

School injuries and their prevention from the present perspective

Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Data Interpretation
- E Manuscript Preparation
- F Literature Search
- G Funds Collection

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abstract

Background: Injuries are considered worldwide to be the most significant health problem, especially in childhood. In the Czech Republic, injuries are the most common cause of death among children and young adults. The aim of the study was to provide more insight in school accidents in the Czech Republic from 2008 to 2018 and to estimate future trends.

Material and methods: Annual reports of the Czech School Inspectorate (CSI) from 2007 to 2017 were the main sources of data.

Results: A high number of injuries occur in the school environment, especially at the primary level. In the Czech Republic, there has been a trend of rising numbers in reported school injuries over the last three years, from 33,000 in 2008 to 46,000 in 2018. Over the last 5 years, the number of reported accidents has increased by 1,000 per year. The most injuries occur in primary schools, within the subject Physical Education.

Conclusions: There are many activities which focus on the prevention of child injuries, the incidence of which has improved in recent years. Experience shows that when prevention programs include innovations and interesting presentation methods, they are successful.

Key words: injuries, cause of death, children, school, prevention.

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INTRODUCTION

Injuries are a serious problem from a medical, social and economic point of view. An injury means a bodily harm caused by a sudden and violent action of external forces. Injuries fall into the category of the most serious events that permanently change the health condition of a large share of the population, increasing the number of premature deaths and leading to significant financial losses for the society [1].

Child injuries are a particularly serious problem, since they can significantly reduce the child's potential, which is at its peak at this age group [2]. Child injuries are the most common causes of death. In developed countries, they account for up to 40% of all deaths in children under the age of fourteen[3].

Injuries are preventable, which means that they can be prevented by adopting protective practices and safe behavior patterns introduced in prevention programs. Such practices must be based on an excellent knowledge of the environment in which injuries occur. Instructional materials for children and young adults must be designed to attract and engage. Today, it is common to use various forms of presentation, such as pictures, stories or games. Nevertheless, newly-designed prevention programs are constantly introducing new elements and interesting innovations.

According to the World Health Organization (WHO), more than 5 million people worldwide die each year as a result of an accident. In the European region, 550,000 people die each year as a result of violence and accidental injuries, representing 6.1% of all deaths [4]. Injuries are considered to be the biggest health problem, especially in childhood, since the most common cause of death of children aged 1-14 is an injury or poisoning [5]. The differences between countries are considerable, mostly influenced by the level of care in accident prevention. In developed countries, injuries account for more than 40% of deaths in children aged 0-14. In the 35 member states of the Organization for Economic Co-operation and Development (OECD), 20,000 children die every year; in developing countries, the number is about 1 million. In the last 25 years, the proportion of deaths due to accidents has increased from 25% to 37%.

Worldwide, the highest and at the same time the most significant accident rate is associated with transport. Traffic accidents account for up to 41% of all deaths due to injuries in children under 14 years of age. This is followed by drowning (15%), intentional injuries (14%), burns (7%) and others.

Sweden, the Netherlands and the United Kingdom are the countries that report the lowest accident rate for children and also the lowest mortality rate in children under 14 years of age due to injuries. The percentage of child mortality due to injuries did not exceed 4.7% [6]. This summary and data analysis is missing in the Czech population. Therefore, the main aim of this study was to describe school accidents in the Czech Republic from 2008 to 2019. Special attention was paid to the fragmentation and description of the highest rate of accidents by educational level, age group, regions, school activity and the most frequent types of injuries. Future trends were estimated although it is expected that they will be strongly affected by the current COVID-19 pandemic.

MATERIAL AND METHODS

Various resources have been used to obtain data on injuries for the Czech Republic and in Czech schools. One of the main sources were the annual reports of the Czech School Inspectorate (CSI) from 2007 to 2017. Other valuable sources on injuries in children and young people were methodological guidelines, documents, reports and strategies

of the Ministry of Health of the Czech Republic (MZCR) and the Ministry of Education, Youth and Sports of the Czech Republic (MSMT): Health 2020 National Strategy for the Protection and Promotion of Health and Disease Prevention, Report on the Health of the Population of the Czech Republic, Ensuring the Safety and Health Protection of Children, Pupils and Students in Schools and School Facilities and the National Action Plan for the Prevention of Child Injuries 2007–2017 and from specialized literature [7]. The collected data was summarized in terms of the absolute number of reported accidents per year and the corresponding total number of students. All data manipulations and post-processing was done in Microsoft Excel 2016. The data was fragmented according to the level as follows: kindergarten (KG), primary school (PS), high school (HS) and high professional school (HPS). Linear regression was done providing trend estimate in terms of trend line slope. The injury index was assessed as a ratio between the number of injuries and the number of students in percentage. The difference in the number of reported school accidents compared to 2007/2008 was assessed to show the evolution in the number of injuries. It is the number of reported school accidents in a given year minus the number of reported school accidents in 2007/2008. Finally, year-on-year change in the number of reported school accidents was evaluated. It is the number of reported school accidents in a given year minus the number of reported school accidents in the previous year.

