RESEARCH REPORT

Is perceived failure in school performance a trigger of physical injury? A case-crossover study of children in Stockholm County

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Objectives: To investigate whether perceived failure in school performance increases the potential for children to be physically injured.
Subjects: Children aged 10–15 years residing in the Stockholm County and hospitalised or called back for a medical check up because of a physical injury during the school years 2000–2001 and 2001–2002 (n = 592).
Methods: A case-crossover design was used and information on potential injury triggers was gathered by interview. Information about family socioeconomic circumstances was gathered by a questionnaire filled in by parents during the child interview (response rate 87%).
Results: Perceived failure in school performance has the potential to trigger injury within up to 10 hours subsequent to exposure (relative risk = 2.70; 95% confidence intervals = 1.2 to 5.8). The risk is significantly higher among pre-adolescents and among children from families at a higher education level.
Conclusions: Experiencing feelings of failure may affect children's physical safety, in particular among pre-adolescents. Possible mechanisms are perceptual deficits and response changes occasioned by the stress experienced after exposure.

Some studies suggest that comparatively poor performance at school may be associated with increased risk of school injuries of all kinds.[1] Furthermore, comparisons between drop outs, students with academic problems, and students with good academic standing have showed an orderly association between school achievement and problem prone behaviour.[2] Perpetrators or victims of acts of violence, for example, were most likely to be found among drop outs, followed by students with academic problems. Moreover, most studies of young (9–18 years) suicide attempters have shown that they have significantly low school achievement, or at least lower achievement than non-attempters.[3–5] The relation between attempted suicide and low school achievement is probably explained by the effects of depression.[4]

The effect of school failure on individual wellbeing and injury experience has both a school and social group component. For example, consideration of position occupied by pupils in the school hierarchy suggests a mechanism by which mental health might be affected independently of social class.[6] This arises because success or failure, and its consequences for self esteem and psychological wellbeing (see also Sibereisen and Todt[7]), is always at least partly relative. The impact of being ''top'' or ''bottom'' in any school, however, will also depend on parental expectations and school pressures for pupils to achieve certain absolute standards. Each of these sets of factors might be expected to have a greater impact on upper class than lower class youth, with the attendant possibility of relative health disadvantage.

Inspired by a comparatively recent epidemiological study showing that intellectual exertion at school is a triggering factor of physical injuries among children,[8] this study investigates the extent to which perceived failure in school performance increases the potential for children to be physically injured.

Focus is placed on early teenagers (10–15 years), an age period where injury risks increase among Swedish children.[9] Attention is paid to children's own feelings about their performance, regardless of how good (or bad) they actually perform. Possible effect modification of some individual and family related characteristics is also considered.

METHODS

Study design

A case-crossover design was used because of its appropriateness for the study of the triggering effects of various exposures on acute health events in general[10–12] and on injury risks in particular.[8 13–16] In a case-crossover design, each case is used as its own control, based on the fact that a person crosses over between short periods of exposure to triggers and longer periods of non-exposure. Trigger exposure during a specific time period prior to the outcome is compared with how often the person (case) is usually exposed to the trigger in question. In this study, experience of failure in one's school performance constitutes the exposure, and physical injury the outcome.

Recruitment criteria and principles

Our research team interviewed 592 injured children, aged 10–15 years, living in the Greater Stockholm area during most of the school years 2000–2001 and 2001–2002. The first six weeks of data collection served as a pilot phase, and therefore data from the interviews conducted at that time are not included in the results reported here.

Children injured at any time during the week (excluding Christmas and summer holidays) and who attended Stockholm County's Children Hospital, whose catchment area covers all of Greater Stockholm (for children up to 15 years), were regarded as eligible cases (also described in Engström *et al*[17] and Laflamme *et al*[18]). Further inclusion criteria were that the injured child received treatment at the hospital, and was either kept in for at least one night or called back for a check up. Children who, because of their health

condition or for practical reasons beyond our control, could not be interviewed within 10 days of injury were excluded.

