

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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2 **correlates among a nationally representative sample**

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50 (1) Introduction

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

60 Childhood injuries can be divided into two major areas: those which are violence-related
61 or intentional injuries and unintentional injuries, so called “accidents”. As both the *World Report*
62 *on Violence against Children* and the *World Report on Child Injury Prevention* state, prevention
63 of violence and injury respectively is the key for improving adolescents’ well-being (Peden et al.
64 2009; Pinheiro & Children 2006).

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

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

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

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

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

99 **(2) Materials & Methods**

100 ***2.1 Setting***

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

108 ***2.2 Sample***

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

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

121 **2.3 Measurements**

122 The data for this study was derived from Greenland's contribution to the Health Behaviour in
123 School-aged Children survey (HBSC) in 2005/2006. The HBSC study was adopted by the WHO
124 in 1983 to cross-sectionally survey 11-, 13- and 15-year-old boys' and girls' health and well-
125 being, social environments and health behaviours. Since then it has been conducted every four
126 years to be constantly enhanced. The questions that were analysed in this study are depicted in
127 the appendix named 'Appendix 1'. Participants were divided into three groups: those not
128 reporting any injuries throughout 12 months preceding the survey ("No Injuries"), those
129 reporting one or two injuries ("1-2 Injuries") and those reporting three or more injuries ("3+
130 Injuries"). The question "During the past 12 months, how many times have you been injured?"
131 had five response options. Those were "1 = I have not been injured", "2 = Once", "3 = Twice",
132 "4 = 3 times" and "5 = 4 times or more". Injuries were defined in the official HBSC survey form
133 as injuries that required medical attention. The literal question specifically included injuries that
134 resulted from playing sports, fighting with each other at different places such as the street or at
135 home, being poisoned, or being burned. Illnesses such as measles or the flu were specifically
136 excluded in the literal question.

137 **2.4 Statistical Analysis**

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

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

147 The distribution of selected variables within each of the three injury occurrence
148 categories was examined primarily. Significant differences between each category and
149 independent variables were explored using Pearson's chi-squared test for categorical variables
150 and ANOVA for the continuous variable age. Then two multinomial logistic regression (MLR)
151 models were used to examine independent variable associations with those who reported no
152 injuries, those reporting 1-2 injuries and those reporting 3+ injuries while adjusting for
153 covariates. The cut points were selected after distributional aspects (Table 1) in combination with
154 peer literature (Acquah et al. 2014b). In comparison to binary logistic regression (BLR), MLR
155 allows to examine the probabilities of more than two distinct outcomes. In the study the
156 dependent variable had 3 possible outcomes, which made MLR more suitable than BLR. The
157 first MLR model included all variables that were shown to be significant in the bivariate analyses
158 ($p < 0.05$). The second model was adjusted only for age and sex. To measure the strength of the
159 associations between the dependent variable and the independent variables we calculated relative
160 risk ratios (RRR) and their respective 95% confidence intervals (CI). All analyses were
161 conducted using the R Statistical Environment for Windows 10 (R Development Core Team
162 2010).

163 **(3) Results**

164 Within the recall period (1 year), 30% of adolescents reported having been injured, 24% of
165 whom reported 1-2 injuries and 6% reported 3 or more injuries. Of the 1-2 Injuries group 57%
166 were male and of the 3+ Injuries group 62% were male. The overall mean age of our sample was
167 13.4 (SD = 1.7). Those reporting alcohol misuse constituted 11.2%, 36% reported smoking
168 tobacco and 12% reported being involved in a physical fight within the last 12 months. Being
169 victim of bullying was affirmed by 37.5% while 42.7% reported being a perpetrator of bullying.
170 Of the participating adolescents 78.7% lived together with their mother, while 60.6% confirmed
171 to live together with their father. A high maternal socioeconomic status (SES) was confirmed by
172 47.1%, while 41.3 % classified their father's SES as high. When asked to assess their own
173 family's wealth 73.5% assessed it as average, 7.3% as below-average, and 19.2% as above-
174 average.

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

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

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

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

192 The second regression model was adjusted only for age and gender. The results are
193 summarized below in Table 3. Those who reported being in a fight (RRR = 1.82; CI = 1.33-
194 2.47), being bullied (RRR = 1.81; CI = 1.47-2.24) and being bullies themselves (RRR = 1.53; CI
195 = 1.25-1.89) were more likely to be injured once or twice. Males were also at a higher risk to be
196 injured once or twice than females (RRR = 1.70; CI = 1.39-2.09).

