yes”, “No”, and “Do not want to answer”. Those who had previously answered that they had not considered suicide were added to those answering “No” to this question and those who said that they did not want to answer (N=1,393) were coded as missing.

Other covariates
Participants were also asked to report their sex (boy/girl), birthday and birth year (from which age in years was calculated), study program (Upper secondary leaving examination/Higher preparatory examination), school year (1st/2nd/3rd), ethnicity: “what do you feel like?” Danish/ Danish and other/ other ethnicity than Danish), living situation: “who do you live with?” (living alone/ living with both parents/ living with one parent: mother or father), parental separation within the last year: “within the last year have your parents moved apart?” (yes/no), and financial strains in the family within the last year: “within the last year have your parents had difficulties paying the bills?” (yes/no), quality of life measured by Cantril’s ladder (range from ‘worst’ (=0) to ‘best’ (=10) life, scores ≥7 indicating high quality of life) (30), and homo- and bisexuality: “Are you mostly attracted
Almost all participants in the Danish National Youth Study 2014 have been linked to their unique Personal Identification Number (CPR) (95% of high school students). Participants were linked to the Danish Civil Registration System and the educational register (31) to identify parents and parents’ highest achieved educational level. Parents’ highest achieved educational level was coded into basic schooling, high school or vocational school and higher education.

**Statistical analysis**

Statistical analyses and data processing were performed using STATA 14. Multi-level logistic regression analyses nesting participants within schools (n=117) and school classes (n=3,146) were applied to test for dependency among participants within the same class and within the same school. Initially the log-likelihood ratio test was used to test if multi-level models were better at describing data than logistic regression assuming no grouping. Interclass correlation coefficients (ICC) were estimated as:

\[
\text{School level: } \frac{\sigma_1^2}{\sigma_1^2 + \sigma_2^2 + \sigma_3^2} \quad \text{& School and class level: } \frac{\sigma_1^2 + \sigma_2^2}{\sigma_1^2 + \sigma_2^2 + \sigma_3^2}
\]

where \(\sigma_1^2\) is the variance at the school level, \(\sigma_2^2\) is the variance at the class level and \(\sigma_3^2\) is the variance at the student level which is approximated to 3.29 (32). To investigate age patterns of self-harm, suicide ideation, and suicide attempts between boys and girls, the log-likelihood ratio test was used to test a model including the interaction between sex and age categories (≤16, 17, 18, ≥19 years) against a model without the interaction. To test the hypotheses of contagion or that of vulnerable people clustering together, multilevel models controlling for individual and social risk factors for self-harm and suicide behaviour were performed. Individual and social risk factors included were sex, age, parental education, parental divorce, financial strains in the family, and homo- and bisexuality, all of which have been found to be associated with self-harm and suicide.
behaviour (2, 15, 16). Multilevel logistic regression was also estimated as odds ratios (OR) with 95% confidence intervals (CI) between individual and social risk factors and self-harm, cutting, burning, scratching, and hitting within the last year, and suicide ideation, and suicide attempt.
Results

Characteristics of study participants

Table 1 shows the overall characteristics of the participants of the National Danish Youth Study and among boys and girls. The study included 66,284 individuals, with more girls (62%) than boys and a mean age of 17.9 years. The vast majority of students attended Upper secondary school leaving examination (92%), perceived themselves as Danish (91%), had parents with higher education (61%), and lived with both parents (65%). A smaller proportion had experienced financial strains in the family (16%) or parental separation (5.3%) within the last year. Participants generally had high quality of life, with a mean score of 7.1 measured by Cantril’s ladder that ranges from ‘worst’ (=0) to ‘best’ (=10) life. A relatively small proportion identified themselves as homo- or bisexual (4.2%). Those with missing answers on self-harm were more likely to be boys, attend Higher preparatory examination, be of other ethnicity, live alone and to have experienced parental separation and financial strains in the family as compared to those included in the study (data not shown).

Self-harm – type and frequency, and suicide ideation and suicide attempts

A total of 12,690 individuals (20%) reported self-harm, with twice as many girls (24%) as boys (12%) reporting self-harm ever (table 2). Approximately half of those reporting that they had ever self-harmed said that they had done this within the last year (8.6%). Among girls, cutting (15%) and scratching (13%) were the most common types of self-harm, whereas among boys, hitting (6.7%) was the most widely used method of self-harm. Twenty percent of girls and 13% of boys said they had ever considered suicide and 3.4% of girls and 1.8% of boys that they had ever attempted suicide.

