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Epidemiology of Strains in Greek Facilitation Classes

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The purpose of the present investigation was to record epidemiologically the strains that occurred in students of the Athletic Facilitation Classes (AFC). The study was carried out at National Level from September 2006 to May 2007 and during this period, we followed 7455 male and 4921 female student-athletes. The data that were recorded by the physical education teachers of the AFC, were registered in SPSS and they were analyzed with χ^2 non-parametric test. During the study a percentage of 19.6 % of total (n = 223) of injuries were strains. One hundred and sixty four (n = 164) strains (73.4%) occurred in the male and fifty nine (n = 59, 26.5%) in female student-athletes (p<0.04). Most strains were recorded in the male than in female student-athletes that attended in AFC, which functioned in the urban regions of prefectures (80.5 vs. 19.5, $\chi^2 = 12.04$, df = 1, p<0.001). A significant number of strains occurred during the months of November (82.3 vs. 17.7, $\chi^2 = 4.69$, df = 1, p<0.03), while the sports in which most strains occurred were soccer, track and field, basketball, bavalleyball and handball. The training surface on which most strains occurred was the synthetic floor, natural grass and the parquet. It is concluded that the epidemiology of the strains in the AFC, have the same patterns as in the current literature is described.

Key words: Muscle strains, athletic facilitation classes, injuries

INTRODUCTION

The Athletic Facilitation Classes (AFC) has developed by the Hellenic Ministry of National Education and Religious Affairs (HMNERA) in 1990 within the middle and high school curriculum. Each selected school operates with two AFC at least. In each AFC, participate about ten students/athletes for team sports and seven for individual sports. Registration of the students in AFC becomes after specific evaluations in various athletic activities. The purpose of AFC developing was to ensure more training and competition opportunities to talented students-athletes for special team and individual sports.

Although, the participation in sports in a regular basis is important for physiological growth and socialization, excessive training and participation in competitive sports subject students to a greater risk of injury than their peers of regular schools (Sumilo and Brown, 2006).

The movement of a human is ensured by the coordination of the muscle/tendon units, that acting in bones via a levers system. During intensive athletic activities such as soccer, basketball, volleyball, running, high jump or triple jump, the muscles absorb large amounts of energy in order to protect the soft tissues from injuries. Sometimes when the producing load is too high, the muscles/tendon units fail to achieve their roles with the result of getting injured.

A muscle strain is an injury, that occurs in the region of the musculotendinous junction after a sudden excessive stretch or by a tension that can not be absorbed.

In the current literature there are a lot of studies investigating the epidemiology of school sport-related injuries (Sørensen *et al.*, 1996; Weir and Watson, 1996; Di Scala *et al.*, 1997; Menckel and Laflamme, 2000; Stergioulas and Mandilas, 2003). Some studies confirmed that the strains appear to be second type of injury in high school athletes (Nelson *et al.*, 2007).

Most of prior strains injury studies that conducted among school age population, who participate in sports, included single sports with limited sample sizes (Verhagen *et al.*, 2004; Collins and Comstock, 2008). However, no epidemiological investigation studied the details of strains in AFC. Therefore, the purpose of the present study was to determine: (1) the incidence of strains in the AFC, (2) the incidence of strains in relation to place of residence, sport, class, training surface, (3) the muscles/tendons units that sustained a strain injury and (4) the differences in all above mentioned parameters amongst male and female students-athletes.

MATERIALS AND METHODS

The present investigation was carried out by the Lab of Health, Fitness and Disability Management, Faculty of Human Movement and Quality of Life, University of Peloponnese and started on January 2005 and finished at the end of December 2008. In order to conduct the study, the researchers took the permission from the Central Committee of AFC-HMNERA. Then sent the research package to the Director of Physical Education (PE) at HMNERA. This package included a cover letter, a questionnaire and the injury report form. In the cover letter the researchers described the study details. At the beginning of the school year 2006-07, the director of the Department of PE informed all PE teachers of AFC by e-mail about the research project and their duty to record and send weekly injury reports to the department of PE at HMNERA. In the present investigation participated all students-athletes that attended AFC at a national level during the 2006-07 school year. During the study period, 1302 AFC were functioning and 12376 students-athletes attending the program for 39 different sports. Certified PE teachers (n =1302) participated in the study as data reporters.

Definition of term strain and collection of data: In order to construct the final report form for the present study, the researchers took into consideration the injury report forms of (1) student accident report form (Sun *et al.*, 2006), (2) student injury and incident report for use in swedish schools (Laflamme *et al.*, 1998; Laflamme and Petersson, 1998), (3) student accident report form (Yang *et al.*, 1998) and (4) incident report form (Stark *et al.*, 1996).

In the final report form the investigators included: (1) anthropometric characteristics of male and female students-athletes of AFC (region of residence, class, sex, age, height, body mass, body mass index, (2) information regarding the sport (training surface, supplements of diet, kind of athletic shoes, preventive taping, number of matches played) and (3) information about strains (month of injury, pattern, degree, preliminary diagnosis and first aid).