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

203 (4) Discussion

204 This study results suggest that the incidence in Greenland for being injured once or twice within
205 the past year was 24.2%, whereas the average cross-national incidence for injuries in adolescents
206 from 9-19 years from all countries that participated in the HBSC survey ranks higher with
207 34.2%. The Greenlandic incidence for injuries in adolescents from 9-19 years for being injured

208 three times or more was 5.6%. That is also lower than the average cross-national incidence of
209 9.4% (Currie et al. 2008). Most of the participating countries (full list of the participating
210 countries: <http://www.hbsc.org/>) had a similar or higher GDP and HDI than Greenland at the
211 time the survey was conducted. Greenlandic adolescents also reported lower rates of witnessing
212 other people being injured or killed in comparison to Iceland, the Faeroe Islands and Denmark
213 (Karsberg et al. 2012). Transportation in Greenland during the summer can only be achieved by
214 air or sea, whilst in the winter travelling on sea ice becomes a valuable traffic component as well
215 (Grydehøj 2014). The lack of large roads and car traffic compared to other highly developed
216 countries could decrease the occurrence of road traffic injuries severely. Since those make up
217 around 57% of all unintentional childhood injury deaths, it could be a possible explanation for
218 the observed low injury incidence rate (Peden et al. 2009).

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

223 We did not find evidence for injuries to be associated with alcohol misuse or smoking.
224 Historically, Greenlandic adolescents have been prone to smoking and binge drinking (Nielsen
225 & Bjerregaard 2007). Even though the impact of inebriation on injury severity remains unclear, it
226 has been proven that alcohol consumption and smoking have been linked to the suffering of
227 injuries in adolescents (Cherpitel et al. 2015; Knapik & Bedno ; Peden et al. 2009; Valdez et al.
228 2016). The mean age of our study's participants was 13.4 years (SD: 1.74). In 2010 Rehm &
229 Shield pointed out that alcohol-attributable deaths in adolescents (0-15 years of age) only
230 account for 0.1 percent of all adolescent deaths worldwide (Rehm & Shield 2013). Skala &

231 Walter also considered the age of 15 to be a threshold after that a rise in repetitive excessive
232 alcohol consumption can be observed (Skala & Walter 2013). Further, the HBSC international
233 report from 2005/06 points out significantly higher rates of drunkenness among 15-year olds
234 than among 11- or 13-year olds (Currie et al. 2008). This aids to demonstrate that our sample
235 may have been too young to be exposed to excessive alcohol consumption, hence significant
236 associations could not be found. Lastly, it remains difficult to assess alcohol consumption
237 through a questionnaire as imprecise recall of alcohol consumption may drive an association to
238 the null (Wilson et al. 2012). The prevalence of smoking in our sample was found to be higher
239 than in other high-income countries. Almost 26% of all participants reported smoking daily and
240 36% report smoking more or less regularly. In comparison, daily smoking prevalence for US
241 American high school students ranks between 9 and 22% (Siqueira et al. 2000). The association
242 between smoking and injury has been subset into four categories of reasoning: direct toxicity,
243 distractibility, associated medical conditions, and confounding factors (Sacks & Nelson 1994).
244 Since the theories of direct toxicity and distractibility are either still questionable or only
245 applicable to drivers, they do not aid to explain a possible relationship between injuries and
246 smoking within our study's cohort. Medical conditions associated with smoking like
247 cardiovascular diseases or cancer usually do not appear in teenagers but rather during adulthood
248 (Burns 2003). The most frequent injuries resulting from smoking are burns, but burns only make
249 up about 3.3% of all unintentional childhood injury deaths in high-income countries (Peden et al.
250 2009; Sacks & Nelson 1994). The missing applicability of the study conducted by Sacks &
251 Nelson as well as the rather small share of burns in injury deaths could explain why we could not
252 find an association between smoking and injuries.

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

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

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

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

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

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

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

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

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

288 (5) Conclusions

289 The results of this study suggest that interpersonal relationships and conflicts are heavily linked
290 with injury occurrence in Greenlandic adolescents. Future programs should consider the risk
291 behaviours that were found to have a negative association with the adolescents' well-being such
292 as bullying and physical fighting. Moreover, further research would benefit from exploring the
293 kinds of injuries Greenlandic adolescents suffer to identify factors that might modify the
294 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)

1 **Table 1 (referred to as ‘Table 1’). Distribution of selected factors according to categories of**
 2 **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

3 **Notes.**

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

5

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)

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

	1-2 Injuries, RRR (95% confidence intervals)	P-Value	3+ Injuries, RRR (95% confidence intervals)	P-Value
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

4
 5 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)

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

4
 5 Reference category = no injuries
 6