Sociodemographic correlates of medically attended injuries in Hungarian school children

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PURPOSE
Adolescence is one of the healthiest periods of life, and therefore mortality from external causes (intentional or unintentional injuries) are the leading cause of death in this age group. However, nonfatal injuries also represent a significant public health burden and a high percentage of them are preventable. To better target prevention efforts, the sociodemographic correlates of medically attended injuries need to be identified. It is well documented that gender, age and socio-cultural status are associated with the occurrence of non-fatal injuries.

METHODS
We analyzed six data sets (2002–2022) from the Health Behavior in School-aged Children Study (HBSC). In all years of data collection, the Hungarian sample is nationally representative of students aged 11–18 years. Binary logistic regression analysis was conducted in each year to examine which factors are associated with injury.

RESULTS
Boys, younger children and more affluent children have a higher risk of sustaining an injury requiring medical attention. Rurality (type of settlement), family structure, predominantly maternal monitoring and family support were found to be associated with injuries in three of the six data collections. Parental education, predominantly paternal monitoring or type of school did not play a role in the occurrence of injuries according to our data.

CONCLUSIONS
There is a need for systematic, ongoing school-based injury prevention programs and home safety campaigns. Sports clubs, training teams should also be part of systematic prevention efforts, as it is assumed that many injuries are sport-related (e.g. horse riding, cycling injuries).
Keywords: medically attended injury, family affluence, parental monitoring, family climate, rurality

Introduction

According to the etiological definition, an injury is a physical damage resulting from the transfer of energy to the tissues of the body beyond the limits compatible with physiological function (1). Based on intent, injuries can be divided into intentional and unintentional injuries, although they often share the same mechanisms (2). Intentional injuries include violent assaults and self-mutilation or suicide. Unintentional injuries are harmful acts and injuries caused by accidents. These injuries often occur in transportation, school or sports settings; they can be related to fires, drowning or poisoning, and even substance use (3). The types of injuries can also vary, including cuts, lacerations, fractures, dislocations, strains, abrasions, bruises, scalds and burns (4).

The issue of childhood injury is a prominent public health concern, with injuries contributing to a significant health burden in childhood and adolescence (3, 5). In fact, unintentional injuries are emerging as the leading cause of both mortality and disability among children and adolescents (6, 7). According to the most recent data in Hungary in 2019–21, the mortality rate for 10–14 year olds was 1.9/100,000, while for 15–19 year olds it was 8.1/100,000 (8). Injuries that are not immediately life-threatening can still have a long-term impact on a person's health and may result in disability. Non-fatal injuries often result in significant loss of time from educational activities (9). In addition to mortality and physical injury, exposure to traumatic events, particularly during childhood, is associated with an increased risk of mental disorders and suicidal behavior. This exposure also correlates with increased incidence of substance abuse, chronic disease, and social problems such as poverty, criminal activity, and violence (10). On the other hand, there are many specific strategies based on sound scientific evidence that are effective and cost-effective in preventing injuries; it is critical that these strategies be more widely implemented (10). It is estimated that two out of three deaths and most nonfatal injuries are preventable (5).

From a public health perspective, research on risk and protective factors is essential for planning and implementing prevention programs. Injury risk factors are sometimes classified into intrinsic vs. extrinsic categories, or personal vs. environment-related factors (11, 12).

Age and gender are generally considered to be personal factors. The risk of injury increases during adolescence, but according to some cross-sectional studies, 11- and 13-year-olds have higher injury rates than 15-year-olds (5, 13). A significant gender effect has also been observed in many studies, with boys being more likely to be injured than girls (4, 13, 14). In terms of personal factors, many adolescents are injured through sports, while others are injured through involvement in physical fights or substance use (15–17). Studies also indicate a higher prevalence of injury among young people with mental health problems (18).

Family factors fall somewhere between personal and environmental variables. Previous research has confirmed associations between injury and family structure and support (19, 20). Parental monitoring strategies appear to be important in the etiology of injury, particularly as adolescents develop independence in decision making in potentially injurious environments (21, 22).