Individual and social risk factors for self-harm, suicide ideation and suicide attempt
Increasing age was associated with higher odds of self-harm ever, suicide ideation and suicide attempts, but with lower odds of self-harm within the last year (table 3). Girls had higher odds of self-harm, suicide ideation and suicide attempts compared to boys. This applied particularly to cutting and scratching within the last year; girls had an OR of 4.84 (95% CI 4.33-5.40) and 3.50 (95% CI 3.18-4.84) respectively. Having parents with lower education was also associated with higher odds of self-harm, suicide ideation and suicide attempt. For example, young people with parents with basic schooling as the highest achieved educational level had 2.04 (95% CI 1.69-2.40) times higher odds of suicide attempt compared to young people with parents with higher education. Parental separation and financial strains in the family within the last year were also associated with higher odds of self-harm. Young people who identified themselves as homo- or bisexual had higher odds for suicide ideation and suicide attempt. For example, homo- and bisexuality were associated with 5.71 (95% CI 4.80-6.79) higher odds of burning within the last year.

**Age and sex patterns**

Figure 2 shows age patterns of self-harm ever, self-harm within the last year, type of self-harm within the last year, and suicide ideation and suicide attempts ever, by sex. The odds of self-harm ever rose with increasing age among both boys and girls, with the odds being significantly higher among girls. Girls also had significantly higher odds of self-harm within the last year compared to boys in all age groups. Among boys there was no significant difference across age groups in the odds of cutting, burning, scratching or hitting within the last year, while among girls there was a tendency to decreasing odds with increasing age. For example, for cutting within the last year, girls aged ≤16 years had an OR=6.77 (95% CI 5.46-8.73) and girls aged ≥19 years had an OR=3.42 (95% CI 2.60-4.50) compared to the reference group of boys aged ≤16 years. Both among boys and girls the odds of suicide ideation and suicide attempts increased with increasing age. For example,
boys aged ≥19 years had 2.35 (95% CI 1.70-3.36) times higher odds of suicide attempts compared to boys aged ≤16 years.

**Clustering of self-harm, suicide ideation and suicide attempts in schools and school classes**

In total, 5,706 (8.6%) individuals reported having self-harmed within the last year, which was approximately half of those reporting self-harm ever (table 4). All log likelihood ratio tests showed multilevel models were better at describing the data than logistic regression model assuming no grouping effects. The interclass correlation coefficients (ICCs) at school level were generally low, ranging from 0.8 to 1.8 percent for all self-harm and suicide behaviour outcomes. For example, at school level the ICC for self-harm within the last year was 1.1 95% CI [0.7-1.7] and for attempted suicide it was 1.8 95% CI [1.0-3.4]. The ICC scores at school and class level ranged from 4.3 percent 95% CI [3.3-5.5] for self-harm within the last year to 6.8 percent 95% CI [5.1-8.7] for cutting within the last year. Sex stratified analysis showed no large differences in ICC-scores between boys and girls. For girls, the highest school and class level variations were found in burning (8.5 percent 95% CI [4.1-17]) and cutting (6.6 percent 95% CI [4.9-8.8]) within the last year; and for boys in ever attempted suicide (13 percent 95% CI [6.6-23]) and scratching (11 percent 95% CI [5.2-21]) within the last year.

To test the hypothesis of contagion or vulnerable people clustering together, multilevel analyses controlling for individual and social risk factors were performed. It was assumed that the clustering of self-harm and suicide behaviour would be reduced if individual and social risk factors could explain most of the clustering. After adjustment all school level and class level ICC scores were reduced (supplementary material, table 5: model 2). The highest school and class level ICC was found for cutting within the last year (ICC 5.6 95% CI [3.9-7.7]).
Discussion

The study showed a high prevalence of self-harm (20% ever and 10% within the last year), suicide ideation (16%) and suicide attempts (2.8%) among Danish high school students. However, no strong evidence of clustering of self-harm, suicide ideation or suicide attempts in schools and school classes was found.

In consistency with previous findings individual and social factors associated with higher odds of self-harm, suicide ideation and suicide attempts was being a girl, having parents with lower education, having experienced parental separation or financial strains in the family within the last year, and identifying as homo- or bisexual (2, 15, 16). Especially young people that identified themselves as homo- or bisexual had high odds of self-harm and suicide behaviour. The odds of both self-harm ever and suicide attempts in our study were considerably higher than the risk estimates reported in the meta-analysis of King et al. 2008. They found the risk ratio to be 2.29 (0.71-7.35) for deliberate self-harm ever and 2.47 (1.87-3.28) for suicide attempts (lifetime). The very high odds of self-harm and suicide behaviour among homo- and bisexual young people in our study could potentially be due to their young age and a particular vulnerability in the years around coming out and developing a sexual identity.

The increasing odds of self-harm ever, suicide ideation and suicide attempts among both boys and girls in older age groups, is most likely a cumulative effect, rather than a result of increasing incidence with increasing age, as girls showed lower odds of all types of self-harm in the last year with increasing age. The results suggest that self-harm, at least, is not an increasingly common phenomenon as young people grow older in high school. This result is important for intervention on self-harm as it might suggest that prevention activities need to be introduced early in high school or before high school to target young people when they are most vulnerable.

