



## Research Article

# School Sports Injuries and Possibilities for Prevention

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### Abstract

**Background:** A high percentage of all sports injuries occur during school sports. **Objective:** The present study examined school sport injuries of all 107 Middle schools (Neue Mittelschule, NMS) in the federal state of Tyrol (Austria). **Methods:** All physical injuries occurring during school sports resulting in the consultation of a medical doctor and, therefore, reported to the general accident department (Allgemeine-Unfallversicherungsanstalt [AUVA]) were evaluated. **Results:** During the school year 2017/18, 1124 school sports injuries were reported among 28,720 pupils in all NMS. The incidence of school sports injuries in this period was 39.1 per 1,000 students per school year. Fifty seven percent of the injuries (n=647) occurred while playing ball sports followed by gymnastics (19%, n=215). The most common injuries were distortions (31%). Upper limb injuries were dominant (55%), with the fingers most commonly affected. Boys were less likely to suffer from upper limb injuries compared to girls (OR=0.66, 95% CI: 0.52; 0.84), while they had a higher risk for injuries to the lower limb (OR=1.48, 95%CI: 1.14, 1.91). **Conclusion and Recommendation:** Injuries in ball sports and gymnastics account for a significant number of all school sport related injuries. Upper limb injuries account for the vast majority of all injuries and are more common in girls than boys. Preventive measures such as a fitness and skill training (e.g. proprioception) may reduce injury rates in school sport.

**Keywords:** Injury; Prevention; Adolescents; Youth; Physical Education

### Introduction

Physical activity and sport are important contributors to the development and well-being of children and adolescents. They provide emotional balance and promote social contacts along with several health benefits. However, this is only one side of the medal, because those who do sports also run the risk of acute and/or chronic damage to their body. Sports participation is connected to a statistically calculable frequency of injury depending on the chosen type of sport and the intensity [1].

Accident statistics show that a high percentage of all sport injuries occur during school sports [2-4]. Depending on gender, age and the sport-related performance capabilities; school sport contributes to up to 51% of total injuries in youth [5]. Even though most school sport injuries are minor and result in only temporary impairments; they can lead to absence from school and therefore cause deficits in the transfer of knowledge [6]. In this context, the undeniably positive sustainable effects of school sports on the physical and psychosocial development of the pupils must not be forgotten [7].

A key aspect of physical education (PE) should be the motivation of children and adolescents for sustainable participation in sports activities. Negative experiences, like injuries suffered during a school sport lesson may challenge the chances of fulfilling this goal [8]. As a consequence, preventive measures to reduce the risk of injury have a high priority [2,3,9,10].

Within the last couple of years several studies have addressed the types of sport causing injuries in school sports [2,11-13]. For example, ball sports were identified as causing

the second most injuries in school sports after artistic gymnastics [2,3,13]. Type, frequency and distribution of sport injuries in accordance to the types of schools, however, have hardly been empirically investigated [14].

The aim of the present study, therefore, was to determine the frequency, type and anatomical-topographical distribution of injuries sustained in PE in Austrian middle school students in order to enhance our understanding of key risk factors that would subsequently allow for the development of preventive measures to reduce accidents in school sports.

### Materials and Methods

In the federal state of Tyrol (Austria) 28,720 students between 10 and 14 years of age attended the 107 middle schools (Neue Mittelschule, NMS) in the school year 2017/18. During this school year, adolescents generally engaged in two PE classes per week. All school sport injuries suffered by students have to be reported to the General Accident Department (Allgemeine Unfallversicherungsanstalt [AUVA]). The AUVA is the social accident insurance for all school children in Austria. Filing a report about the accident (AUVA Accident Report) is a mandatory procedure. Electronically submitted reports include data about the school, the injured student as well as some information about how the accident happened. Teachers specify how the accident occurred along with the type of sport when it occurred. Further, the scene of the accident and the mechanism of the injury are documented by the teacher while the doctor is responsible for medical diagnosis of the injury and

determination of treatment. In the context of this study, all physical harm suffered during PE and school sports that resulted in the consultation of a medical doctor were considered an injury.