Some of the variation in child injury rates between populations can be explained by differences in the social and physical environments in which children live. Some characteristics of the social and physical environment (area-level variables) that are often associated with injury rates include neighborhood safety, poverty, educational attainment, and access to services (23). Globally, injury mortality rates are higher in low-income countries (10). Although higher socioeconomic status is the most commonly cited factor in reducing the risk of injury, this is not the case for sports- and recreation-related injuries (24).

Further examination of environmental factors has shown that the risk of both fatal and non-fatal injuries increases with increasing rurality (25, 26). Broader societal factors affecting health, such as unsafe built environments, inadequate product safety standards, inadequate social safety nets, and inconsistent institutional policies, are exacerbated by limited resource availability. In environments with inadequate emergency trauma care services or inequitable access to such services, the impact of injuries can be magnified (10).

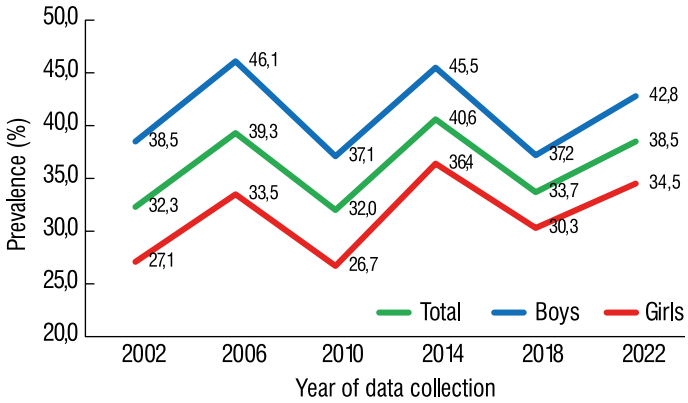
The scope of the problem: prevalence of medically attended (non-fatal) injuries in Hungary

According to the Health Behaviour in School-aged Children Study, 38.5% of 11- to 18-year-old students in Hungary reported having been injured at least once in 2022 (27). Significant changes in injury prevalence can be observed in 2022 compared to the previous data collection year. Although no clear pattern emerges, it can be concluded that the prevalence is higher in 2022 than in the 2018, 2010 and 2002 data collections, both for the total sample and for boys and girls separately (27). In all survey years, boys are more likely to be injured *(Figure 1)*.

The current study

The aim of the study was to determine how socio-demographic factors influence the incidence of non-fatal unintentional injuries among Hungarian schoolchildren. Some of the factors to be investigated here are personal factors such as age and gender, some of them represent the external/environmental level. In this context, the relationship between injury and family structure, support, parental supervision (mother and father separately), family wealth, parental education, rural status (type of settlement), and type of school was investigated.

Figure 1: Changes in the prevalence of medically attended injuries between 2002 and 2022



Source: HBSC, 2022

Table 1: Sample sizes and main attributes of the samples by survey years

	N TOTAL	BOYS (%)	GIRLS (%)	5TH GRADERS (%)/(MEAN AGE)	7TH GRADERS (%)/(MEAN AGE)	9TH GRADERS (%)/(MEAN AGE)	11TH GRADERS (%)/(MEAN AGE)
2002	5958	45.8	54.2	23.9 (11.5)	25.4 (13.5)	23.7 (15.5)	27.0 (17.5)
2006	5450	47.8	52.2	24.2 (11.7)	25.3 (13.6)	27.0 (15.7)	23.4 (17.6)
2010	8096	48.9	51.1	23.2 (11.7)	23.5 (13.7)	27.8 (15.7)	25.5 (17.7)
2014	6182	49.7	50.2	28.8 (11.7)	26.7 (13.7)	24.5 (15.8)	20.0 (18.0)
2018	5997	48.9	51.1	26.2 (11.7)	27.7 (13.8)	27.1 (15.9)	19.0 (17.9)
2022	6291	49.1	50.9	35.6 (11.7)	18.4 (13.7)	31.8 (15.8)	24.7 (18.0)

