

# Injuries among adolescents in Greenland: behavioural and socio-economic correlates among a nationally representative sample

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## Abstract

**Background.** Injuries are among the most important threats to adolescent health, making examination of the patterns and risk factors a critical area of research. There exists a paucity of information on the health and injury experience of school-attending adolescents in Greenland. Consenting Greenlandic schoolchildren (n=2 254) aged 9 to 19 years were included in the Health Behavior in School-Aged Children (HBSC) study 2005/2006. The primary outcome measure was experience of injury within the 12 months preceding the survey.

**Methods.** This study made use of two multinomial regression models to examine injury occurrence regarding potential influencing factors such as physical activity, risk behaviors, bullying and family socioeconomic status.

**Results.** Those reporting 1-2 injuries within the recall period were more likely to be male (RRR=1.70; CI=1.39-2.09), be involved in physical fighting (RRR=1.82; CI=1.33-2.47), be bullied (RRR=1.81; CI=1.47-2.24) and bully others (RRR=1.53; CI=1.25-1.89). Those reporting three or more injuries were again mostly male (RRR=2.13; CI=1.44-3.14), involved in physical fighting at higher rates (RRR=4.47; CI=2.86-7.01), bullied more often (RRR=2.43; CI=1.65-3.57) and more likely to bully others (RRR=1.67; CI=1.13-2.45). Living without mother proved to be a significant risk factor for those suffering 3 or more injuries during the recall period (RRR=1.63; CI=1.05-2.52). The study results support the idea that factors that were found to be associated with injury occurrence, such as bullying and aggressive behaviour, should be taken into account when conducting future research on the nature of injuries in Greenlandic adolescents. More research on this topic is needed to identify factors that might modify the associations between injuries and adolescent behaviour and socioeconomic status.

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# **(1) Introduction**

Adolescent injuries are an emerging global health problem. It is estimated by the World Health Organization (WHO), that injury accounts for almost one million deaths among young people under the age of 18 each year worldwide, making it one of the most urgent adolescent health problems to tackle (Djeboua et al. 2016). From the age of one on until reaching adulthood injuries account for a major portion of adolescent deaths. Even though ways to decrease the likelihood and severity of each kind of injury are known, prevention and awareness still trail behind the current state of research (Peden et al. 2009). Considering that effective measures to prevent injuries do exist, it must be a focal point of injury research to determine what puts adolescents at risk for and protects them against injuries.

Childhood injuries can be divided into two major areas: those which are violence-related or intentional injuries and unintentional injuries, so called “accidents”. As both the *World Report on Violence against Children* and the *World Report on Child Injury Prevention* state, prevention of violence and injury respectively is the key for improving adolescents’ well-being (Peden et al. 2009; Pinheiro & Children 2006).

The most common causes of unintentional injuries in adolescents are road traffic injuries, drowning, burns, falls, and poisonings. Risk factors all of these causes share are male gender, poverty and lack of supervision or care (Peden et al. 2009). In high-income countries road traffic and drowning related injuries account for more than two thirds of all unintentional injury deaths among people aged less than 20 years. To compare, in low- and middle-income countries other causes (including categories such as smothering, asphyxiation, bites, hypo/hyperthermia and natural disasters) and road traffic accidents account for more than 60 percent of all childhood deaths (Harvey et al. 2009).

Intentional injuries and thus violent behaviour have accompanied mankind since their early beginnings, even making various scientists defend a theory that defines violence as an inherited instinct in man (Lorenz 1966; Tinbergen 1951).

Interpersonal violence and injuries can lead to harm that threatens the physical and psychological integrity in ways that range from harmless to possibly life-threatening. Adolescents are viewed as a population at risk for suffering and perpetrating interpersonal violence resulting in serious injury. The devastating effect of adolescent violence was described by David-Ferdon & Simon in 2014, when they showed that more U.S. youth die from homicide each year than from cancer, heart disease, birth defects, flu and pneumonia, respiratory diseases, stroke, and diabetes combined. International research has shown that social marginalization and adverse familiar circumstances (e.g. familiar abuse and neglect) as well as drug abuse and economic inequality can be considered as risk factors for being involved in violence (David-Ferdon & Simon 2014; Kobusingye O 2010). Protective factors include a safe and care-giving familiar environment, strong social bonds outside of the family, an understanding of responsible drug use, and high socio-economic status (Bushman et al. 2016).