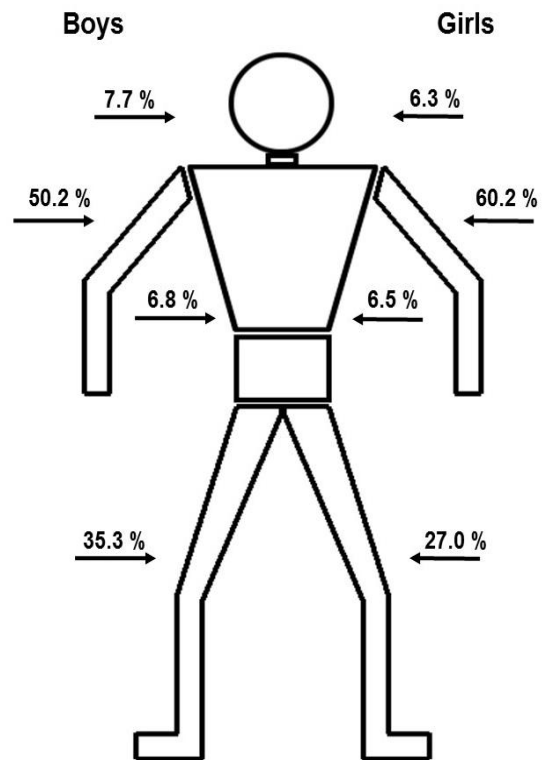
**Analyses**

As part of the description of the data, relative and absolute frequencies were calculated. In order to determine the incidences (number of injuries per 1,000 students per school year), the frequencies of the annual AUVA accident reports were put in relation to the total number of students, which was provided by the federal state of Tyrol. Sport injuries of the school year 2017/18 were compared in terms of the injured body parts (head, trunk, spine, upper and lower extremity), types of injury (commotion cerebri, contusions, lacerations, distortions, fractures, torn ligaments, muscle/tendon injuries and others) and type of sport (ball games, artistic gymnastics, athletics, water sports, winter sports). Further, odds ratios were calculated to examine sex-differences in injury location.

**Results**

A total of 1124 school sport injuries (538 in girls and 586 in boys) were reported to the AUVA in the school year of 2017/18. The incidence of school sports injuries during the study period was 39.1 per 1,000 students per school year.

The most common types of injuries were distortions (31%; n=344) and fractures (26%; n=290) (Table 1).



**Figure 1:** Prevalence of injuries by Anatomical-topographic location in boys and girls during the school year 2017/18.

Location Injury type	Head		Trunk, Spine		Upper Limb		Lower Limb		Total N (%)
	Girls N (%)	Boys N (%)	Girls N (%)	Boys N (%)	Girls N (%)	Boys N (%)	Girls N (%)	Boys N (%)	
Commotion Cerebri	6(18)	10(22)	-	-	-	-	-	-	16(1)
Contusions	7(20)	8(18)	14(40)	17(42)	73(23)	79(27)	21(14)	33(16)	252(22)
Lacerations	16(47)	22(49)	6(17)	5(13)	12(4)	17(6)	7(5)	12(6)	97(9)
Distortions	-	-	7(20)	7(17)	97(30)	82(28)	63(43)	88(43)	344(31)
Fractures	5(15)	4(9)	2(6)	5(13)	113(35)	90(30)	29(20)	42(20)	290(26)
Ruptured Ligaments	-	-	-	-	10(3)	8(3)	12(9)	15(7)	45(4)
Muscle/Tendon Injury	-	-	4(11)	5(13)	9(2)	9(3)	6(4)	9(4)	42(4)
Others	-	1(2)	2(6)	1(2)	10(3)	9(3)	7(5)	8(4)	38(3)
<b>Total</b>	<b>34(100)</b>	<b>45(100)</b>	<b>35(100)</b>	<b>40(100)</b>	<b>324(100)</b>	<b>294(100)</b>	<b>145(100)</b>	<b>207(100)</b>	<b>1124</b>

**Table 1:** Injury types and location of 1124 school sport injuries (538 girls; 586 boys) in 28,720 NMS pupils in Tyrol (Austria) during the school year 2017/18.

Nevertheless, minor injuries like lacerations, distortions and contusions (n=693) were twice as common as serious injuries like fractures and ruptured ligaments (n=335). The upper limb was most frequently affected with 54.9% (n=618). Particularly finger injuries were prominent 31% (n=342). In the lower limb, ankle injuries and knee injuries were reported most frequently (14%, n=154 and 6%, n=71, respectively), while 5% (n=57) of injuries occurred at the toe region.

Across the entire number of school sport injuries, injuries to the upper extremities (n=618) were more common than injuries to the lower extremities (n=352). Boys, however,

were less likely to experience injuries to the upper extremities (OR=0.66, 95%CI: 0.52, 0.84) compared to girls, while they were more likely to experience injuries to the lower extremities (OR=1.48, 95%CI: 1.14, 1.91). No sex differences were observed for the prevalence of head and trunk/spine injuries (Figure 1).

Most PE injuries were caused by ball sports (57%; n=647), followed by gymnastics (19%; n=215) and winter sports (10%; n=111). Injuries in athletics and swimming were less common (Table 2).

