

Injuries Among Slovenian Physical Education Teachers: A Cross-Sectional Study

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A cross-sectional study was carried out to examine the frequency and types of serious injuries in physical educators throughout their professional career, in relation to their gender, age and teaching level, certain factors causing the injuries and the consequences of those injuries on their working ability. The subjects (n = 468) answered a self-administered questionnaire. In men, one group's higher frequency of injuries was 1.8 (95% CI [1.26, 2.57]) times higher than in women. Every year in age increased the odds for moving into a group with a higher frequency of injuries by 7.6% (95% CI [1.06, 1.10]). The most common injuries for both genders were lower limb injuries. The most common cause of injury was the teacher's own mistake. Over 60% of teachers had to modify their teaching after an injury. It is necessary to further explore preventive strategies to reduce injuries in these workers.

occupational health injuries physical educators age gender teaching level

1. INTRODUCTION

Satisfaction at work is crucial for the success and professional development of an individual [1]. Studies show that satisfaction at work for teachers of various subjects is influenced by the factors of the working environment, such as working conditions, relationship with colleagues, work load, earnings and realistic expectations from superiors as well as sociodemographic characteristics, e.g., gender, age, teaching level and length of work experience [2, 3, 4].

Physical education (PE) teachers are a distinct part of the teaching profession due to their specific working environment, which is different from standard classrooms. Their work is carried out in changing weather conditions (outside, indoor sports halls, swimming pools, ski slopes, etc.) [5, 6]; it is also physically more demanding,

as they have to walk, run and demonstrate sports skills to students, practise with students, help them in executing skills by providing physical support. They also set up and dismantle sports equipment [7, 8]. When teaching, and prior to the demonstration of skills or joint practice with students, teachers often do not warm up [9]. Injuries are also caused by various sudden movements, when they wish to prevent potential accidents of students [6, 9, 10]. Teachers are constantly under psychological pressure, as they have to ensure a safe environment for students' practice [6], while being aware that the number of students injured has increased enormously in the past 10 years [11]. As a result, PE teachers are more often injured at work [9, 10, 12] and also have more chronic health problems than other professions [8, 9, 10, 12, 13]. There are no differences between genders regarding chronic injuries and

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the prevalence of chronic injuries is higher in older teachers and those teaching in secondary schools [9].

Despite their healthier lifestyles [14, 15, 16], PE teachers more often take sick leave than the general population [8]; as a result of various injuries, particularly musculoskeletal ones, only a small proportion of teachers is capable of working until the official retirement age [7, 10].

In the light of the rather sparse scientific literature on the injuries of PE teachers, we conducted a cross-sectional study on Slovenian PE teachers, in which our primary goals were (a) to determine the most common injuries of PE teachers as well as the differences among them according to gender, age and teaching level and (b) to identify the location and cause of injuries and their consequences.

2. METHODS

A self-administered questionnaire was created; before administration, 20 PE teachers (10 men and 10 women), with different length of work experience and working at different teaching levels, qualitatively validated the questionnaire for content. The original questionnaire was shortened slightly, according the recommendations of the validation group. It consisted of the following parts:

- demographics (gender, age, length of work experience, teaching level);
- leisure physical activity (number of hours of leisure physical activity per week, three most frequently attended sports in leisure time, past experience in sports);
- serious musculoskeletal injuries (number of injuries in professional career, type of injury, sport where an injury occurred, activity that led to injury, location of injury, cause of injury, number of sick days, duration of rehabilitation in days, insurance held at the time when injury occurred, effects of injury on future professional work). Injuries that caused a teacher to miss work and resulted in long-lasting consequences that limited their working ability were considered serious.

The study was approved by the Human Research Ethics Committee of the Faculty of Sport, Ljubljana, Slovenia, and supported by the Ministry of Education and Sport. The questionnaire was sent to all primary and secondary schools in Slovenia ($N = 584$) by regular mail. The response rate was 80.14%. This sample size ($N = 486$) represented 29% of the Slovenian PE teacher population. Teachers were informed of the objectives of the study, and of the voluntary and anonymous character of their participation.

Data were analysed with PASW Statistics 18.0 (SPSS). Basic (descriptive) statistics of variable distribution were calculated. Due to a large number of variable categories, they were grouped (see section 3). The model for predicting the frequency of injuries by age, gender and teaching level was constructed with ordinal logistic regression. The same predictors were used in binary logistic models for different types of injuries.