Cases were identified at the hospital by emergency staff. They informed the parents about the project and asked for their permission to let an interviewer approach them to further explain the project and possibly interview their child. Two interviewers were involved (one for each school year), both of whom had experience of working with traumatised children. Table 1 shows some characteristics of the interviewed children.

Interview losses were frequent during the early days of data collection but reduced in number as the project went on and routines stabilised. Furthermore, as might be expected,[19] most parents agreed to their child being interviewed, and most children approved of the interview (in total 86%). A brief questionnaire about family socioeconomic circumstances was also filled in by parents while their children were being interviewed (response rate 87%).

The interview consisted largely of fixed response questions (extensively described in Laflamme *et al*[18]), and lasted about 30 minutes. It generally took place at the hospital in a peaceful and undisturbed environment.

For perceived school failure, the interviewer explained to the child the kind of situation and feeling encompassed by the question, pointing out that it was more a matter of what the child thought of and felt about his or her own performance rather than a matter of what it actually turned out to be. The various circumstances when it could occur were also clarified (see below).

The project and data collection instrument were approved by the research ethics committee at Karolinska Hospital.

Definitions

The injuries considered, in accordance with the International Classification of Diseases, Version 9,[20 21] were those occurring by ''accident'' (E807-E928) and those attributable to ''interpersonal violence'' (E960-E969). Injuries resulting from deliberate self harm or intoxication (E950-E959) were excluded because of difficulties faced by the interviewers in conducting an interview shortly after hospital registration.

Table 1 Some characteristics of the interviewed children (n = 592)*

Characteristics	% Of all injured
Sex	
Girls	36.8
Boys	63.2
Age	
10	12.8
11	17.1
12	19.4
13	21.0
14	21.0
15	8.8
Household educational level	
High	41.0
Low	41.9
No information	17.1
Child own academic expectations	
University studies	14.5
Less than university studies	33.4
Do not know	51.7
No answer	0.3
Perceived parental academic expectations	
University studies	8.8
Less than university studies	29.9
Do not know	61.0
No answer	0.3

*Each injury corresponds to one case in this study as we do not have any child who suffered more than one injury during the study period.

A child's perceived failure included situations where the child expressed the perception of failing an examination, not succeeding in the performance of assignments/exercises, or being the recipient of unfavourable comments from a teacher (or expressing a sense of being unfairly assessed by one).

Whether the child was an exposed case or not was determined by questions identifying episodes of experienced failure the same day and the day before the injury. Children who reported having experienced any of the required items during a certain time period before the injury (hazard period) were defined as exposed cases. All others were regarded as unexposed. Children's usual frequency of exposure was established by asking how often on a daily, weekly, or monthly basis, or during the school term, they regarded themselves as having experienced disappointment.

Children's social position was measured considering both their household socioeconomic status based on parental occupation[22 23] and their household educational level, based on the educational level of the person with the highest education in the household (as reported in the parental questionnaire). In this study, focus was placed on household highest education level and two categories were used: a professional high school degree or less, more than a professional high school degree.

Statistical analyses

Exposed time was calculated as the length of the hazard period multiplied by the usual frequency of experience of failure during the school term in question. In one case experiences of this kind occurred frequently enough for hazard periods to overlap, and adjustment was made for this. The number of unexposed hours was calculated by subtracting the exposed hours per school term from the total number of hours per school term.

Standard Mantel-Haenszel methods for follow up studies with sparse data in each stratum were used for the statistical analyses.[24–26] Effect was measured in terms of relative risk, estimated by the ratio of the observed exposure odds at time of injury onset to expected exposure odds. Calculations were made using SAS software, version 8.01.

Hazard periods of varying length were examined. We tested whether the triggering effect remained as long as 10 hours after exposure to perceived school failure. Analyses of effect modification were also conducted with different induction periods. The factors considered were sex and age (10–12 or 13–15 years) of the child, education level in the household (university degree or not), and perceived parental expectancy regarding future academic level. Differences between groups were tested by χ^2 analysis.[27] Because of missing data in 13% of cases, one exposed case was lost regarding educational level.

RESULTS

Of the 592 children, 12.5% reported experience of perceived failure at least once during the past school term and 2.0% at least once a week. Also, 1.0% experienced failure on day of injury, of which two within two hours before injury and six within 6 to 10 hours.

Table 2 shows that the relative risk of being injured is 2.7 times higher (95% CI 1.2 to 5.8) among children exposed to an episode of experience of failure 10 hours before the injury than during periods of no such experience. The risk is about as high when exposed six hours before the injury (relative risk = 2.8; 95% confidence intervals 1.1 to 7.5) and much higher when exposed within an hour before the injury (relative risk = 7.6; 95% confidence intervals 1.9 to 29.9).

The longlasting effect of experienced failure is significantly more important among pre-adolescents than among early teenagers (10.8 compared with 1.6; χ^2 test $p<0.05$) and

Key points

- Being disappointed with your own performance at school can trigger the occurrence of physical injuries.
- The trigger effect may last up to 10 hours after exposure, with a relative risk of physical injury more than two and a half times higher (RR = 2.5) after exposure than during unexposed periods.
- The trigger risk is larger among pre-adolescents and among children from highly educated households.
- It is suggested that a potential mechanism of influence in the case of unintentional injuries is that of disrupted concentration and attention processes of the victim, a phenomenon much related to stress responsiveness that may, in turn, influence injury risk through changes in perception and attention.

among children from highly educated households than poorly educated ones (7.2 compared with 1.2; χ^2 test $p<0.05$).

DISCUSSION

Main findings

The study provides evidence that being disappointed with your own performance at school, albeit rather uncommon, has the potential to trigger the occurrence of physical injury. It also suggests that the trigger effect may last up to 10 hours after exposure, with a relative risk of physical injury more than two and a half times higher (relative risk = 2.5) after exposure than during unexposed periods. Furthermore, this increase in risk is substantially larger among pre-adolescents and among children from highly educated households.

Turning to the interview material, several types of triggering circumstances and a number of potential injury mechanisms can be identified. Of the six injured children, two were disappointed with their actual results after an examination, two others with the manner in which they managed an examination or an assignment/exercise. The other two specified that their disappointment had to do with difficulties in grasping/understanding the whole of a lesson (language or mathematics).

Five of six injuries were unintentional and resulted in bone fractures (legs, hands, wrists). They were incurred either while playing, during school gymnastics, or while walking. Two children lost balance and three lost control over their action while playing. This, in turn, suggests that one possible mechanism between exposure of the kind studied herein and physical injury is that of perceptual deficit (that is, in peripheral vision) and response changes occasioned by stressful situations. Examples of such relations have been found in studies conducted among intercollegiate and recreational athletes[28–31] where it has been observed that people with high negative life events scores (one year previously) experienced greater peripheral narrowing and slower central vision reaction time during stress than those with life events scores that were low. Similar observations have also been made for children for whom executive functioning is not fully developed.[32]

The sixth injury case, a girl, was severely brutalised and injured by a group of schoolmates after school hours. She had been quarrelling with them earlier during the school day. As this injury was incurred through inter-personal violence, it is difficult to attribute its occurrence to phenomena like temporary perceptual deficits. Rather, the case may reflect the ''multi-problem children'' described in previous studies, who accumulate stressful events, encounter academic difficulties and have inter-relational problems with their peers.[1 2] The episode of bullying that the girl was exposed to earlier during the day cannot be regarded as a confounding factor, as we observed in an earlier study that the trigger effect of bullying has a shorter induction period.[17] Should the case be eliminated from the analysis, because of a more restrictive case event definition that would increase similarity between mechanisms, the relative risk would remain at a similar level—that is, 2.2 (95%CI 0.9 to 5.2).

While the data at hand are incapable of revealing why younger pupils are more at risk than older ones, the effect modification of higher education of the household (with one missing value) goes in the expected direction. One possible mechanism lying behind the effect of parental education could be perceived high parental expectations concerning the child's academic achievement.[4] This aspect was covered during the interview by asking the children what academic level they thought their parents were expecting them to reach as well as the level they actually wished to reach. The response alternatives in both instances were: compulsory school, college (technical or preparatory to university), university, do not know—see table 1). In this study, focus was placed on the perception of the child about parental expectation. While many children answered that they did not know (including three of our six exposed cases), we can see that of the three exposed children who came from highly educated households, two thought their parents were expecting them to complete a university degree.

It is possible that the question of discrepancy between perceived parental expectation and children's own is easier to address with more precision when the questions refers to more concrete phases in the child's life, for instance when

Table 2 Relative risk of injury (with 95% confidence intervals) after perceived school failure with three different hazard periods, for all injured children and according to child characteristics

	0–60 minutes		0–360 minutes		0–600 minutes	
Characteristics	Number of cases (exposed)	RR (95% CI)	Number of cases (exposed)	RR (95% CI)	Number of cases (exposed)	RR (95% CI)
All children	592 (2)	7.6 (1.9 to 29.9)	592 (4)	2.8 (1.1 to 7.5)	592 (6)	2.7 (1.2 to 5.8)
Sex						
Girls	218 (1)	8.0 (1.2 to 54.7)	218 (1)	1.5 (0.3 to 8.8)	218 (2)	1.9 (0.6 to 6.3)
Boys	374 (1)	7.3 (1.0 to 50.6)	374 (3)	4.2 (1.3 to 13.9)	374 (4)	3.4 (1.2 to 9.7)
Age						
10–12 years	292 (1)	18.3 (2.6 to 127.8)	292 (2)	10.0 (1.6 to 62.3)	292 (3)	10.8 (2.1 to 55.4)
13–15 years	300 (1)	4.8 (0.7 to 33.1)	300 (2)	1.7 (0.5 to 6.1)	300 (3)	1.6 (0.6 to 4.3)
Household education level						
High	248 (1)	21.3 (3.0 to 150.2)	248 (1)	3.6 (0.5 to 24.3)	248 (3)	7.2 (2.2 to 23.7)
Low	243 (1)	5.4 (0.8 to 37.0)	243 (2)	1.9 (0.6 to 6.8)	243 (2)	1.2 (0.4 to 3.9)

they are about to end compulsory school or when they have started high school.

Furthermore, it is important to note that in Sweden children are not evaluated ''relatively''—that is, in comparison with each other—but rather in relation to the achievement of predefined goals. Also, they do not receive grades—and thereby are not ranked—until towards the end of compulsory school.

Limitations

The case-crossover design eliminates problems of confounding from stable risk factors and most control selection bias by using cases as their own controls. However, case selection bias may occur. One possibility is that some children who experience school failure during the hazard period before the injury might decline to be interviewed. We expected such case selection to be very uncommon but, if it did happen, it would have led to an underestimation of the relative risk.

A further possible source of bias is misclassification, regarding both case and control information. A comparatively low rate of experienced failure among the injured children was expected as the Swedish school system is not very much based on performance when children are aged 10 to 15 years (corresponding to school grades 4 to 8). However, we do not know whether the prevalence of exposure reflected by our data is representative, as there is no information available concerning the expected value of perceived failure in the age group considered. A true low exposure frequency only reflects exposure opportunity and does not lead to bias in itself.

Exposure to failure during the case period before the injury was expected to be well captured by the data collection instrument used. The interviewers established a time schedule for each child, helping them to link exposures to the points in time of their daily school activities. All interviews were conducted as soon as possible after the injury occasion, and a time limit for the interview was set at 10 days so as to minimise the risk for recall bias. Furthermore, the interviewers were not informed about the lengths of the hypothesised hazard periods. However, during the data collection we noted that it was hard for younger children to remember exactly when during the previous week they had experienced failure, but not difficult for them to recall whether they had experienced it or how many times. We therefore used usual frequency of disappointment during the school term in question rather than a specific time window as control information.

Stockholm County's Children's Hospital (for children aged 0–15), where the cases were defined, has a catchment area covering entire Greater Stockholm, and as many as 75% of all children aged 10–15 admitted to hospital within the county were treated there during the study period. Interview losses were frequent during the early days of data collection but reduced in number as the project went on and routines stabilised. Missing cases due to hospital staff not requesting attendance (33%) or because the parent or the child, or both, did not want to attend (13%) are not expected to introduce any systematic bias into the data because they are mostly related to the pace of work at the hospital rather than to patient characteristics.

In conclusion, it seems that perceived failure in school performance may have an impact on children's physical safety. Unintentional injuries may be triggered through disrupted concentration and attention processes of the victim—a phenomenon much related to stress responsiveness that may influence injury risk through changes in perception and attention. The fact that the trigger effect was especially strong among children from highly educated households was partly expected.

Policy implications

From a more general point of view, this study represents an effort better to understand the individual mechanisms underlying childhood injury occurrence, a research area not much explored. In Sweden, for instance, we have come a long way in building safety into the child environment (so called passive prevention). But we need to learn more about how children perceive their existence, what affects their activities and might disturb their attention, and in what ways this might have an impact on their safety.

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Conflicts of interest: none declared.

REFERENCES

1 **Petridou E**, Kouri N, Tricopoulos D, *et al*. School injuries in Athens: socioeconomic and family risk factors. *J Epidemiol Community Health* 1994;**48**:490–1.
2 **Beauvais F**, Chavez EL, Oetting ER, *et al*. Drug use, violence, and victimization among white American, Mexican American, and American Indian dropouts, students with academic problems, and students in good academic standing. *J Counseling Psychology* 1996;**43**:292–9.
3 **Gasquet I**, Choquet M. Gender role in adolescent suicidal behavior: observations and therapeutic implications. *Acta Psychiatr Scand* 1993;**87**:59–65.
4 **Lewis SA**, Johnson J, Cohen P, *et al*. Attempted suicide in youth: its relation to school achievement, educational goals, and socioeconomic status. *J Abnorm Child Psychol* 1988;**16**:459–71.
5 **Rohn RD**, Sarles RM, Kenny TJ, *et al*. Adolescents who attempt suicide. *J Pediatr* 1977;**90**:636–8.
6 **West P**. Health inequalities in the early years: Is there equalisation in youth. *Soc Sci Med* 1997;**44**:833–58.
7 **Sibereisen RK**, Todt E, eds. *Adolescence in context. The impact of family, school, peers, and work in adjustment*. New York: Springer Verlag, 1994.
8 **Petridou E**, Mittleman MA, Trohanis D, *et al*. Transient exposures and the risk of childhood injuries: a case-crossover study in Greece. *Epidemiology* 1998;**9**:622–5.
9 **Engström K**, Laflamme L, Diderichsen F. Socio-economic differences in injury risk in childhood and youth. A national study of intentional and unintentional injuries. *Injury Prevention* 2002;**8**:137–42.
10 **Maclure M**. The case-crossover design: A method for studying transient effects on the risk of acute events. *Am J Epidemiol* 1991;**133**:144–53.
11 **Mittleman MA**, Maldonado G, Gerberich SG, *et al*. Alternative approaches to analytical designs in occupational injury epidemiology. *Am J Ind Med* 1997;**32**:129–41.
12 **Hallqvist J**, Möller J, Ahlbom A, *et al*. Does heavy physical exertion trigger myocardial infarction? A case-crossover analysis nested in a population based case referent study (SHEEP). *Am J Epidemiol* 2000;**151**:459–67.
13 **Redelmeier DA**, Tibshirani RJ. Association between cellular-telephone calls and motor vehicle collisions. *N Engl J Med* 1997;**336**:453–8.
14 **Vinson DC**, Mabe N, Leonard LL, *et al*. Alcohol and injury. A case-crossover study. *Arch Fam Med* 1995;**4**:505–11.
15 **Valent F**, Brusaferro S, Barbone F. A case-crossover study of sleep and childhood injury. *Pediatrics* 2001;**107**:59–71.
16 **Roberts I**, Marshall R, Lee-Joe T. The urban traffic environment and the risk of child pedestrian injury: a case-crossover approach. *Epidemiology* 1995;**6**:169–71.

17 **Engström K**. Social differences in injury risks in childhood and youth. Exploring the roles of structural and triggering factors. [Doctoral thesis]. Stockholm: Karolinska Institutet, Department of Public Health Sciences, 2003.
18 **Laflamme L**, Engström K, Möller J, *et al*. Bullying in the school environment: an injury risk factor? *Acta Psychiatr Scand* 2002;**106**:20–5.
19 **Scheidt PC**, Brenner RA, Rossi MW, *et al*. Parental attitudes regarding interviews about injuries to their children. *Injury Prevention* 2000;**6**:51–5.
20 **World Health Organisation**. *International classification of diseases*. Ninth Revision (ICD9). Geneva: WHO, 1977.
21 **Socialstyrelsen**. *Classification of diseases 1987. Systematic catalogue*. Swedish version of International Classification of Diseases, Ninth Revision (ICD9). [In Swedish]. Stockholm: Liber/Allmänna förlaget, 1986.
22 **Eriksson R**. Social class of men, women and families. *Sociology* 1984;**18**:500–14.
23 **Andersson LG**, Eriksson R, Wärneryd B. To describe the social structure. [In Swedish]. *Statistisk Tidskrift* 1981;**19**:113–36.
24 **Marshall RJ**, Jackson RT. Analysis of case-crossover designs. *Stat Med* 1993;**12**:2333–41.
25 **Mittleman MA**, Maclure M, Robins JM. Control sampling strategies for case-crossover studies. An assessment of relative efficiency. *Am J Epidemiol* 1995;**142**:91–8.
26 **Greenland S**, Robins JM. Estimation of a common effect parameter from sparse follow-up data. *Biometrics* 1985;**41**:55–68.
27 **Rothman KJ**. *Modern epidemiology*. Boston: Little, Brown, 1986.
28 **Williams JM**, Andersen MB. Psychosocial influences on central and peripheral vision and reaction time during demanding tasks. *Behav Med* 1997;**22**:160–7.
29 **Trent AP**. Psychosocial antecedents of athletic injury: the effects of life stress and social support on female collegiate gymnasts. *Behav Med* 1992;**18**:127–38.
30 **Williams JM**, Tonymon P, Andersen MB. Effects of life-events stress on anxiety and peripheral narrowing. *Behav Med* 1990;winter:174–81.
31 **Williams JM**, Tonymon P, Andersen MB. The effects of stressors and coping resources on anxiety and peripheral narrowing. *Journal of Applied Sports Psychology* 1991;**3**:126–41.
32 **Patel DR**, Pratt HD, Greydanus DE. Pediatric neurodevelopment and sports participation. When are children ready to play sports? *Pediatr Clin North Am* 2002;**49**:505–31.

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Mountain women
To Antonia Navas a midwife in Morocco

During El Salvador's civil war (1981–1992), the guerrilla was able to survive entrenched in the mountains. The symbolic term Mountain Women was coined to refer to those women arising from the civil population who became cornerstones of the Salvadorian guerrilla, because of their caring role, deeply rooted in the feminine identity. The Women—in one of their traditional roles—were ''the mountains'' of the guerrilla.

Ten years later when the peace agreements (2002) occurred, this photograph was taken that shows two midwives in a village of the desolate border between El Salvador and Honduras, where thousands of men have migrated.

The hug in front of the camera was their answer to our question on their resources for living. They smiled and said: ''we only have the mountains and ourselves''.

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