Materials and methods

Our analysis was performed on Hungarian datasets from the Health Behavior in School-aged Children Study (HBSC), collected in 2002, 2006, 2010, 2014, 2018, and most recently in 2022. The HBSC is a WHO collaborative cross-national study of health behavior, involving 48 countries (in 2018), mostly from Europe and North America. The Hungarian study was designed and conducted according to the HBSC guidelines and related international protocols (28–33). The Hungarian sample included nationally representative data from 5th, 7th, 9th, and 11th grade students. The representative sample is selected on the basis of the public education statistics of the respective examination year (school year) using a multistage stratified sampling procedure (27, 34–37).
Participants completed the Hungarian-language version of the internationally standardized HBSC paper-based or (in 2022) online questionnaire in the classroom. Trained research assistants administered the questionnaires during regular class time, and no school personnel were present at the time of the survey. Participation was voluntary and anonymous, and prior to the administration of the questionnaires, parents were informed about the significance of the survey and the option to opt out. The design of the Hungarian survey was approved by the Ethics Committee of the Medical Research Council *(Table 1)*.
All variables in the analysis were the part of the Hungarian language version of the HBSC mandatory questionnaires.

- The item for *injury* was the following[1]: "During the past 12 months, how many times were you injured and had to be treated by a doctor or nurse?" The answer categories: "I was not injured in the past 12 months / 1 times / 2 times / 3 times / 4 times or more". In our analysis we used this item as a binary variable ("Have not been injured vs. have been injured at least once).
- Participants' *grade* (referring to their age) and *gender* were included in the analysis in their original format.
- The level of rurality was evaluated with the variable of *settlement type* where respondents needed to indicate where they live (response options were: Budapest (the capital) / county seat / other city / village or smaller).
- The *family structure* question is used to identify different types of families (biological, reconstructed, single-parent, etc.) based on the presence of the mother or father. For this item, respondents were originally instructed to indicate with whom they live most of the time. In our analysis, we used this item as a binary variable: traditional family (where both mother and father are present) vs. non-traditional family (other cases).
- The *Family Affluence Scale* (FAS III) is an indicator of socioeconomic status and is based on simple indicators of affluence in the respondent's home (38). Based on an internationally validated six-item scale, respondents were asked whether they owned the following items at home and how many of each they owned: car(s), computer(s)/ laptop(s), bathroom(s), and dishwasher, whether they had a separate bedroom, and how many times they had traveled abroad on vacation. The scale ranges from 0-13. In the analysis, it was used as low/medium/high affluence based on international cut-off points.
- *Parental education* was determined separately for mother and father. In the original question, the levels of education were: has not finished primary school/primary school/certified skilled worker / secondary school / higher education / I don't know / I don't know my parents, and these options were organized into basic / secondary / higher education categories.
- The perceived *support from family* is part of the Multidimensional Scale of Perceived Social Support (MSPSS) used in the 2014 study (39). There are 4 items of family support where respondents have to indicate their agreement on a 7-point Likert scale with certain statements about help, support and attention from family. The average item score (based on four items) was used as a continuous variable in the analysis.
- The measure of *parental monitoring* is based on the instrument developed by Brown et al. (40). The items used (five items in 2002-2014 and six items in 2018-2022) are designed to assess children's perceptions of their parents' knowledge of their lives outside the home. The items are presented separately for mothers and fathers. Each item has four response options: knows a lot / knows a little / doesn't know / doesn't have / doesn't see this person. It

1. Before answering the question about the occurrence of injury respondents were presented the following forewords: 'Many young people get hurt or injured from activities such as playing sports or fighting with others at different places such as the street or home. Injuries can include being poisoned or burned. Injuries do not include illnesses such as measles or the flu. The following questions are about injuries you may have had during the past 12 months'.

was used as a continuous scale in our analysis, created by summing the scores of all related items.

- Finally, we included the school's sponsor as a potentially important sociodemographic variable. This information did not come directly from respondents, but was added to the dataset based on sample characteristics as follows: state/church/other schools.

Binomial logistic regression was performed separately in each year using the R3Step method. Involvement in medically attended injuries was predicted by gender, age, settlement type, parental education, family structure, family affluence, family support, parental monitoring, and school type. Because of the possible interdependence of responses within a school class, the above analyses were corrected for clustering. Weighted data were used in all analyses to ensure representativeness. Analyses were performed using IBM SPSS Statistics and Jamovi software.