3. RESULTS

3.1. Participants

In the studied sample, 282 of the subjects were men (60.3%) and 184 were women (39.3%), while two PE teachers did not state their gender (0.4%); 296 taught in primary (63%) and 172 in secondary schools (37%). The structure of the sample according to gender, length of work experience and teaching level was similar to PE teacher population data found in the registries of the Ministry of Education and Sport.

The average age was 43.4 ± 10.0 years for men and 41.5 ± 8.0 years for women. Men had, on average, 18.4 ± 11.1 years of work experience, women 17.5 ± 8.8 years. For the purpose of the study, PE teachers were divided into three age groups (≤ 35 , 36–45, > 45 years of age).

Teachers, on average, participated in leisure physical activity 7.2 ± 4.0 h per week. Table 1 shows the number of teachers who participated in different sports.

3.2. Frequency of Injuries

The reported frequency of injuries in PE teachers (four groups: 0, 1, 2, ≥ 3 injuries) according to

TABLE 1. Present Sports Activity of Physical Education Teachers and Their Past Experience in Sports

Sports	Present Sports Activity		Past Experience in Sports	
	Males (n = 279)	Females (n = 181)	Males (n = 276)	Females (n = 178)
Aerobic	369 (49.3)	314 (65.3)	46 (8.7)	44 (13.9)
Ball	194 (25.9)	54 (11.2)	264 (50.0)	114 (36.0)
Racket	70 (9.3)	35 (7.3)	21 (4.0)	7 (2.2)
Strength	44 (5.9)	29 (6.0)	117 (22.2)	96 (30.3)
Other	72 (9.6)	49 (10.2)	80 (15.2)	56 (17.7)

Notes. The numbers in parentheses are percentages.

their gender, age and teaching level was analysed with ordinal regression. In this way, a model formed according to the -2 log likelihood (-2LL) criterion revealed high statistical significance ($p < .001$) and a moderate effect of the predictor set (Nagelkerke pseudo $R^2 = .154$). Statistically significant factors were gender ($p = .001$) and age ($p < .001$). In men, one group's higher frequency of injuries was 1.8 (95% CI [1.26, 2.57]) times higher than in women. Every year in age increased the odds for moving into a group with a higher frequency of injuries by 7.6% (95% CI [1.055, 1.097]).

During their professional careers, 65.1% of male and 55% of female PE teachers experienced at least one serious injury. There were more male injured teachers and the proportion of injured teachers and the number of their injuries increased with age. Only a quarter of teachers over the age of 46 had not been injured yet (Table 2).

3.3. Leisure Physical Activities

Leisure physical activities of teachers were not included in the final regression model, as their

influence on the number of injuries was very weak and statistically insignificant. The univariate analysis showed that there were no significant correlations between the number of serious injuries in PE teachers and the sports (see Table 1) that teachers practised in the past ($p = .558$) and present ($p = .905$).

3.4. Anatomical Location of Injuries

Teachers reported 73 different anatomical locations of serious injuries, which were sorted into 8 groups according to their characteristics. The most frequent were ankle and foot injuries (32% of all men and 23.9% of all women in the study) (Table 3), where the following types of injuries were reported: ankle sprain, dislocation and fracture of ankle; Achilles tendon injury; fracture of the calcaneus; midfoot fracture; toe injuries; fracture of the metatarsals; heel bruise; partially ruptured ligaments in the ankle joint; fracture to either malleolus and an injury of a lateral ligament in ankle. The second most common group of injuries were knee injuries (20.9% of men and 15.6% of women).

TABLE 2. Proportion of Injured Physical Education Teachers by Gender and Age (%)

No. of Injuries	Gender		Age (years)		
	Male (n = 278)	Female (n = 180)	≤35 (n = 121)	36-45 (n = 159)	≥46 (n = 179)
0	34.9	45.0	62.8	35.8	25.1
1	23.4	33.3	24.0	32.1	25.1
2	22.3	12.8	7.4	18.2	26.3
≥3	19.4	8.9	5.8	13.8	23.5

TABLE 3. Proportion of Injured Physical Education Teachers by Anatomical Location of Injury, Gender, Age and Teaching Level (%)

Anatomical Location of Injury	Gender		Age (years)			Teaching Level	
	Male	Female	≤35	36–45	≥46	Primary	Secondary
Ankle and foot	32.0	23.9	17.4	27.0	38.0	31.8	22.1
Knee	20.9	15.6	9.1	23.3	22.3	14.5	26.2
Upper limb	12.6	9.4	3.3	15.7	13.4	12.2	9.9
Other	8.6	6.7	2.5	8.2	10.6	7.8	7.6
Lower back and neck	7.9	10.6	2.5	9.4	12.8	7.8	10.5
Shoulder	5.8	2.2	0.8	4.4	6.7	3.4	5.8
Lower limb (other)	5.0	2.8	3.3	4.4	4.5	4.4	3.5
Head	4.0	6.1	8.3	3.1	2.8	5.1	4.1

With the exception of injuries to the back, neck and head, there were more injured men than women. Primary school teachers listed more injuries to ankles and feet, whereas secondary school teachers listed more knee injuries. In other types of injuries, the results were similar, regardless of teaching level.

Younger teachers reported more injuries to the head and other injuries of legs, apart from injuries to ankles, feet and knees. In all the other types of injuries, older teachers reported more injuries.

Although the differences in injury frequency between genders, ages and teaching level were quite substantial in the sample, only the influence of age was significant at 5% error rate in some of anatomical locations (Table 4). Especially high were the odds for shoulder injuries in older PE teachers, followed by all three most frequent locations of PE teachers' injuries, i.e., ankle and

foot, knee and upper limb. In contrast, odds for head injuries were lower in older teachers, even though not statistically significant ($p = .14$).

3.5. Location, Injury Mechanism and Consequences of Injury

The questionnaire allowed multiple answers (several injuries, factors, effects). Teachers were injured most often in regular PE lessons and when participating in leisure physical activity. The most common cause of injury was the teacher's own mistake; a high proportion of injuries occurred due to faulty floor surfaces (Table 5).

According to the teachers' answers, the median of sick leave after serious injury was 14 days, whereas rehabilitation lasted 30 days. Only 73.9% of teachers held additional personal accident insurance at the time of injury.

TABLE 4. Results of Binary Logistic Regression Models for Predicting Anatomical Location of Injuries by Gender (Male), Age and Teaching Level (Primary School)

Anatomical Location of Injury	-2LL p	Nagelkerke R^2	Adjusted OR (95% CI)		
			Gender	Age (years)	Teaching Level
Ankle and foot	.002	.045	1.18 [0.76, 1.85]	1.04** [1.01, 1.06]	1.44 [0.92, 2.27]
Knee	.006	.047	1.50 [0.85, 2.62]	1.04* [1.01, 1.07]	0.61 [0.36, 1.02]
Upper limb	.029	.040	1.22 [0.63, 2.36]	1.05** [1.01, 1.08]	1.36 [0.70, 2.64]
Other	.149	.030	1.72 [0.74, 3.99]	1.03 [0.99, 1.08]	0.84 [0.39, 1.80]
Lower back and neck	.019	.047	0.64 [0.33, 1.24]	1.05** [1.02, 1.09]	0.72 [0.38, 1.39]
Shoulder	.003	.100	2.25 [0.72, 7.00]	1.08** [1.02, 1.14]	0.54 [0.22, 1.34]
Lower limb (other)	.609	.014	1.81 [0.64, 5.14]	1.01 [0.96, 1.06]	1.24 [0.46, 3.34]
Head	.431	.022	0.76 [0.29, 2.03]	0.96 [0.91, 1.01]	0.84 [0.31, 2.26]

Notes. * $p < .05$; ** $p < .01$; OR = odds ratio, CI = confidence interval; -2LL $p = -2$ log likelihood p value.

TABLE 5. Location, Injury Mechanism and the Consequences of Injury

Variable	N	(%)
Location of injury	267	
regular PE lessons		(67.8)
leisure physical activity		(57.7)
elsewhere		(18.4)
outdoor school activities		(12.0)
extracurricular sports activities in school		(9.7)
extracurricular sports activities in sports club		(8.2)
Injury mechanism	240	
through own fault (carelessness, clumsiness, etc.)		(63.8)
surface defect (uneven, slippery floor, etc.)		(40.4)
other factors		(45.4)
injury during leisure physical activities caused by another person		(9.2)
injury during PE lessons caused by students		(3.8)
injury did not occur during physical activity		(0.4)
Physical status after injury	393	
same as prior to injury		(53.2)
worse		(46.8)
Effect of injury on future professional work	460	
teaching ability same as prior to injury		(38.9)
adapted teaching		(61.1)

Notes. PE = physical education.

Over 60% of teachers had to modify their teaching after their injury and almost half of them were physically less capable after the injury (Table 5).

4. DISCUSSION

The main findings of our study indicate that PE teachers are a group with specific professional requirements resulting in increased risk for certain injuries. Among Slovenian PE teachers, serious injuries occur more often in men. However, the data are conflicting, whereas in Canada women are injured more often than men [9] and among Swedish PE teachers there are almost no differences between the genders regarding the possibility of teachers becoming injured (0.55 versus 0.52 of injury per teacher per year for men and women, respectively) [14]. Numerous Slovenian male PE teachers work part-time in the afternoons as coaches in addition to their regular job [17]; additional work similar to the regular pro-

fession is an important factor for a larger number of chronic (overuse) injuries [9].

Similarly to other studies [9, 10], it has been found that the frequency of injuries increases with the teachers' age: every year in age increases the odds for moving into a group with a higher frequency of injuries by 7.6%. During the lessons, PE teachers in Slovenia tend to favour demonstrating the sports skills that students should learn [17]. In comparison to their younger colleagues, a more thorough warm-up is more necessary among older teachers, yet the time for doing so is short; furthermore, sudden movements, which teachers perform when helping students, could be very dangerous factors for the occurrence injuries [9]. Negative influences of the working environment (inadequate floor surfaces, different weather conditions during outdoor activities, etc.) accumulate with years of working in the same profession [6]. The influence of age is presumably even more important than indicated by our results, as (seriously) injured older teachers

probably retire earlier or change their profession [7, 8]. In addition, the present study did not examine the (time-limited) incidence of injuries; therefore, injuries are also more frequent in older teachers as a result of their chronic nature (some injuries are permanent and never heal) [18].

It can be concluded that in Slovenia, after controlling for age, there are no major differences in the injury rates among the teachers from various teaching levels, although primary school teachers have reported more injuries to ankles and feet, whereas secondary school teachers listed more injuries of knees, lower back, neck and shoulder. In Canada, high school teachers have been injured more often, with the age of teachers considered a cause [9].

The most common injuries in the professional career of Slovenian PE teachers are injuries to ankles, feet and knees, with a higher proportion of men being injured (52.9% of men versus 39.5% of women). Similarly, among Canadian PE teachers, injuries in lower limbs are most common, particularly chronic injuries of knees and ankles [9]. A slightly lower incidence of injuries in lower limbs has been reported among Belgium PE teachers [12]. In contrast, knee injuries have been particularly frequent among Swedish PE teachers [10]. Increased risk of injuries and osteoarthritis of knees has been found in both genders; Swedish female PE teachers had to change their work more often as a result of knee injuries. The reasons for such injuries probably lie in the nature of the teaching profession and working conditions. Specifically, teachers spend most of their working time standing, walking or running [9, 10], and the floor surfaces in sports halls, particularly older ones, are often not sufficiently springy (thin plastic coating, outdoor tarmac or concrete surfaces, wooden floor laid on the surface with expired supporting function due to age) [19]. As a result, landing, slipping or fast movements of the lower limbs on inadequate (mostly artificial) surfaces more quickly result in injuries of ankles, feet and knees [20, 21].

The analysis of various anatomical locations of injuries has revealed that most injuries are more frequent in men, with the exception of back, neck and head injuries. In contrast with the findings of

the present study, the Swedish study did not reveal important differences between the genders in injuries of the back and neck [10]. Among both Slovenian and Swedish male teachers, shoulder injuries occur more often than among females. Injuries of the lower back, cervical part of spine and shoulders are more common in older people for both teachers [9, 10] and the general population [8, 22]. The risk for the lower back is probably related to long periods of standing with high static loading of the lumbar spine [9, 10], which is further aggravated during some occupation specific tasks, such as protection tasks during gymnastics, carrying heavy objects, etc. [9].

Slovenian PE teachers most often become injured when working and in their leisure time. PE teachers are a physically highly active population [10, 15, 16]; as a result, the possibility of injuries in sports leisure time activities is higher [10]. Many PE teachers have past experience in competitive sports [10]. Although Canadian teachers' past sports experience was not related to acute injuries [9], participation in competitive or elite sports is an important risk factor for knee injuries among Swedish teachers [10]. The findings of the present study indicate that the number of serious injuries is not related to the sports in which teachers participated in the past or present.

Slovenian PE teachers most often reported being injured due to their own fault. Although most teachers had sports experience prior to the study [9, 10] and had acquired additional sports skills and knowledge about teaching methods and safe participation in sports during the study [9, 17], it can be assumed that they had insufficient knowledge on preventing injuries and injury risk factors; they also seemed to be less careful at work and in their leisure time activities. Probably the preparation for work was inadequate; furthermore, working conditions in numerous sports halls were inappropriate [19], as 40% of teachers listed an uneven and slippery floor surface as a cause of injury [23].

Due to injuries in the past year, 42.7% of Canadian PE teachers had to use medical help; 7.9% were later absent from work for an average of 3.3 days; 24% of teachers listed consequent limitations at work [9]. The data are not comparable

with the present study, as Slovenian teachers reported all serious injuries during their career, which resulted in medical help and absence from work. Slovenian teachers stated that after a serious injury they were absent from work for 14 days with rehabilitation lasting 30 days. Over 60% of teachers stated that they had to adapt their teaching as a result of injury, indicating that they were limited in their professional work (e.g., in demonstrating skills, when helping pupils, when joining the practice). Almost half of them were physically less prepared, which was a risk for the recurrence of injury [18].

Only three quarters of Slovenian teachers held a personal accident insurance at the time of injury, indicating a poor attitude towards their own professional safety, which is surprising as mere membership in the Slovenian PE Teachers' Association provides such insurance.

The results indicate that some urgent measures have to be taken, particularly in the groups with the highest risk of injuries, i.e., men and older teachers. This is especially important due to the extension of years of service. Most injuries are more frequent in men, which points to lower attention at work; in addition, men participate in ball sports in their leisure time more often [24]. It is recommended that aerobic activities should be practised, as studies in other countries indicate that teachers who participate in aerobic activities in their leisure time, experience health problems less often [9, 16].

Teachers should be considerably more cautious both when preparing for their lessons and during those lessons. Prior to demonstrating skills, teachers should warm up or use indirect demonstration methods (posters, video or pictures). Teaching how to teach PE in Slovenia is still directed too much toward teachers demonstrating skills and not enough to indirect methods of presenting movement [25]. It can be concluded that older teachers are less experienced in using information and communications technology [17, 25]; therefore, they should be taught different teaching methods (e.g., presenting motor skills with video recordings), as this approach could lead to a decrease in injury rates.

It is also particularly important that sports halls should have an adequate floor surface, as teachers listed poor surface as a cause of injuries. As a result of risk in the working environment, factors of professional risk and the effects of chronic injuries on the quality of work and life should be studied in detail. To maintain working ability, good preparation for work, understanding of the injury risk factors and injury mechanism [18], regular prevention exercises [9], suitable and sufficiently long rehabilitation after injuries [18] and especially aerobic leisure time activity [9] and healthy working environment are necessary. All teachers should also hold personal accident insurance, as the risk of injuries in their profession is high.

Limitations to the Study

Although a questionnaire with teachers reporting injuries themselves has low validity, it is the easiest way to obtain data [9]. Such research approach is appropriate as PE teachers during their studies learn in detail about the musculoskeletal system and injuries and so can reliably evaluate their own health status in relation to the characteristics of their profession. However, we cannot exclude the possibility of a selection bias, supposing that teachers concerned with work-related injuries were more inclined to complete the questionnaire. We must also stress the recall bias problem that other cross-sectional studies reported [9, 10], and urge for a prospective approach and systematic recording and reporting of injuries acquired during PE lessons, as only large prospective studies will result in clear and undisputable answers.

REFERENCES

1. Quick JC. Occupational health psychology: historical roots and future directions. *Health Psychol.* 1999;18(1):82–8.
2. Bogler R. Two profiles of schoolteachers: a discriminate analysis of job satisfaction. *Teaching and Teacher Education.* 2002;18:665–73.
3. Yezzi JA, Lester D. Job satisfaction in teachers. *Psychol Rep.* 2000;87(3 Pt 1):776.