The relatively low school level ICC’s for self-harm, suicide ideation and suicide
attempt are in line with previous findings, which also have suggested school level variation in these phenomena of between one and two percent (28). To our knowledge we are the first to report school class level variation in self-harm, suicide ideation and suicide attempts. We consistently found school class level variation to be higher than school level variation, although also rather low this was between four and seven percent in sex, age and school program-adjusted analyses. The higher school class level variation could indicate that factors associated with social dynamics and norms between students may be more important for self-harm, suicide ideation and suicide attempts, than local conditions such as geography and neighbourhood socio-economic characteristics as represented by school location. After further adjustment for individual and social risk factors, school and class level, variations in self-harm, suicide ideation and suicide attempts decreased, suggesting that individual level factors may be more important than contagion through shared school or school class environment. The school and class variation for self-harm and suicide behaviour was not remarkably higher from the school and class level variation found for other phenomenon such as substance use and wellbeing (33, 34), suggesting that the contagious effect of self-harm and suicide behaviour might not be exceptional as compared to other factors in youth. The contagious effect of self-harm and suicide behaviour could also go through other mechanisms than social relations and norms at the school. It has been suggested that new social media as well as traditional media reporting of suicide may inspire to self-harm and suicide behaviour (35). The ICC at class level for cutting was relatively robust after adjustment for individual and social risk factors (5.6 95% CI [3.9-7.7]), wish might suggest that cutting is a particular contagious form of self-harm.

Strengths and limitations

The large survey sample is one of the main strengths of our study. The study included an almost complete sample of Danish high school students. Since all general high schools were invited and
participation rates at all levels were high (school level: 87%, class level: 96% and individual level: 85%), the study population is assumed to be largely representative of students in Danish high schools and the risk of selection bias is considered to be low. Participation was however slightly socially screwed as those with missing information on self-harm were more likely to attend Higher preparatory examination, be of other ethnicity, live alone and to have experienced parental separation and financial strains and as the study did not include young people in vocational schools or outside the education systems. Non-response analysis of participants in the Danish Youth Study 2014, showed that participants were slightly more likely to be of Danish origin, have parents with a higher educational level and higher income (29). It is therefore most worrisome that the prevalence of self-harm and suicide behavior was so high in a group of relatively resourceful young people. The low non-response rate led to almost intact units (schools and classes), which is particularly advantageous for investigating clustering effects in schools and school classes.

The study also included a wide range of measures of self-harm and suicide behaviour, which made it possible to give a detailed description of self-harm and suicidal behaviour in Danish high-school students. The Danish National Youth Study also included several known individual and social risk factors for self-harm, suicide ideation and suicide attempts, which made it possible to show how well-known risk factors at the individual level were associated with self-harm and suicidal behaviour. However, our list of risk factors was not comprehensive and many more factors are known to exist, such as mental illnesses and substance abuse disorders and adverse childhood environment and experiences (14-16). Adjusting for further individual and social risk factors may have decreased the ICC’s at both school and school class level.

All self-harm and suicide behaviour outcomes were self-reported and students were asked if they had ever self-harmed, thought of suicide or attempted suicide. We had no means of verifying these reports because we were only able to distinguish type of self-harm for the self-harm
outcomes and if the behaviour was current (within the last year) or referred to past behaviour, potentially before enrolling into high school. Furthermore, self-poisoning, drug or alcohol abuse, starvation or stopping medication as means of harming oneself were not included in the self-harm questions. Those who did not want to answer whether they ever considered suicide or if they had ever attempted suicide was coded conservatively as no. This may have led to underestimation of the prevalence of suicide ideation and suicide attempts, as suicide behaviour is a sensitive topic that young people may wish to keep private.

**Conclusion**

This study showed that the school and the class accounted for a relatively small part of the variation in self-harm and suicide behaviour. Our results indicate that individual factors are more important than school and class factors in contributing to these phenomena and hence to prevention of self-harm and suicide behaviour. Prevention activities need to be introduced early in high school or before high school to target young people when they are most vulnerable and were the prevalence of self-harm are highest.

**Contribution:** VP and JST had the idea for the study and designed the paper. VP performed the analyses and drafted the manuscript. All authors contributed to discussing and commenting on the paper. JST is the study guarantor.

**Funding:** nothing to report
**Conflict of interest Declaration:** Nothing to report

**Ethic approval:** Ethics approval was not necessary under Danish law as this study did not include human biological material.
Key points:

- This study shows that self-harm was common
- In total, 12,960 (20%) reported self-harm ever and 5,706 (8.6%) within the last year.
- Prevalence of self-harm and suicide behavior was higher among girls than boys.
- Among girls, cutting (15%) and scratching (13%) was the most common type of self-harm.
- Among boys, hitting (6.7%) was most prevalent.
- The school and the class accounted for a relatively small part of the variation in self-harm and suicide behaviour.
- School and class level variation was consistently higher than school level variation, although also rather low.
References:
