

INJURIES OF PRIMARY SCHOOL CHILDREN DURING SPORTS ACTIVITIES POŠKODBE OSNOVNOŠOLSКИH OTROK PRI ŠPORTNI DEJAVNOSTI

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ABSTRACT

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Introduction: The purpose of the research was to analyse the injuries of primary school children in the framework of organised sports activities at school and in clubs or associations, and in leisure time without professional guidance.

Methods: We surveyed 631 participants, of which there were 282 boys and 349 girls from eight Slovenian primary schools. Frequencies were calculated and a Chi-square test was performed.

Results: In physical education (PE) at school, 32% of the participants were injured in one school year, and there were no statistically significant differences in the number of injuries according to sex ($p=0.18$) and age ($p=0.12$). Most injuries were recorded in the lower extremities (50%), in the form of wounds. The participants were injured less often in PE at school than in a club or association, and more often than in their leisure time. The participants were absent from PE classes for longer after an injury in a club or association than in PE, while no significant differences in absences after injury were found. At school, the participants were most often injured in ball games, boys in football (43%) and girls in volleyball (19%). In activities in a club or association, we recorded the most injuries in boys in martial arts (18%) and dance for girls (19%). In their leisure time, boys suffered the most injuries from football (26%) and cycling, while girls suffered the most from running and rollerblading.

Conclusion: In the last ten years, the number of injuries in PE has increased in Slovenia. Based on the obtained results, we propose measures to reduce injuries and thus encourage more sports activities among children and adolescents, while ensuring their safety.

IZVLEČEK

Ključne besede:

poškodbe
otroci
osnovne šole
športna vzgoja
prosti čas

Izhodišča: Namen raziskave je bil analizirati poškodbe učencev osnovne šole v okviru organizirane športne dejavnosti med poukom v šoli in klubu/društvu ter v prostem času brez strokovnega vodstva.

Metode: Anketirali smo 631 učencev, od tega 282 fantov in 349 deklet iz osmih slovenskih osnovnih šol. Izračunane so bile frekvence in izveden hi-kvadrat test.

Rezultati: Pri športni vzgoji v šoli se je v enem šolskem letu poškodovalo 32 % učencev; statistično značilnih razlik v številu poškodb glede na spol ($p = 0,19$) in starost ($p = 0,12$) nismo ugotovili. Največ poškodb smo zabeležili na spodnjih okončinah (50 %), in sicer v obliki ran, sledijo nategi mišic in zvini sklepov. Učenci so se pri športni vzgoji v šoli manjkrat poškodovali kot v klubu ali društvu in večkrat kot v prostem času brez strokovnega vodstva. Učenci so bili dlje odsotni po poškodbi v klubu ali društvu kot pri športni vzgoji v šoli, medtem ko do bistvenih razlik v odsotnosti po poškodbi pri pouku v šoli in dejavnosti v prostem času nismo ugotovili. V šoli so se učenci največkrat poškodovali pri igranju žogo; fantje pri nogometu (43 %), dekleta pri odbojki (19 %). Pri dejavnostih v klubu ali društvu smo največ poškodb pri fantih zabeležili pri borilnih športih (18 %), pri dekletih pa pri plesu (19 %). V prostem času je bilo pri fantih največ poškodb pri nogometu (26 %) in kolesarjenju, pri dekletih pa pri teku in rolanju.

Zaključki: V desetih letih se je v Sloveniji število poškodb pri športni vzgoji povečalo, športne zvrsti, pri katerih prihaja najpogosteje do poškodb, pa se niso bistveno spremenile. Na podlagi dobljenih rezultatov smo predlagali ukrepe za zmanjševanje poškodb. Ti spodbujajo športno dejavnost otrok in mladostnikov, hkrati pa zagotavljajo njihovo varnost.

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1 INTRODUCTION

Sport-related injuries have become a field of great interests to researchers, and such injuries among children and adolescents are an important public health problem, accounting for 30% to 40% of all injuries (1, 2), with a wide range of negative consequences (3). Sports injuries are associated with different risk factors, such as sex, age, previous injury, early specialisation, cognitive and behavioural abilities, socioeconomic status, and so on (4, 5). Understanding different risk factors is a basis for injury prevention in children and adolescents (6).

The risk of injury is usually higher in young children who are not aware of the risks when playing, and their parents are usually unable to mitigate these risks using evidence-based prevention principles (7-9). Daily physical activity declines as children get older (10), and as they enter adolescence they become less motivated to engage in sports (11, 12). However, they also become more independent and less monitored by parents during physical activity, and often injured during the team sports (5, 13). In a multicentre study more than one third of Slovenian adolescents older than 15 years reported at least one injury requiring medical attention during the previous year, and half of those injuries occurred while doing sports (14). Most studies examining sports injuries among children and adolescents reported that boys were more prone to injuries due to their riskier behaviour, lack of use of protective equipment, and even socialisation issues (4, 6, 15-17).

Despite the fact that injury prevention is explained in the physical education (PE) curriculum, such injuries still occur during PE classes. Even more, some authors have reported that PE injuries are more common than leisure time or after-class sport-related physical activity injuries. However, other authors from Slovenia and Finland have shown that the occurrence of injuries during PE classes is actually lower than in other contexts (13, 16), stressing the role of the PE teacher with regard to monitoring physical activity and the use of active injury prevention measures. Injuries are more frequent during competitive sports regardless of the different age groups (e.g. children or adolescents) (18, 19). Fortunately, the severity of most injuries that occur in PE classes is low, affecting mainly the lower extremities (20-23), while in preschool and early primary school children (i.e. the first three grades) head injuries are also common (9, 22, 23). The severity of injuries is reported based on the time needed to return to physical activity and/or sport, which is usually between one and three weeks, indicating mild to moderate injuries (20), and there are only few severe injuries requiring more than two months to return to such activities (24).

As finding out the magnitude of problem is the first step in injury prevention, we conducted a large epidemiological study a decade ago in which it was found that the incidence rate of PE class injuries in Slovenia was 16%, while the incidence of leisure time injuries was more than twice this, at 36% (13). Additionally, the study showed no sex-related difference in the incidence of injuries during PE classes, but there were differences in the sports most related to the injuries in boys (football, basketball) and girls (volleyball, basketball). However, it was interesting that the boys were injured during the same sports as in the PE classes, while in girl's leisure time the injuries were related to rollerblading, cycling and volleyball.

Given the importance of sports injuries in the primary school population, the main aim of our study was to analyse PE classes and leisure time physical activity injuries in primary school students and to determine whether there were significant changes in comparison to the previously published data from decade ago (13).

2 METHODS

2.1 Study design

This was a cross-sectional study in which primary school students self-reported injuries sustained during PE classes, sports training (in clubs and associations) and leisure-time physical activity in previous year. Injuries were reported using the same report form that was used in our previous study (please see details below) (13).

2.2 Subjects

We invited 1,342 children from eight primary schools from three different Slovenian regions (Goriška region, Gorenjska region and Central-Slovenian region). The research included children from three large schools in an urban area, three small schools from a semi-urban environment and two small schools from a rural environment. The response rate was 47%, so the final sample included 631 participants. Among them there were 282 boys (44.7%) and 349 girls (53.9%) Pupils ranged in age from 12 to 15 years, with a mean age of 13.4±1 years. The study was approved by the Ethical Board of the Faculty of Sport at the University of Ljubljana. After the verbal consent of the participants was obtained, the PE teachers from the primary schools distributed the injury report forms and written consent forms to the participants. The injury report forms were taken home to be reviewed, signed and approved by participants and their parents, who signed a written consent for their child to participate in this study. All injury report and consent forms were returned to the PE teachers after two weeks.

2.3 Statistical analyses

All the data was analysed using the IBM SPSS Software for Windows (version 21, SPSS Inc., Armonk, New York, USA). Categorical variables are given as numbers and percentages, and numeric variables are presented as means and standard deviations. All numeric variables were first checked for normality of distribution with the Shapiro-Wilk's test. The differences in injury proportions were assessed with a chi-square test. The significance level was set at a p-value of <0.05.

3 RESULTS

The results showed that 68% of the interviewed participants engage in organised after-school sports activities in an association or club, and 83% regularly engage in leisure time sports activities without professional guidance, and thus only 17% of the respondents were classified as inactive in this regard. We found that there were no statistically significant differences between the sexes in the frequency of engaging in sports activities in a club or association ($\chi^2=12.75$; $p=0.18$), or sports activities in leisure time without professional guidance ($\chi^2=7.08$; $p=0.68$).

Table 1 presents the number of injuries of the male and female participants during PE classes at school. The majority of children that completed the survey were not injured in such classes (68%), and 22% of them were injured only once. The results show (Table 1) that there are no statistically significant differences between the sexes ($\chi^2=4.81$; $p=0.19$), nor were there any statistically significant differences between the age categories ($\chi^2=13.95$; $p=0.12$; not shown in the table).

The most frequent injuries were to the skin (e.g., wounds, 32.0%), followed by muscle injuries (29.7%), joint sprains (28.6%), fractures (5.0%), ligament injuries (3.5%) and dislocations (1.2%). The most frequently injured anatomical areas were the knee (19.0%), ankle (17.1%), fingers (16.8%) and elbow (12.7%), while the least injured anatomical areas were the ribs (0.6%), abdomen (0.3%) and pelvic girdle (0.3%). Most of the injuries occurred in the main part of the PE class (65.0%), while injuries during

the warm-up and cool-down phase represented 13% and 21% of all injuries, respectively.

There are statistically significant differences in cumulative injury incidence between PE classes and sports training in clubs and associations ($\chi^2=93.596$; $p<0.001$) and leisure time physical activity ($\chi^2=43.889$; $p<0.001$). There were more injuries during sports training in clubs and associations than in PE classes, but surprisingly injuries during leisure time physical activity were less frequent in comparison to PE classes.

More than half of all the injured participants (56%) did not need to take time off PE classes. In the rest of the cases (44%) the injuries were slight to mild, with 22% needing an absence from PE classes of less than a week, 16% suffering a moderate injury needing a one- or two-week absence, and only 6% of all cases having a severe injury that needed more than four weeks of absence. When compared with sports training injuries suffered in a club or association, injuries in PE classes required significantly less time to return to activity, indicating a lower severity ($\chi^2=27.278$; $p=0.001$), and this was especially true for severe injuries. There were no differences in the severity between those injuries sustained in PE classes and during leisure time physical activities ($\chi^2=7.04$; $p=0.63$).

Finally, we analysed cumulative sport-related injury incidence in PE classes, sports training in clubs and associations, and leisure time physical activity. Among boys who were injured during PE classes ($N=118$), boys were injured during football (43%) and basketball (20%). Girls ($N=180$) sustained most injuries during volleyball (19%), followed by injuries during natural movement activities (18%), basketball (16%) and gymnastics (16%). Overall, it should be stressed that more than half (52%) of all injuries during PE classes are related to team sports. In contrast, team sports were responsible for only 26% and 28% of all injuries sustained during sports training in clubs and associations and leisure time physical activity, respectively. During organised sports training, out of 169 injured boys, 18% were injured when doing martial arts, and out of 206 injured girls, 19% were injured during dance classes. In comparison, injuries during leisure time physical activity were most common among boys playing

Table 1. Injury prevalence during PE classes for boys and girls.

			Number of injuries				Overall	χ^2	p
			1×	2×	>3×	Not injured			
Sex	Boys	N	59 20.9%	20 7.1%	6 2.1%	197 69.9%	282 100.0%	4.81	0.19
	Girls	N	80 22.9%	20 5.6%	18 5.3%	231 66.2%	349 100.0%		
Overall		N	139 22.0%	40 6.3%	24 3.8%	428 67.8%	631 100.0%		

Legend: χ^2 - two-way chi-square test; p - statistical significance

football, where 26% of 137 boys were injured, and during cycling, where 22% were injured. Out of the 147 girls who were injured during leisure time physical activity, 27% were injured during running and 22% while rollerblading.

4 DISCUSSION

The main findings of our study indicate that primary school children are very physically active, with only 17% of the participants being physically inactive. However, during the last school year almost one third of the participants were injured during PE classes (32%), but fortunately only 44% needed to be absent from PE classes because of this, and the majority of injuries were slight to mild. The results showed no differences in injury occurrence between boys and girls. The most frequent type of injuries were skin wounds, muscle strains and joint sprains, together accounting for 90% of all injuries. Additionally, the data suggests that injury prevalence during PE classes is lower than during sports training in clubs and associations, but higher than during leisure time physical activity.

The proportion of physically active participants found in this study is comparable to in our earlier study, a decade ago, when we reported that 88% of the participants were physically active (13). Moreover, our latest data suggests that there are no longer any significant differences in physical activity between boys and girls, as they are now equally active, when a decade ago boys were more so than girls.

However, concerns should be raised regarding the significant increase in those injured during PE classes, which has actually doubled in the ten-year period between our studies, from 16% to 32% ($\chi^2=88.228$; $p<0.001$). Still, although we have registered an increase in cumulative injury incidence, the proportion of injuries during PE classes in the current study is still the same or lower than reported in Sollerhed et al., which gives cumulative incidences of 57%, 32%, 36% and 51% for Sweden, New Zealand, the United States and Germany, respectively (25). The reasons for this increase in injury prevalence in Slovenia are not clear, and we are aware that methodological differences and selection and recall bias could partially be responsible for it, but factors related to it should be investigated in the future to better mitigate the risk. For example, it would be meaningful to link injury data with the physical fitness status of children, as Slovenia has excellent data in the form of the SLOfit system, which has now been measuring and monitoring the physical fitness of children in Slovenia for three decades (26).

Our results showed that there were more injuries during sports training in clubs and associations than during school PE classes, and the participants were often injured

more than once during such training. This is perhaps not unexpected, as this training is sport-specific and the same injury mechanism may repeat (e.g. landing from a jump during basketball or volleyball), causing re-injury. During PE classes there is more diversity of movement patterns, and the intensity is also generally lower than during training. Surprisingly, the participants reported fewer injuries in activities performed without professional guidance during their leisure time than in PE classes. This is in contrast to our previous findings (13), when there were more injuries during leisure time than in PE classes, as well as the results from a cross-sectional Finnish data (16), where the fewest injuries were also reported for children and adolescents during PE classes. One of the possible explanations for this could be that in their free time children engage in activities that they are good at (unlike some PE activities), and that they can easily stop when they feel tired. This underlines the importance of systematic injury prevention efforts, which should start with good data collection. A dedicated, online and nationwide injury reporting system should be in place to provide more reliable data, better participant compliance and real-time injury tracking, as this would enable PE teachers to implement evidence-based prevention programs (23).

The most frequent type of injuries were skin wounds, muscle strains and joint sprains, and this is in concordance with Swedish and German national data, which showed that the most common injuries in primary school children were muscle strains and joint sprains, followed by blows and wounds (2, 20).

More than half of the participants reported not being absent from PE classes due to an injury, and only 6.5% reported being absent for more than three weeks. Other studies have also shown that most participants return to sports and other physical activities soon after an injury. For example, Sundblad et al. (20) reported that 70% of injured students started doing sports again one week after an injury, while Abernethy and MacAuley (27) found that only 12% of students were absent from physical education after an injury, and more than half started sports activities again within two weeks.

Most of the injuries reported in PE classes in the current study occurred in team ball games (soccer, basketball and volleyball), regardless of the sex of the injured person. When comparing the most recent data to that in our previous work we may conclude that not much has changed regarding injuries in certain sports in the context of physical education. Even 10 years ago, ball games predominated in injury reports, with football and basketball for boys and volleyball and basketball for girls. The pattern of injuries during sports training and leisure time physical activities in the current study was comparable to that in our historic cohort. Our data is also in line with other studies which found that most injuries occur during ball games (24). For

example, Schwebel et al. (5) reported that the majority of injuries in children aged 12 to 15 occur during basketball, football and cycling. Some authors have also pointed that boys are more frequently injured in team sports and girls in individual ones (21), and generally regardless of the sex team sports account for more than two-thirds of all hospital-treated injuries in this context (5, 14).

Finally, with regard to the anatomical location of the injuries, the most common sites were the lower extremities (50%), namely injuries to the thigh, knee, tibia, ankle, calf and foot, and to the upper extremities (46%), and thus to the elbow, fingers, wrist, palm and shoulder. These results are as expected due to the contact nature of the team sports during which the injuries occurred. A similar anatomical distribution of injuries was also reported in other studies (21-23).

We would like to acknowledge some limitations to our study that should be addressed in future research. The first and major limitation is the sample size, as we would need a larger sample if we wanted to generalise our findings. In the future, it would make sense to use a unique online nationwide injury reporting system, which would increase the response rate and improve the logistics of research. The second limitation is the study design, as we are aware that a prospective cohort study would be better instead of a cross-sectional study, which limits conclusions about causality. Another problem with a cross-sectional approach is the potential recall bias, as it is difficult for a child to recall all or even any injuries after prolonged period of time, which contribute to the poor estimation of the true cumulative injury incidence. The use of an appropriate injury registration system would also address this issue. Finally, there is a need to update the questionnaire to better reflect for latest consensus regarding the recording and reporting of epidemiological data on injuries during physical activity and sports (28).

5 CONCLUSION

Our data suggests that the injury occurrence during PE classes has increased over the last ten years in Slovenia, while the sports in which injuries occur most frequently and the anatomical distribution of injuries have not changed significantly. We have not managed to identify the reasons for such an increase, mainly due to the methodological issues related to the cross-sectional design of the study.

Injury prevention is an important issue that should be addressed comprehensively with the inclusion of various experts. We need a feasible injury reporting system that would enable the tracking of injuries in real time, and provide reliable epidemiological data about injury prevalence and incidence. Such a system could be linked with the already existing and long-standing system that

tracks the physical fitness of children in order to tailor evidence-based injury prevention programmes and monitor their success. Finally, it is also necessary to provide PE teachers with additional training, where they would acquire knowledge about the implementation of prevention measures in everyday practice. PE teachers are currently trained to teach functional motor skills to increase physical literacy among children and adolescents. However, the pupils who attend PE classes have a wide range of functional movement skills, interest and motivation for PE, as well as diverse goal orientations and fitness levels. The problem is that a PE teacher can have an above- or below-average physically fit child in their class, and it is necessary to adjust or find an average level of activity that suits everyone, but at the same time satisfies the learning objectives. Individualisation of PE classes could be an important part of reducing the risk of injury, but this would probably require more hours of PE classes per week.

However, if proven successful then such an injury prevention approach could also be applied in sports clubs and societies.

CONFLICTS OF INTEREST

The authors declare that no conflicts of interest exist.

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ETHICAL APPROVAL

The study is in accordance with the Declaration of Helsinki. The study was approved by the Ethical Board of the Faculty of Sport at the University of Ljubljana.

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