RESULTS

With the child mortality rate of 8.5%, the Czech Republic, together with Mexico and Portugal, is one of the countries with the highest child mortality rate [6]. Injuries are the most serious events permanently changing the health condition of the Czech population [8]. They come third as causes of death in general, and first in the age group of children and young adults. In the Czech Republic, 26,500 children are hospitalized for an accident, and 445,000 children under the age of fourteen are treated on an outpatient basis [3].

THE MOST COMMON CAUSES OF INJURIES

Insufficient supervision by adults is the most common cause of an injury, but even more importantly, it is the lack of knowledge on the part of children regarding how to avoid the risk of an injury. In addition to road accidents, these are mostly accidents due to falls and burns [9]. For the period between 2009 and 2015, the National Register of Childhood Injuries lists falls or stumbles (19%) and hitting or kicking by another person (13%) to be the most common reasons for an accident; however, interventions with another object (6%) and other causes of falls are also mentioned, such as missteps, jumps, etc. [10].

THE MOST COMMON PLACES OF INJURIES

The most serious accidents occur in traffic, but the most common place of injury for children is the home and school [3]. According to statistics, 26% of all reported accidents from the beginning to the end of compulsory school attendance are registered in the school environment [11]. Zvadová [12] adds that school accidents make up 20 to 40% of all accidents between 6 and 14 years of age.

SPECIFICS OF SCHOOL INJURIES

The National Action Plan for the Prevention of Child Injuries [6] identifies school accidents as a significant group of injuries that occur during education in schools, in school facilities, or in the provision of school services and related activities. Thanks to the clearly defined conditions for the registration and reporting of accidents imposed on school directors by the Methodological Instruction of the Ministry of Education, Youth and Sports [13], it is possible to compare data on reported school accidents over the past 10 years very accurately. Schools that have some specific focus, for example teaching specialized physical exercises, may tend to have a higher number of accident reports, where the

physical actions of some martial arts are associated with a potential risk of injury [14]. For this reason, it is important to monitor accident data within the central system.

Injuries to children are registered not only by the CSI, but also by the Ministry of Health through the Institute of Health Information and Statistics of the Czech Republic. However, the statistics of this office are based only on reports from medical doctors, and they typically do not examine where and how the accident actually occurred. The doctor only enters into the records the information provided by the person accompanying the injured child.

SCHOOL ACCIDENT STATISTICS FROM 2008 TO 2019

Kindergartens, primary schools, secondary schools, colleges and other school facilities reported a total of 31,000 school accidents in the school year 2006/2007. Until the school year 2014/2015, the number of reported accidents did not exceed 37,000. Moreover, it was lower in some years. For example, in the school year 2012/2013, the number of reported injuries was only 29,000. The number of reported accidents has increased over the last five years (Table 1). The reason for this trend of an increasing number of reported injuries may be declining movement skills of children and pupils, and also a growing tendency of these age groups to engage in riskier activities [15].

Table 1. General overview of reported school accidents and number of students

School year	NUMBER OF SCHOOL ACCIDENTS REPORTED							NUMBER OF STUDENTS			
	Total*	Total+	KG	PS	HS	HPS	Other	Total	KG	PS	HS
2006/2007	31149							1785338	285419	919800	580119
2007/2008	33488	33488	679	22759	9771	279		1752067	291194	888000	572873
2008/2009	31456	30714	698	20530	9288	198		1728108	301620	858627	567861
2009/2010	31983	31983	793	20852	10338			1710075	314008	836372	559695
2010/2011	31890	31890	1220	17831	12839			1695998	328612	830908	536478
2011/2012	36626	36626	1036	24648	10228	714		1683094	342521	835796	504777
2012/2013	29191	29191	901	19748	8047	495		1677504	354340	848755	474409
2013/2014	31441	21315		21315				1684374	363568	868324	452482
2014/2015	38710							1701712	367603	894815	439294
2015/2016	41648	41648	1421	26145	10612	38	3432	1719255	367361	921054	430840
2016/2017	43177	43177	1635	26832	11048	38	3624	1738794	362653	947497	428644
2017/2018	44572	44572	1657	27994	11083	49	3789	1755789	362756	967717	425316
2018/2019	45726	45726	1697	28945	11245	47	3792	1771281	363776	982878	424627