Results

Gender appears to be an important predictor of medically attended injuries: boys have a higher risk of being injured than girls *(Table 2)*. The risk for girls is 30-40% lower than for boys. Age seems to be another important factor – older students have a lower risk of injury – but the difference between the higher grades (9th and 11th) does not show a clear pattern. The difference is significant for 11th graders compared to 5th graders. The relationship between injury and family affluence is very well estab-

Table 2: Results from binary logistic regression analysis 2002–2022

	2002	2006	2010	2014	2018	2022
Gender						
Boy-girl	**0.613 (0.531–0.708)**	**0.576 (0497–0.669)**	**0.769 (0.670–0.882)**	**0.664 (0.574–0.767)**	**0.741 (0.644–0.851)**	**0.703 (0.614–0.806)**
Grade						
5th–7th grade	**0.916 (0.714–1.175)**	**1.378 (1.080–1.759)**	1.047 (0.838–1.310)	0.927 (0.739–1.161)	**0.697 (0.566–0.857)**	0.978 (0.772–1.239)
5th–9th grade	0.861 (0.673–1.101)	1.146 (0.901–1456)	0.891 (0.711–1.117)	0.974 (0.767–1.236)	**0.555 (0453–0.681)**	**0.763 (0.616–0.945)**
5th–11th grade	**0.761 (0.598–0.969)**	0.902 (0.706–1.153)	**0.732 (0.579–0.926)**	0.806 (0.632–1.027)	**0477 (0.383–0.595)**	**0.558 (0445–0.700)**
Rurality/Settlement						
Budapest – county seat	**0.761 (0.585–0.989)**	0.955 (0.724–1.260)	0.861 (0.713–1.039)	0.915 (0.726–1.153)	**0.758 (0.582–0.986)**	0.896 (0.742–1.082)
Budapest – other city	**0.771 (0.616–0.965)**	0.834 (0.665–1.062)	**0.801 (0.664–0.967)**	0.838 (0.669–1.049)	**0.774 (0.625–0.958)**	0.916 (0.756–1.109)
Budapest – village or smaller	0.808 (0.643–1.015)	**0.713 (0.556–0.915)**	**0.684 (0.515–0.909)**	0.951 (0.719–1.258)	0.814 (0.657–1.009)	1.025 (0.762–1.378)
Mother's education						
Basic – secondary	0.965 (0.787–1.168)	**0.797 (0.656–0.967)**	1.104 (0.930–1.310)	0.883 (0.729–1.070)	1.019 (0.837–1.241)	0.749 (0.620–0.906)
Basic – higher	0.884 (0.703–1.113)	**0.724 (0.577–0.908)**	**1.251 (1.026–1.524)**	0.908 (0.729–1.131)	1.038 (0.876–1.356)	0.926 (0.757–1.132)
Father's education						
Basic – secondary	0.983 (0.813–1.188)	**1.350 (1.026–1.521)**	0.886 (0.747–1.051)	1.010 (0.829–1.230)	1.018 (0.841–1.233)	1.187 (0.993–1420)
Basic – higher	1.008 (0.812–1.251)	0.957 (0.764–1.198)	**0.809 (0.668–0.980)**	0.828 (0.665–1.031)	1.060 (0.841–1.280)	1.060 (0.874–1.286)
Family structure						
Traditional – non-traditional	1.016 (0.838–1.232)	**1.218 (1.013–1465)**	**1.194 (1.020–1.393)**	1.080 (0.919–1.268)	1.046 (0.891–1.229)	**1.226 (1.049–1434)**
Family affluence groups						
Low – medium	**1485 (1.081–1.551)**	**1.295 (1.081–1.551)**	**1.281 (1.094–1.500)**	1.147 (0.973–1.353)	**1.361 (1.150–1.611)**	1.066 (0.904–1.258)
Low – high	**1.804 (1450–2.244)**	**1.558 (1.283–1.966)**	**1467 (1.198–1.797)**	**1.545 (1.224–1.950)**	**1.980 (1.615–2438)**	**1474 (1.207–1.801)**
Perceived family support	–	–	–	**0.977 (0.963–0.990)**	**0.984 (0.968–1.000)**	**0.984 (0.970–0.998)**
Monitoring (mother)	0.968 (0.924–1.014)	**0.947 (0.906–0.989)**	**0.904 (0.866–0.944)**	–	**0.939 (0.902–0.977)**	0.974 (0.939–1.011)
Monitoring (father)	**0.925 (0.891–0.960)**	1.003 (0.966–1.041)	0.990 (0.960–1.021)	–	0.982 (0.955–1.010)	1.009 (0.982–1.036)
School maintainer						
State – church	–	–	0.904 (0.762–1.257)	0.843 (0.666–1.068)	0.983 (0.799–1.209)	1.058 (0.861–1.299)
State – other	–	0.873 (0.694–1.114)	0.954 (0.770–1.882)	0.782 (0.576–1.061)	0.764 (0.525–1.113)	1.146 (0.765–1.716)