This study aims at answering the question: what are the socioeconomic and behavioural correlates that are associated with injury occurrence among Greenlandic adolescents? Despite the importance of research on injury and violence among Greenlandic adolescents, research on it remains sparse. The last English-language paper addressing the topic of adolescent aggression and violence was written by Schnohr & Niclasen in 2006. The authors reported an increase in the prevalence of bullying in Greenlandic schools. In comparison to 35 other countries (located in Europe and North America) Greenland ranked 7<sup>th</sup> in terms of bullying others several times during the month preceding survey. Greenlandic schoolchildren showed above-average

percentages for bullying others as well (Schnohr & Niclasen 2006). Those numbers stress the need of further research to be conducted on the topic of injuries among Greenlandic adolescents and their socio-economic and behavioural correlates.

## (2) Materials & Methods

### *2.1 Setting*

The current study is based on data collected in Greenland, the world's largest island. Greenland is an autonomous territory within the Kingdom of Denmark. The population is 56,225, making it the most sparsely populated territory on earth. School-aged children, classified as children between 5 to 19 years of age, make up a total of 11,291 inhabitants, accounting for 20.1% of the total population (Blaabjerg 2019). The gross domestic product (GDP) per capita is 41,800\$ (Agency & Office 2016) and the Human Development Index (HDI) is 0.786 (Avakov 2015), which both classify Greenland as a highly developed country.

### *2.2 Sample*

In Greenland, 2,254 secondary school students (52% females) aged 9 - 19 years with a mean age of 13.4 years participated in the survey. The final sample included 2,217 participants, as 37 participants had to be excluded since they did not have complete information on the variables age or gender. The students were selected through random selection of classes within targeted school years or grades. Sampling was either conducted by simple random sampling of school classes by using a computerized random sampling procedure or systematic sampling of every n-th class from the list using a random starting point (Roberts et al. 2009). Detailed information about the questionnaire, data collection methods and study design can be found on the HBSC website - <http://www.hbsc.org/>. Informed consent from adolescents participating in the HBSC

survey was obtained. Informed parental consent was also obtained, and the data frame was stripped of potentially identifying characteristics. No individual participant was contacted during or after the research period.

### **2.3 Measurements**

The data for this study was derived from Greenland's contribution to the Health Behaviour in School-aged Children survey (HBSC) in 2005/2006. The HBSC study was adopted by the WHO in 1983 to cross-sectionally survey 11-, 13- and 15-year-old boys' and girls' health and well-being, social environments and health behaviours. Since then it has been conducted every four years to be constantly enhanced. The questions that were analysed in this study are depicted in the appendix named 'Appendix 1'. Participants were divided into three groups: those not reporting any injuries throughout 12 months preceding the survey ("No Injuries"), those reporting one or two injuries ("1-2 Injuries") and those reporting three or more injuries ("3+ Injuries"). The question "During the past 12 months, how many times have you been injured?" had five response options. Those were "1 = I have not been injured", "2 = Once", "3 = Twice", "4 = 3 times" and "5 = 4 times or more". Injuries were defined in the official HBSC survey form as injuries that required medical attention. The literal question specifically included injuries that resulted from playing sports, fighting with each other at different places such as the street or at home, being poisoned, or being burned. Illnesses such as measles or the flu were specifically excluded in the literal question.