KG - kindergarten, PS - primary school, HS - high school, HPS - high professional school

* reported in the literature

+ sum of individual items (KG + PS + HS + HPS + others)

With respect to the stated values of school accidents, it is necessary to take into consideration that any increase can be caused both by an actual increase of the observed phenomenon and also by a more accurate reporting of this phenomenon [16]. As stated in the last CSI annual report for the school year 2018/2019, teachers are becoming increasingly more meticulous in reporting minor incidents for which they would not have previously assumed the possibility of compensation. The number of accidents according to individual educational levels from the data of the Czech Statistical Office [17] in total corresponds to the reported number of accidents according to the Annual Reports of the Czech School Inspectorate, except for the school years 2008/2009 and 2013/2014 (Table 1). The presumed cause may be a change in the methodology of data collection and also the unavailability of data on accidents for individual educational levels for specific school years (school years 2006/2007, 2013/2014, and 2014/2015).

The reported school injuries have an increasing tendency especially for the primary school level (Fig. 1). Trend line slope for the total number of injuries was 986 injuries per year with the coefficient of determination $R^2 = 0.7058$. It was 98, 783 and 104 injuries per year for KG, PS and HS, respectively, with $R^2 = 0.8983, 0.6527$ and 0.1035 .

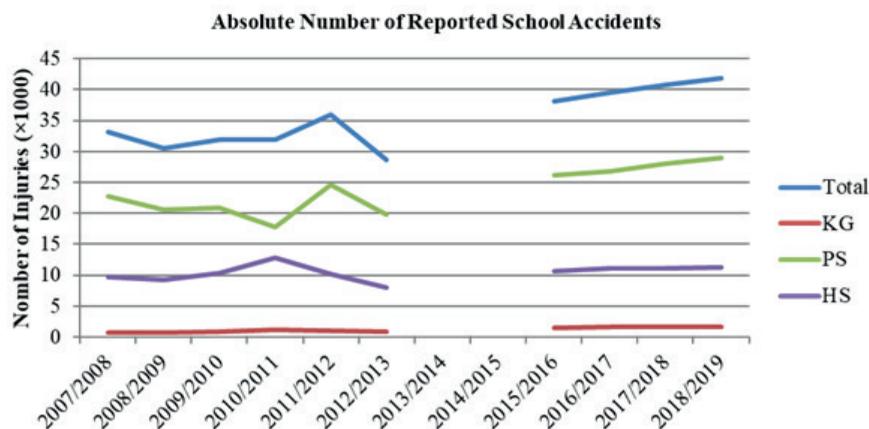


Fig. 1. General overview of reported school accidents

(KG - kindergarten, PS - primary school, HS - high school)

The increasing trend is also confirmed by the Injury Index (Table 2) which remains under 3%, i.e. less than 3% of the students experience an injury related to the reported school accident. This result is even more pronounced when expressed in terms of the difference in the number of accidents with respect to 2007/2008 (Fig. 2).

Table 2. Injury index (No injuries / No students $\times 100$ (%))

School year	Total	KG	PS	HS
2007/2008	1.90	0.23	2.56	1.71
2008/2009	1.77	0.23	2.39	1.64
2009/2010	1.87	0.25	2.49	1.85
2010/2011	1.88	0.37	2.15	2.39
2011/2012	2.13	0.30	2.95	2.03
2012/2013	1.71	0.25	2.33	1.70
2013/2014	-	-	2.45	-
2014/2015	-	-	-	-
2015/2016	2.22	0.39	2.84	2.46
2016/2017	2.27	0.45	2.83	2.58
2017/2018	2.32	0.46	2.89	2.61
2018/2019	2.36	0.47	2.94	2.65

KG - kindergarten, PS - primary school, HS - high school

However, the year-on-year change in the total number of accidents seems to have a gradual declining trend at least in the last three years (Table 3, Fig. 3).

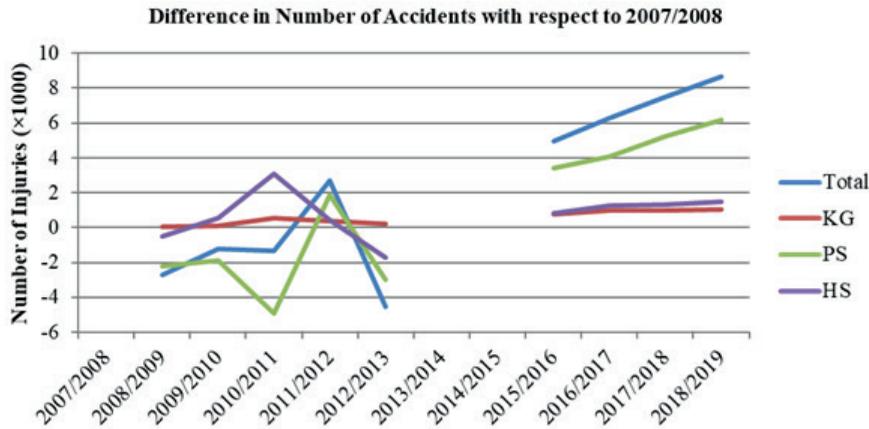


Fig. 2. Change in the number of reported school accidents compared to 2007/2008. It is the number of reported school accidents in a given year minus the number of reported school accidents in 2007/2008

(KG - kindergarten, PS - primary school, HS - high school)

Table 3. Year-on-year change in the number of accidents. It is the number of reported school accidents in a given year minus the number of reported school accidents in the previous year

School year	Total	KG	PS	HS
2008/2009	-2693	19	-2229	-483
2009/2010	1467	95	322	1050
2010/2011	-93	427	-3021	2501
2011/2012	4022	-184	6817	-2611
2012/2013	-7216	-135	-4900	-2181
2013/2014				
2014/2015				
2015/2016				
2016/2017	1337	214	687	436
2017/2018	1219	22	1162	35
2018/2019	1153	40	951	162

KG - kindergarten, PS - primary school, HS - high school

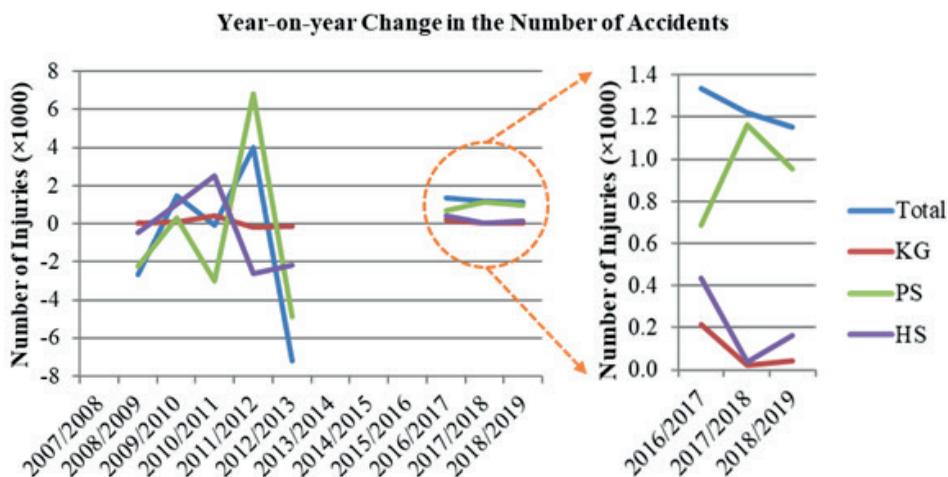


Fig. 3. Year-on-year change in the number of accidents with zoom on last three years. It is the number of reported school accidents in a given year minus the number of reported school accidents in the previous year

KG - kindergarten, PS - primary school, HS - high school, HPS - high professional school

THE HIGHEST RATE OF ACCIDENTS BY EDUCATIONAL LEVEL

Primary schools register the highest number of reported accidents every year. Since the school year 2007/2008, there have been between 18,000 and 29,000 reported accidents annually. For the school year 2018/2019, the number of primary school accidents was 29,000 which represented 62% of the total number of reported accidents in the Czech Republic between 2018 and 2019 [15].

THE HIGHEST RATE OF ACCIDENTS BY AGE GROUP

Zvadová states that the age range of 11–12 years for girls and 12–13 years for boys is the most risky one due to the acceleration of growth in puberty and associated weight gain. For girls, 39% of all accidents occur throughout the period around the age of 12, and for boys, 37% of all accidents around the age of 13. In the stated age range, an accident affects every fourth girl and every third boy. Injuries in boys are more frequent by 18% compared to girls. Overweight and obese children are four times more likely to be injured [12].

THE HIGHEST RATE OF ACCIDENTS BY REGIONS

Since 2008, the highest school accident rate has been reported by the Pardubice Region and the Vysočina Region. The lowest school accident rate is in Prague. Every year, Pilsen ranks 6th to 9th out of 14 monitored regions [15].