lished: in most of the data collections, medium affluence is associated with higher injury risk, but high affluence proved to be a consistent predictor across survey years. This means that highly affluent students are 50-100% more likely to be injured (odds range from 1.467 to 1.980). In three of the six survey years, family structure seems to be associated with injury risk: children in non-traditional families have a higher risk of being injured (even after controlling for parental monitoring). The variable of family support also appears to be associated with injury risk: higher perceived family support was associated with lower injury risk. It should be noted that despite significant associations, the odds ratios are around 1. Mother's monitoring also contributes to injury risk across three survey years: higher monitoring reduces the risk of being injured by 5-10%. In some data collections, settlement type emerged as a significant independent variable, which generally means that living outside the capital city lowers the risk of getting injured, but this was not true in 2014 and 2022 *(Table 2)*.

Some independent factors remained insignificant across data collections. School type, parental education, and paternal supervision did not appear to contribute to injury risk *(Table 2)*.

Discussion

In the present paper we analyzed several socio-demographic and family-related determinants of medically attended injuries among young people in Hungary, using six data collections between 2002 and 2022.

Our results regarding the association between gender and injuries were as expected: boys have an increased risk of injury in all data collections. This association has been widely documented in the literature and has been confirmed for different types, non-fatal or fatal injuries and across different data collection methods (41–44). With regard to the effect of age, it is a general finding that smaller children have higher odds for some types of injury. However, it is during adolescence that the risk of injury increases, mainly due to risky behavior, and mortality rates are highest (5, 45). Our data are consistent with other HBSC findings, in that the odds of medically attended injuries appear to be lower for older students than for younger ones (13). Age differences are plausible: older students are more cautious, have higher skill levels, are less involved in bullying and fighting, and attention problems may also decrease at this age.

The present findings on the impact of urban-rural differences in injuries are not fully consistent with the existing evidence. According to our data, in some data collections it can be observed that not living in the capital city reduces the risk of injuries requiring medical attention. This is somewhat contradictory to the general finding that the risk of both fatal and non-fatal injuries increases with increasing rurality (26). The rate of hospital admission for unintentional injuries was significantly higher among rural residents for all types of unintentional injuries except poisoning and pedestrian injuries (25, 46). Possible reasons for the higher injury rates in rural areas are higher mortality from motor vehicle trauma and rural exposure to dangerous farm machinery and open water, etc. (25). However, in our case, the higher risk in the capital may be related to higher intensity of sports activities and higher accessibility of health care providers.

Surprisingly, parental education did not appear to be consistently associated with medically attended injuries in our analysis. Some studies have found that unintentional injuries are significantly higher in children with the lowest level of parental education (47). The results were similar when stratified by gender and type of injury, and when parental education was considered separately for mother and father. Injury hospitalization was also found to be 1.5 times higher for children whose mothers had only a primary education (48). The effect of education on injuries was also confirmed by *Ma et al*. In a study, students whose mothers had either lower than a secondary school education or a postgraduate degree were more likely to suffer (non-fatal) injuries (41).