4. Kovess-Masféty V, Sevilla-Dedieu C, Rios-Seidel C, Nerrière E, Chan Chee C. Do teachers have more health problems? Results from a French cross-sectional survey. *BMC Public Health*. 2006;6:101–13. Retrieved December 8, 2012, from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1523205/>.
5. Fejgin N, Ephraty N, Ben-Sira D. The work environment and burnout of physical education teachers. *J Teach Phys Educ*. 1995;15(1):64–78.
6. Ramzaninezha R, Hemmatinezhad MA, Nejadajadi A, Hoseini Keshtan M. Job retention factors among physical educators. *World Journal of Sport Sciences*. 2009;2(3):154–9. Retrieved December 8, 2012, from: [http://www.idosi.org/wjss/2\(3\)09/2.pdf](http://www.idosi.org/wjss/2(3)09/2.pdf).
7. Bizet I, Laurencelle L, Lemoyne J, Larouche R, Trudeau F. Career changes among physical educators: searching for new goals or escaping a heavy task load? *Res Q Exerc Sport*. 2010;81(2):224–32.
8. Sandmark H, Wiktorin C, Hogstedt C, Klenell-Hatschek EK, Vingard E. Physical work load in physical education teachers. *Appl Ergon*. 1999;30(5):435–42.
9. Lemoyne J, Laurencelle L, Lirette M, Trudeau F. Occupational health problems and injuries among Quebec's physical educators. *Appl Ergon*. 2007;38(5):625–34.
10. Sandmark H. Musculoskeletal dysfunction in physical education teachers. *Occup Environ Med*. 2000;57(10):673–7. Retrieved December 8, 2012, from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1739871/>.
11. Nelson NG, Alhadj M, Yard E, Comstock D, McKenzie LB. Physical education class injuries treated in emergency departments in the US in 1997–2007. *Pediatrics*. 2009;124(3):918–25. Retrieved December 8, 2012, from: <http://pediatrics.aappublications.org/content/124/3/918.long>.
12. André C, Cloes M, Deroanne R. La traumatologie des professeurs d'éducation physique [Traumatology of physical education teachers]. *Revue de l'Education Physique*. 1991;31(4):177–86.
13. Palma A, Mattos UA, Almeida MN, Oliveira GE. Level of noise at the workplace environment among physical education teachers in indoor bike classes. *Rev Saude Publica*. 2009;43(2):345–51. Retrieved December 8, 2012, from: http://www.scielosp.org/pdf/rsp/v43n2/en_7297.pdf.
14. Åstrand PO, Bergh U, Kilbom Å. A 33-year follow-up of peak oxygen uptake and related variables of former physical education students. *J Appl Physiol*. 1997;82(6):1844–52. Retrieved December 8, 2012, from: <http://jap.physiology.org/content/82/6/1844.long>.
15. Mišigoj-Duraković M, Duraković Z, Ružič L, Findak V. Gender differences in cardiovascular diseases risk for physical education teachers. *Coll Antropol*. 2004;28 Suppl 2:251–7.
16. Pihl E, Matsin T, Jürimäe T. Physical activity, musculoskeletal disorders and cardiovascular risk factors in male physical education teachers. *J Sports Med Phys Fitness*. 2002;42(4):466–71.
17. Kovač M, Sloan S, Starc G. Competencies in physical education teaching: Slovenian teachers' view and future perspectives. *European Physical Education Review*. 2008;14(3):299–323.
18. Bahr R, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. *Br J Sports Med*. 2005;39(6):324–9. Retrieved December 8, 2012, from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1725226/pdf/v039p00324.pdf>.
19. Jurak G, Strel J, Kovač M, Bednarik J, Filipčič T, Leskošek B, et al. Analiza šolskega športnega prostora s smernicami za nadaljnje investicije. Končno poročilo [Analyses of school sport infrastructure with guidelines for further development. Final report]. Ljubljana, Slovenia: Fakulteta za šport; 2012.
20. Olsen OE, Myklebust G, Engebretsen L, Holme I, Bahr R. Relationship between floor type and risk of ACL injury in team handball. *Scand J Med Sci Sports*. 2003;13(5):299–304.
21. Pasanen K, Parkkari J, Rossi L, Kannus P. Artificial playing surface increases the

- injury risk in pivoting indoor sports: a prospective one-season follow-up study in Finnish female floorball. *Br J Sports Med.* 2008;42(3):194–7.
22. Monteiro MS, Alexandre NMC, Ilmarinen J, Rodrigues CM. Work ability and musculoskeletal disorders among workers from a public health institution. *International Journal of Occupational Safety and Ergonomics (JOSE)*. 2009;15: 319–24. Retrieved December 8, 2012, from: <http://www.ciop.pl/31331>.
 23. Drago JL, Braun HJ. The effect of playing surface on injury rate: a review of the current literature. *Sports Med.* 2010;40: 981–90.
 24. Starc G, Sila B. Ura športa na dan prežene vse težave stran: tedenska športna dejavnost odraslih v Sloveniji [An hour of sport a day takes all troubles away: weekly sporting activity of adults in Slovenia]. *Šport.* 2007;55(3):27–36.
 25. Kovač M, Jurak G, Starc G, Strel J. The importance of research-based evidence for political decisions on physical education. In: Hardman K, Green K, editors. *Contemporary Issues in Physical Education: International Perspectives*. Maidenhead, UK: Meyer & Meyer Sport; 2011. p. 47–68.