THE HIGHEST RATE OF ACCIDENTS BY SCHOOL ACTIVITY

The highest number of reported school accidents since 2008 comes from group activities within the subject of Physical Education. School breaks are second in terms of accident occurrence. The third place relates to individual activities in Physical Education and the fourth place to standard classes. To a lesser extent, accidents also occur during school trips or specific courses [15]. The National Register of Childhood Injuries states that 54% of accidents occur directly at school and during sports events, on school playgrounds and other premises [10].

THE MOST FREQUENT TYPES OF INJURIES

According to the National Register of Childhood Injuries, the most common type of injury between 2009 and 2015 was a fracture, accounting for almost 50%. Concussion, contusion and various forms of joint injuries were among other frequent types [10]. Injuries that occur at school are most often related to the upper limb (50%), followed by the lower limbs, head, neck or chest area [15]. The International Classification of Diseases contributes to the detailed description of specific injuries. It aims to ensure that diseases, injuries, causes of death and other relevant health problems are reported and classified in the same way in all WHO Member States [18].

PREVENTION

The influences of family and school are the key factors in the prevention of injuries in children. It is the school education system that is the second most important place where children and young people can be influenced in a long-term and effective way about how to handle the common risks of life. This is also confirmed by the motto of the methodological instruction of the MSMT for the School Preventive Program for Kindergartens and Primary Schools and School Facilities:

“The most effective and cheapest prevention is the healthy upbringing of children in the family and at school. Good education of children is also a program of prevention of individual health-damaging and life-degrading addictions and phenomena” [19].

The aim of this methodological instruction is to offer the school specific ways to become a place for safe and effective education. However, each school is unique and thus it must decide about the particular areas on which to focus in its preventive activities.

Another important document is the National Strategy for the Primary Prevention of Risk Behavior of Children and Youth for the Period 2013–2018 [20], which focuses on prevention of the development of risks in the behavior of children and youth. These risks also include injuries during sports activities and in transport.

The document Methodological Guidelines for Ensuring the Safety and Health Protection of Children, Pupils and Students in Schools and School Facilities established by the MSMT [13] focuses on the safety of students. The school has to ensure the safety and health protection of students in education. Attention is paid to the responsibilities of students, their health conditions and requirements, supervision, protective equipment and specific school activities, such as swimming, ski training, etc.

PREVENTIVE EDUCATIONAL MATERIALS

Based on methodological instructions and recommendations, a number of preventive materials focusing on injuries in children and young people have been created. Contracting authorities, sponsors or creators of the materials include individual regions, cities, state health institutes, health insurance companies, ministries or non-profit organizations. In the years 2007 to 2014, the Vysočina Region co-financed, in cooperation with the State Institute of Public Health in Prague several publications entitled: *So That Nothing Happens* (2014), *Danger Lurks Everywhere* (2013), *Now I Know* (2007). These workbooks and methodological worksheets incorporate pictorial material and focus on kindergarten and primary school children.

The mutual cooperation of the General Health Insurance Company, the Capital City of Prague and the non-profit organization called Childhood without Injuries resulted in a number of preventive educational materials in the pdf format, such as the documents “Home Security Audit”, “Tips for Games, Activities and Worksheets”, “Prevention of Risk Behavior”, “First Aid” and others. The added value is linked to the innovative approach, which is aimed at children and young people and attempts to address them with artistic color elements, memory games, jigsaw puzzles, coloring books, etc. [17].

Between 2003 and 2010, a specially adapted ambulance travelled to the district towns of the Czech Republic, bringing teaching materials for schools, activities for children and information for their parents. The van from the project partner Mercedes Benz attracted the necessary attention and promoted associated activities such as press conferences, training for teachers and other events. A similar event was the mobile “Giant Kitchen” project, which focused on accidents at home. Here, too, a specially adapted car toured the schools and offered them experience and new information through an interestingly designed interior [12].

CONCLUSION

Injuries to children do not happen without a reason, they have their causes. An important role of preventive measures is to anticipate and avoid risky situations. It is necessary to look for new innovative forms of presentation of prevention programs aimed at children and youth. A special role is played by the school, especially the primary school, where the largest number of accidents occur every year. On the other hand, while the total number of reported school accidents has been increasing every year since 2007/2008, there is a declining year-on-year trend. This may suggest that prevention programs work and have a positive impact.

In today’s world, which is literally full of information stimuli, the attention of children makes ever-increasing demands on the attractiveness of such programs. Properly targeted and timed prevention programs for children and young people can help them to avoid their injuries. It is expected that the current COVID-19 pandemic will have a tremendous effect on data collected and reported in near future considering strong school attendance

restrictions in the Czech Republic. A close follow-up and analysis of data and prevention programs will be needed even more with special focus on mental health possibly negatively affected by the pandemic-related restrictions.

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