Despite the fact that parental education appeared to be unrelated to injury, one of our most consistent and powerful findings is the effect of family affluence on injury occurrence. It implies that high or even medium family affluence is associated with a higher risk of injury. This finding is consistent with previous findings from the HBSC study, which concluded that adolescents from highly affluent families were more likely to report having had at least one medically attended injury in the past 12 months (49). This may be due to greater participation in sports activities or easier access to medical services. However, the relationship between socioeconomic status and injuries is complex. While a simple inverse relationship between injury mortality and socioeconomic status has been observed, evidence of socioeconomic inequalities in non-fatal injury rates is not entirely consistent (44). Based on emergency department records and cross-sectional studies, it has also been concluded that the risk of hospitalization due to injury is higher for children from families with the lowest and highest incomes than for children from middle-income families (41, 48).

Family structure was found to be an important factor in only three of our six data collections. Here, non-traditional family structure was found to increase the likelihood of injury. The majority of studies argue that non-traditional family structures are risk factors for adolescent injury (19). For example, *Ma et al.* found that children living with grandparents or a single parent were at increased risk of injury (41). However, *Laursen* and *Nielsen* found that living in a one- or two-parent family had little or no effect on injury (48). In a longitudinal study, *Malvaso et al.* concluded that "family type" did not play an important role: stepfamily structure per se is not a risk factor for injury (50). One reason, beyond the

risk reduction of intact families, would be the possibility of greater parental monitoring. This is partly supported by our results: maternal monitoring was associated with injuries in three of the six data collections, whereas paternal monitoring did not play an important role. In this context, parental supervision and monitoring have been repeatedly shown to reduce the risk of injury in younger children (21, 22, 51). In older children and adolescents, high quality parenting may reduce risky practices, but too much and too little parental supervision significantly increased the number of injuries in this age group (51, 52). On the other hand, parental support was found to be associated with injury risk. This finding is consistent with the well-documented association that stronger family cohesion and a better parent-child relationship are associated with better health outcomes, and low parental caregiving behavior leads to an increased risk of injury (53, 54).

We did not find an effect of school type on injury involvement. Previous findings provide some support for the idea that school policies influence injury rates. It is also possible that the school type variable does not contain information about school characteristics that may be relevant to injury risk. However, other studies have found some school-related variables to be associated with higher injury rates, such as the availability of sports facilities, the presence of an injury prevention program, or proximity to a hospital (55).

In summary, we have seen that gender, age and socioeconomic background have a consistent impact on unintentional injuries. Boys, younger adolescents and adolescents from more affluent families have a higher risk of being injured. The association between rurality, family structure, predominantly maternal monitoring, perceived family support and injuries has been confirmed in some data collections. The findings suggest that the higher risk of injury for more affluent students is mainly due to greater involvement in physical/sports activities. Although the present paper has addressed the social and family associations of injury, the relationship between physical activity, fighting behavior and injury is worthy of further investigation in these datasets. Nevertheless, there is a need for more detailed injury data.

On the other hand, the inconsistent pattern of injury prevalence and the increase shown both in our data and in the rate of fatal childhood injuries should intensify prevention efforts in Hungary. There is a need for systematic, ongoing school-based injury prevention programs as well as home safety campaigns. Sports clubs, training teams should also be part of systematic prevention efforts, as it is assumed that many injuries are sport-related (e.g. horse riding, cycling injuries). In parallel with prevention efforts, the development of pediatric emergency and trauma care is essential to reduce the burden of disease from late hospitalization.

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Author Contributions

All authors contributed to the conception and design of the study. Data collection and analysis was performed by *Dóra Eszter Várnai, Ágnes Németh, Edit Sebestyén, Zsolt Horváth, Noémi Kovács. Gabriella Páll* and *Zoltán Ringwald* commented on the results. The first draft of the manuscript was written by *Dóra Eszter Várnai*. All authors read and approved the final version of the manuscript.

Ethical Approval

The design of the Hungarian survey was approved by the Ethics Committee of the Medical Research Council (ID number IV/1638- 3 /2022/EKU).

Consent to participate

Informed consent was obtained from all study participants or their parents.

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