Sport types \ Location	Total	Ball Games	Gym-nastics	Athletics	Water Sports	Winter Sports	Others
Head/Throat	79 (7%)	56 (9%)	8 (4%)	-	-	12 (11%)	3 (5%)
Trunk/Spine	75 (7%)	13 (2%)	25 (12%)	7 (8%)	-	22 (20%)	8 (14%)
Finger	342 (31%)	298 (46%)	24 (11%)	2 (2%)	-	12 (11%)	6 (10%)
Hand	82 (7%)	26 (4%)	31 (14%)	-	-	13 (7%)	12 (15%)
Wrist	70 (6%)	48 (7%)	12 (6%)	4 (5%)	-	4 (4%)	2 (3%)
Forearm	41 (4%)	6 (1%)	18 (8%)	4 (5%)	-	12 (11%)	1 (2%)
Elbow Joint	33 (3%)	12 (2%)	9 (4%)	3 (3%)	-	6 (5%)	3 (5%)
Upper Arm	14 (1%)	-	5 (2%)	-	-	4 (4%)	2 (3%)
Shoulder	36 (3%)	12 (2%)	14 (7%)	4 (5%)	2 (29%)	4 (4%)	3 (5%)
Toes	57 (5%)	39 (6%)	12 (6%)	3 (3%)	3 (42%)	-	-
Foot	32 (3%)	8 (1%)	10 (4%)	4 (5%)	2 (29%)	6 (5%)	2 (3%)
Ankle	154 (14%)	81 (12%)	34 (16%)	32 (37%)	-	2 (2%)	5 (8%)
Lower Leg	23 (2%)	10 (1%)	2 (1%)	2 (2%)	-	7 (6%)	2 (3%)
Knee Joint	71 (6%)	38 (6%)	9 (4%)	15 (18%)	-	5 (4%)	4 (7%)
Thigh	15 (1%)	-	2 (1%)	6 (7%)	-	2 (2%)	5 (8%)
<b>Total</b>	<b>1124</b>	<b>647</b>	<b>215</b>	<b>86</b>	<b>7</b>	<b>111</b>	<b>58</b>
Percentages are rounded							

**Table 2:** Anatomical-topographic location and sport types of 1124 school sport injuries of 28,720 NMS pupils in Tyrol (Austria) during the school year 2017/18.

## Discussion

A total number of 1124 reported injuries reflects an incidence of 39 injuries per 1,000 students per school year in NMS in Tyrol (Austria). These results are comparable to those reported for previous years. During the school-year 2010/11, for example, an incidence of 40.4 injuries per 1,000 students has been reported [15]. The present study also showed that minor injuries, such as lacerations, distortions and contusions, were twice as likely to occur than serious injuries (i.e. fractures, ruptured ligaments). Injuries affected predominantly the upper limbs and particularly the fingers, which has been previously shown as well [4,8].

Generally, more than half of all injuries could be attributed to ball sports (58%), followed by gymnastics (19%). Other studies also reported that ball games are the dominant contributors to injuries in PE [8,15]. This may also explain sex differences in the location of injuries with injuries to the upper extremities more commonly occurring in girls, while injuries to the lower extremities are more common in boys. Football/soccer is the dominant sport in boys while volleyball or basketball is more common in girls [15]. Further it has been argued that a more active and vicious engagement of boys in ball games compared to girls may contribute to a difference in injury location [16]. Despite the higher prevalence of injuries during ball games it should be considered that ball games are commonly perceived as more enjoyable than other physical activities and thus they should be integrated in physical education lessons [8].

## Possibilities for prevention

PE and school sports should promote a positive attitude towards sports and physical activity. Injuries during PE or

school sports, however, may hinder this goal [8]. Preventive measures to minimize the risk for injuries during physical activities in school are, therefore, of high importance [9,11,17]. Facilitating and ensuring on-task behavior throughout the entire lesson along with the development of fundamental movement skills are critical contributors for injury prevention [4,8]. Given the high prevalence of injuries during ball games a particular focus on object control skills, such as passing and catching, may be warranted. In addition to the development of fundamental skills a basic understanding of the dynamics of ballgames needs to be developed prior to practising more advanced and sport-specific skills [2].

Holm et al. [18] found in their study that a combination of sensorimotor training and a specific warm-up program significantly lowers the injury frequency in ballgames. Various other studies also showed a reduction in injuries, particularly to the lower extremities, with a sensorimotor training (e.g. implementation of balance disc) [3,10,11,19-21]. Balance exercises can be easily implemented during PE lessons or in the regular classroom with relatively small efforts. Adjusting ball size and weight according to age and abilities of the students could be another approach as the stress on the muscular-skeletal system during ball games is higher in youth compared to adults [22].

## Limitation

While the present study provides representative data on injury rates in 10- to 14-year old students in the federal State of Tyrol (Austria) it should be considered that limited information on individual risk factors such as obesity or deficits in motor skills was available. Further, the potential deficiencies in data collection by teachers or doctors cannot be assessed.

## Conclusion and Recommendation

Results of the present study showed an injury incidence of 39 per 1,000 students per school year in Austrian middle school students. Most injuries occurred during ball games and artistic gymnastics. The dominance of injuries to the upper limb, predominantly the fingers, may be attributed to a lack of relevant technical skills. Accordingly, basic motor and technical skills should be emphasized in physical education in order to prevent these injuries in school sports. In addition, sensorimotor training has been shown to be a useful measure in reducing the risk for injuries to the lower extremities.

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**Received date:** July 24, 2018; **Accepted date:** August 02, 2018; **Published date:** August 04, 2018

**Citation:** Greier K, Drenowatz C, Ruedl G (2018) School Sports Injuries and Possibilities for Prevention. *J Health Sci Educ* 2(4): 144.

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