### **2.4 Statistical Analysis**

Our analyses focused on covering a wide spectrum of risk and protective factors that are known to play a role in injury occurrence among adolescents. In accordance with current peer-reviewed literature we examined the following independent variables: gender, age, vigorous physical

activity (VPA), VPA (outside school hours), smoking, alcohol misuse, physical fighting, bullying victimization, bullying perpetrator, parent socio-economic status, living with parents & self-assessed wealth (Acquah et al. 2014a; Acquah et al. 2014b; Celedonia et al. 2013; Garmy et al. 2018). The definitions of the variables were set by the HBSC and can be looked up on the website <http://www.hbsc.org/>. The relevant questions and examined variables and coding can be found in the appendix under the name ‘Appendix 1’.

The distribution of selected variables within each of the three injury occurrence categories was examined primarily. Significant differences between each category and independent variables were explored using Pearson’s chi-squared test for categorical variables and ANOVA for the continuous variable age. Then two multinomial logistic regression (MLR) models were used to examine independent variable associations with those who reported no injuries, those reporting 1-2 injuries and those reporting 3+ injuries while adjusting for covariates. The cut points were selected after distributional aspects (Table 1) in combination with peer literature (Acquah et al. 2014b). In comparison to binary logistic regression (BLR), MLR allows to examine the probabilities of more than two distinct outcomes. In the study the dependent variable had 3 possible outcomes, which made MLR more suitable than BLR. The first MLR model included all variables that were shown to be significant in the bivariate analyses ( $p < 0.05$ ). The second model was adjusted only for age and sex. To measure the strength of the associations between the dependent variable and the independent variables we calculated relative risk ratios (RRR) and their respective 95% confidence intervals (CI). All analyses were conducted using the R Statistical Environment for Windows 10 (R Development Core Team 2010).



### (3) Results

Within the recall period (1 year), 30% of adolescents reported having been injured, 24% of whom reported 1-2 injuries and 6% reported 3 or more injuries. Of the 1-2 Injuries group 57% were male and of the 3+ Injuries group 62% were male. The overall mean age of our sample was 13.4 (SD = 1.7). Those reporting alcohol misuse constituted 11.2%, 36% reported smoking tobacco and 12% reported being involved in a physical fight within the last 12 months. Being victim of bullying was affirmed by 37.5% while 42.7% reported being a perpetrator of bullying. Of the participating adolescents 78.7% lived together with their mother, while 60.6% confirmed to live together with their father. A high maternal socioeconomic status (SES) was confirmed by 47.1%, while 41.3 % classified their father's SES as high. When asked to assess their own family's wealth 73.5% assessed it as average, 7.3% as below-average, and 19.2% as above-average.

Table 1 depicts the distribution of the independent variables within the three categories of the dependent variable. Significance was found in the psychological aggression category (Bullying victimization, Bullying perpetrator, Physical fighting) and in social categories such as living together with their mother. Furthermore, being male and practising VPA outside of school settings yielded higher percentages of injury occurrence. Of the aforementioned results only living together with their mother has a protective impact on injury occurrence. All other factors are found to go along with an increase in injuries. No significant differences were found with respect to age, substance use or economic status. Further factors that did not prove to be significant were living with fathers, VPA and talking to friends of the same and opposite gender.

After adjusting for all covariates our first regression model delivered the following results (Table 2). Those who were injured once or twice within the last year proved to be bullied more

often (RRR = 1.58; CI = 1.25-1.99). Involvement in physical fighting increased the risk for injuries significantly (RRR = 1.58; CI = 1.14-2.20). Males were overrepresented among those who reported being injured once or twice (RRR = 1.54; CI = 1.23-1.93).

The significant associations between getting injured three times or more were being male (RRR = 1.62; CI = 1.05-2.51), being bullied (RRR = 2.29; CI = 1.48-3.54) and being involved in a physical fight (RRR = 3.42; CI = 2.09-5.59).

The second regression model was adjusted only for age and gender. The results are summarized below in Table 3. Those who reported being in a fight (RRR = 1.82; CI = 1.33-2.47), being bullied (RRR = 1.81; CI = 1.47-2.24) and being bullies themselves (RRR = 1.53; CI = 1.25-1.89) were more likely to be injured once or twice. Males were also at a higher risk to be injured once or twice than females (RRR = 1.70; CI = 1.39-2.09).

Significant associations were found between being injured 3 times or more and being male (RRR = 2.13; CI = 1.44-3.14), physical fighting (RRR = 4.47; CI = 2.86-7.01), being bullied (RRR = 2.43; CI = 1.65-3.57) and bullying others (RRR = 1.67; CI = 1.13-2.45). Living without mother was associated a significantly with the suffering of three or more injuries as well (RRR = 1.63; CI = 1.05-2.52). All variables that are not mentioned above (e.g. talk to friends, same gender) did not yield any significant results.

#### **(4) Discussion**

This study results suggest that the incidence in Greenland for being injured once or twice within the past year was 24.2%, whereas the average cross-national incidence for injuries in adolescents from 9-19 years from all countries that participated in the HBSC survey ranks higher with 34.2%. The Greenlandic incidence for injuries in adolescents from 9-19 years for being injured

three times or more was 5.6%. That is also lower than the average cross-national incidence of 9.4% (Currie et al. 2008). Most of the participating countries (full list of the participating countries: <http://www.hbsc.org/>) had a similar or higher GDP and HDI than Greenland at the time the survey was conducted. Greenlandic adolescents also reported lower rates of witnessing other people being injured or killed in comparison to Iceland, the Faeroe Islands and Denmark (Karsberg et al. 2012). Transportation in Greenland during the summer can only be achieved by air or sea, whilst in the winter travelling on sea ice becomes a valuable traffic component as well (Grydehøj 2014). The lack of large roads and car traffic compared to other highly developed countries could decrease the occurrence of road traffic injuries severely. Since those make up around 57% of all unintentional childhood injury deaths, it could be a possible explanation for the observed low injury incidence rate (Peden et al. 2009).

Injuries have long been known to be more prevalent amongst males, who accounted for about 68% of all injury-related deaths in 2010 (Lozano et al. 2012). It was shown that male adolescents accounted for 57% (1-2 Injuries) and 62% (3+ Injuries) of all injuries in the respective groups.

We did not find evidence for injuries to be associated with alcohol misuse or smoking. Historically, Greenlandic adolescents have been prone to smoking and binge drinking (Nielsen & Bjerregaard 2007). Even though the impact of inebriation on injury severity remains unclear, it has been proven that alcohol consumption and smoking have been linked to the suffering of injuries in adolescents (Cherpitel et al. 2015; Knapik & Bedno ; Peden et al. 2009; Valdez et al. 2016). The mean age of our study's participants was 13.4 years (SD: 1.74). In 2010 Rehm & Shield pointed out that alcohol-attributable deaths in adolescents (0-15 years of age) only account for 0.1 percent of all adolescent deaths worldwide (Rehm & Shield 2013). Skala &

Walter also considered the age of 15 to be a threshold after that a rise in repetitive excessive alcohol consumption can be observed (Skala & Walter 2013). Further, the HBSC international report from 2005/06 points out significantly higher rates of drunkenness among 15-year olds than among 11- or 13-year olds (Currie et al. 2008). This aids to demonstrate that our sample may have been too young to be exposed to excessive alcohol consumption, hence significant associations could not be found. Lastly, it remains difficult to assess alcohol consumption through a questionnaire as imprecise recall of alcohol consumption may drive an association to the null (Wilson et al. 2012). The prevalence of smoking in our sample was found to be higher than in other high-income countries. Almost 26% of all participants reported smoking daily and 36% report smoking more or less regularly. In comparison, daily smoking prevalence for US American high school students ranks between 9 and 22% (Siqueira et al. 2000). The association between smoking and injury has been subset into four categories of reasoning: direct toxicity, distractibility, associated medical conditions, and confounding factors (Sacks & Nelson 1994). Since the theories of direct toxicity and distractibility are either still questionable or only applicable to drivers, they do not aid to explain a possible relationship between injuries and smoking within our study's cohort. Medical conditions associated with smoking like cardiovascular diseases or cancer usually do not appear in teenagers but rather during adulthood (Burns 2003). The most frequent injuries resulting from smoking are burns, but burns only make up about 3.3% of all unintentional childhood injury deaths in high-income countries (Peden et al. 2009; Sacks & Nelson 1994). The missing applicability of the study conducted by Sacks & Nelson as well as the rather small share of burns in injury deaths could explain why we could not find an association between smoking and injuries.

Consistent with existing research, bullying victimisation as well as bullying others was

associated with increased injury occurrence. Being involved in bullying as a victim or perpetrator goes along with an increased risk of physical fighting (Rudatsikira et al. 2008) that can likely lead to severe injury. Physical fighting was, as just mentioned, a significant risk factor for suffering from injury.

The results aid to show an association between living without mother and being injured three times or more within the last twelve months after adjusting only for age and gender, whereas living without father was not found to impact injury occurrence. Research has reported that an increase of adults living within a household goes along with a decrease in the risk of injury (Haynes et al. 2003). Parents also play a deciding role in teaching their children about injury prevention, thus the reduction of parental contact may put adolescents at risk to suffer from injuries (Wong & Breslin 2017). Our results only partially support these claims since we could show that living without a mother is associated with an increase in injury occurrence whereas living without a father showed no association. to impact injury occurrence..

This study provides valuable insight into a largely uncharted topic of global health research. To our knowledge this is the only study to have examined injury epidemiology among adolescents in Greenland. Despite that, the current study also had the following limitations, since, besides giving valuable insight, it also remains confined and silent on several topics.

First, the study does only include students that go to school and it does not include adolescents that do not attend school at all.

Secondly, some questions such as drug use, bullying, or physical fighting might have altered our findings in form of a recall bias, as the participants had to recall information within a rather large time frame which might have altered their recall ability and accuracy (Celedonia et

al. 2013; Wilson et al. 2012). Also, all the questions were self-reported, which may have been subject to social desirability and non-response bias (Acquah et al. 2014a).

Lastly, the cross-sectional nature of the dataset prevents us from drawing causal inference from our findings. The results must be interpreted within their own time context. Longitudinal data is necessary to establish the aforementioned causal pathways and to take into account the nature of change over time. Still our results have value not only for the historical aggregation of data, but they also play a role in understanding how young populations, and their behaviours, might change over time.

The body of research on injuries in circumpolar regions, especially Greenland, is confined at present. Therefore, this study also stresses the need for further examination of this topic.

## (5) Conclusions

The results of this study suggest that interpersonal relationships and conflicts are heavily linked with injury occurrence in Greenlandic adolescents. Future programs should consider the risk behaviours that were found to have a negative association with the adolescents' well-being such as bullying and physical fighting. Moreover, further research would benefit from exploring the kinds of injuries Greenlandic adolescents suffer to identify factors that might modify the associations pointed out in this study.

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**Table 1** (on next page)

Table 1. Distribution of selected factors according to categories of injury occurrence among school attending adolescents in Greenland. (2005/2006)

**Table 1 (referred to as ‘Table 1’). Distribution of selected factors according to categories of injury occurrence among school attending adolescents in Greenland. (2005/2006)**