The second report form included the diagnosis of the strain, the treatment (surgery, time of rehabilitation, time of absence from school and time absence from training and competition). The PE teachers recorded all strains that occurred in AFC during training, as well as those that occurred during competition for individual (track and field, wrestling, gymnastics, etc.) and team sports (basketball, soccer, volleyball, etc.).

As reportable strain was defined an injury to a muscle/tendon unit, that occurred during participation in a sport (training, competition) and limits student-athlete's participation the following day of injury or requires further medical attention (Garrett and Duncan, 1988).

The concentration of the data in weekly basis and their transmission via e-mail to the Department of Physical Education in the HMNERA minimized the possibility to forget recordings of student-athletes. Moreover, the physical education teachers with the second form that supplemented, gave all the information that was related to the rehabilitation process of the students-athletes and their return to school.

Statistical analysis: All strain data were coded for male and female student-athletes using month, place of residence, sport, class of enrolment and playing surface as categorical variables. Statistical analysis were carried out using Statistical Package for Social Sciences (version 14, SPSS inc. Chicago) software. Frequencies of strains were calculated for the aforementioned categorical variables. Statistical significance of differences among the variables was estimated using the non-parametric χ^2 test (applying Fisher's exact test where appropriate). Statistical significance was set at $p < 0.05$ for all analysis (Kabitsis, 2004).

RESULTS

During the study that lasted from the beginning of September, 2006, until the end of the June, 2007, $n = 223$ strains were recorded. One hundred sixty four strains (73.4%) occurred in male and 59 (26.5%) in female student-athletes ($p < 0.04$). Most of the strains occurred during the months of November, December, January, February and March. Significant difference in frequencies was observed between male and female athletes only the month of November (82.3% vs. 17.7%, $\chi^2 = 4.69$, $df = 1$, $p < 0.03$, Table 1).

Most of strains occurred in the male students/athletes, who attended AFC, that operated in the urban regions (80.5 vs. 19.5%, $\chi^2 = 12.04$, $df = 1$, $p < 0.001$, Table 2). Males that participated in the sport of soccer, sustained the majority number of strains ($n = 93$). Then, followed the sport of in track and field with $n = 29$ strains (44.8% in male vs. 55.2%, in female students-athletes, $\chi^2 = 4.95$, $df = 1$, $p < 0.02$), handball with 25 strains (44.0 vs. 56.0%, $\chi^2 = 4.63$, $df = 1$, $p < 0.03$) and volleyball with 12, (16.6% in males vs. 83.4%, $\chi^2 = 12.04$, $df = 1$, $p < 0.001$, Table 3). Although, the frequency of the strains was similar to all classes, the significant difference between male and female was observed only in the number of the

Table 1: Frequencies of strains according to the recording month

Month	Males		Females		χ^2 df = 1
	N	%	N	%	
September 2006	3	100.0	0	0.00	0.00
October 2006	10	100.0	0	0.00	0.00
November 2006	28	82.3	6	17.7	4.69*
December 2006	21	77.7	6	22.3	2.05
January 2007	23	76.6	7	23.4	1.91
February 2007	36	62.0	22	38.0	0.16
March 2007	21	70.0	9	30.0	0.38
April 2007	11	78.5	3	21.5	1.20
May 2007	11	64.7	6	35.3	0.11

* $p < 0.03$

Table 2: The incidence of strains according to the place of residence

Place of residence	Males		Females		χ^2 df = 1
	N	%	N	%	
Rural region	30	77.5	11	22.5	1.32
Urban region	87	80.5	21	19.5	12.04*
Capital of Prefecture	30	71.4	12	28.6	0.86
Athens/Thessaloniki	17	53.1	15	49.9	1.83

* $p < 0.001$

Table 3: Strains according to sport participation

Sport	Males		Females		χ^2 df = 1
	N	%	N	%	
Track and field	13	44.8	16	55.2	4.95**
Swimming	4	80.0	1	20.0	0.52
Soccer	93	100.0	0	0.0	0.00
Basketball	12	70.5	5	29.5	0.27
Volleyball	2	16.6	10	83.4	12.04††
Handball	11	44.0	14	56.0	4.63†
Gymnastics	2	28.5	5	71.5	3.97**

* $p < 0.05$; ** $p < 0.02$; † $p < 0.03$; †† $p < 0.001$

Table 4: Strains and attending class

Classes	Males		Females		χ^2 df = 1
	N	%	N	%	
First	46	70.1	19	29.9	1.08
Second	56	70.0	24	30.0	1.03
Third	62	79.4	16	20.6	7.58*