	No Injuries (n=1456)	1-2 Injuries (n=503)	3+ Injuries (n=116)	P-Value
Age (mean)	13.4	13.4	13.2	0.319
Gender (male)	43.4	56.7	62.1	<0.001
VPA (≥4 days)	48.2	53.4	44.5	0.082
VPA outside school (≥4 days)	49.1	52.5	60.2	0.048
Smoking (Yes)	35.5	35.9	39.8	0.666
Alcohol misuse (≥2/month)	10.0	12.5	14.0	0.168
Bullying victimisation (≥2/month)	32.6	46.9	54.4	<0.001
Bullying perpetrator (≥2/month)	39.5	50.4	52.2	<0.001
Physical fighting (≥2 fights)	8.7	16.4	33.3	<0.001
Job father (Skilled job)	42.4	38.4	45.3	0.352
Job mother (Skilled job)	47.6	48.6	41.7	0.516
Talk to same gender				0.222
Very easy (n = 701)	49.3	44.0	39.8	
Easy (n = 528)	34.7	38.2	38.6	
Hard (n = 141)	9.3	10.0	10.8	
Very hard (n = 52)	3.3	4.4	2.4	
Does not have/see this person (n = 56)	3.5	3.3	8.4	
Talk to opposite gender				0.229
Very easy (n = 383)	28.3	28.0	29.2	
Easy (n = 423)	31.7	30.7	29.2	
Hard (n = 281)	21.6	19.8	13.9	
Very hard (n = 135)	9.1	12.5	9.7	
Does not have/see this person (n = 132)	9.3	9.1	18.1	
Self-assessed wealth				0.478
Well-off (n = 139)	19.2	18.1	23.0	
Average (n = 1394)	72.9	75.7	72.0	
Not well-off (n = 363)	7.9	6.2	5.0	
Live without mother	19.9	23.6	29.4	0.024
Live without father	39.5	37.2	45.9	0.235
Live without both parents	13.2	13.6	17.4	0.457

**Notes.**

All variables are expressed as proportions (in %) except for age (mean).



## Table 2 (on next page)

Table 2. Relative risk ratios and 95% confidence intervals for injury-influencing factors among school attending adolescents in Greenland. Adjusted for all significant variables. (2005-2006)

**Table 2 (referred to as ‘Table 2’). Relative risk ratios and 95% confidence intervals for injury-influencing factors among school attending adolescents in Greenland. Adjusted for all significant variables. (2005-2006)**

	<b>1-2 Injuries, RRR (95% confidence intervals)</b>	<b>P-Value</b>	<b>3+ Injuries, RRR (95% confidence intervals)</b>	<b>P-Value</b>
Gender	1.54 (1.23-1.93)	<0.001	1.62 (1.05-2.51)	0.030
VPA outside school	1.08 (0.86-1.34)	0.510	1.30 (0.85-1.98)	0.228
Physical fighting	1.58 (1.14-2.20)	0.006	3.42 (2.09-5.59)	<0.001
Bullying victimisation	1.58 (1.25-1.99)	<0.001	2.29 (1.48-3.54)	<0.001
Bullying perpetrator	1.26 (1.00-1.59)	0.051	1.15 (0.74-1.79)	0.530
Live without mother	1.19 (0.92-1.56)	0.185	1.45 (0.91-2.32)	0.116

Reference category = no injuries

**Table 3**(on next page)

Table 3. Relative risk ratios and 95% confidence intervals for injury-influencing factors among school attending adolescents in Greenland. Adjusted for age and gender. (2005/2006)

**Table 3 (referred to as ‘Table 3’). Relative risk ratios and 95% confidence intervals for injury-influencing factors among school attending adolescents in Greenland. Adjusted for age and gender. (2005/2006)**

	1-2 Injuries, RRR (95% confidence intervals)	P-Value	3+ Injuries, RRR (95% confidence intervals)	P-Value
Gender	1.70 (1.39-2.09)	<0.001	2.13 (1.44-3.14)	<0.001
VPA outside school	1.05 (0.85-1.30)	0.652	1.38 (0.93-2.06)	0.108
Physical fighting	1.82 (1.33-2.47)	<0.001	4.47 (2.86-7.01)	<0.001
Bullying victimisation	1.81 (1.47-2.24)	<0.001	2.43 (1.65-3.57)	<0.001
Bullying perpetrator	1.53 (1.25-1.89)	<0.001	1.67 (1.13-2.45)	<0.001
Live without mother	1.21 (0.94-1.56)	0.133	1.63 (1.05-2.52)	0.028

Reference category = no injuries