* $p < 0.05$

Table 5: The playing surface and strains

Playing surface	Males		Females		χ^2 df = 1
	N	%	N	%	
Natural grass	54	100.0	0	0.00	0.00
Tartan	10	52.6	9	48.4	1.19
Earth	10	58.8	7	41.2	0.25
Synthetic floor	43	71.6	17	28.4	1.32
Parquet	20	55.5	16	44.5	1.28
Cement	12	85.8	2	14.2	2.73
Tapi	12	85.8	2	14.2	0.25

strains suffered by male student-athletes, who attended the third class (79.4 vs. 20.6 %, $\chi^2 = 7.58$, $df = 1$, $p < 0.005$, Table 4). Most of the strains occurred in playing surfaces such as natural grass, synthetic floor and parquet, while no significant differences were observed between male and female students/athletes (Table 5). The

Table 6: Muscle/tendon units strains

Muscles	Males		Females		χ^2 df=1
	N	%	N	%	
Quadriceps	58	70.7	24	29.3	1.95
Abductors	49	74.2	17	25.8	1.41
Hamstring	36	73.4	13	26.6	1.55
Gastrocnemius	12	85.7	2	14.3	4.11*
Other	9	75.0	3	25.0	1.72

*p<0.04

Table 7: Degrees of strains

Injury degree	Males		Females		χ^2 df=1
	N	%	N	%	
First	103	80.4	25	19.6	14.12††
Second	61	64.3	34	35.7	0.14
Third	0	0.0	0	0.0	0.00

††p<0.001

muscle/tendon units in which occurred most strains were quadriceps, abductors, hamstring and gastrocnemius. The significant difference between male and female students/athletes was observed only in the number of gastrocnemius strains (85.7 vs. 14.3 %, $\chi^2 = 4.11$, df = 1, p<0.04, Table 6). Most of strains that the females students-athletes suffered were of the first degree (80.4 vs. 19.6, $\chi^2 = 14.12$, df = 1, p<0.01, Table 7).

DISCUSSION

The purpose of this trial was to record strains in large populations, which were 7455 male and 4921 female students/athletes, who participated in a variety of sport activities in all AFC between October 2006 up to the end of May 2007.

The results of our study revealed that the most strains occurred in males rather than in female student-athletes of AFC. Both genders suffered more strains during the month of February, while in November there were significant differences between them. Although many male and female students/athletes participated in a variety of sports, soccer was one in which more strains occurred in males. A large percentage of strains occurred in students who were residents of schools that functioned in urban regions and attended AFC in the third class. More strains occurred in students that practiced on synthetic floor. Moreover, the muscle/tendon units that injured both male and female students/athletes were the quadriceps. In the present investigation we selected a definition for the strain that had been used by Garrett and Duncan (1988).

We found that of all injuries 19.6% were strains. These results are comparable with the below studies. Yard *et al.* (2008), found an incidence of 17.9% muscle strains, in a population of 637446 athlete exposures.

Collins and Comstock (2008) conducted in other study in the 2005-2006 and 2006-2007 school years from a nationally representative sample of 100 US high schools by using an injury surveillance system, determined that the incidence of muscle strains was 20.1%.

Borowski *et al.* (2008) conducted a study collected basketball-related injury data during the 2005-2006 and 2006-2007 academic years from 100 nationally representative. They found that the high school basketball players sustained 1518 injuries during 780 651 athlete exposures for an injury rate of 1.94 per 1000 athlete exposures. A 17.7% of the most frequent injury diagnoses were muscle/tendon strains.

Most of the strains (n = 58) were occurred in the month of February. It seems that in this month students athletes are participating in a larger number of the training sessions and games. Also, in the winter months the temperature is low and the weather affects the biomechanics of the muscle/tendon units of the lower extremities and become more prone to injuries. The above results are similar with the study of Backx *et al.* (1991).

Also, it was observed that one hundred and eight strains occurred in male/female student-athletes that attended the AFC, which functioned in urban of prefectures, with the males to sustain more injuries than females. A possible explanation of this discrepancy is the sport facilities in Urban regions, that is not maintaining in a good condition.

We found that strain rates were similar for males and the female students-athletes at all classes, with the males to sustain more strains in the third class. Some studies supported that more injuries occurred in the students that attended the first class (Stark *et al.*, 1996; Maitra, 1997), while others found the students of the third class suffered more strains (Jovic *et al.*, 2001; Damore *et al.*, 2003).

According to the sport in which the most strains occurred, the soccer was the first followed by track and field, handball, basketball and volleyball. Although, there no epidemiological publishing studies in the classical athletic school as functioned in the Eastern European countries to investigate the incidence of the strains, the results of our study are similar with the most of investigations (Collins and Comstock, 2008; Borowski *et al.*, 2008).

Natural grass and synthetic floor were the playing surfaces in which most strains were occurred. Since in the above two playing surfaces conducted the majority of sports, like soccer, basketball and handball it is logical this increasing rate. The results of our study agree with the results of others studies (Di Scala *et al.*, 1997; Laflamme *et al.*, 1998; Sumilo and Brown, 2006).

It is well accepted that in the sport in which the muscle/tendon units of the lower extremities is using, are sustained more strains. We found that quadriceps, abductors and hamstring were the muscles that injured more in both males and females students-athletes. The results of our study was confirmed by many studies with small differences in the injury pattern of strains (Damore *et al.*, 2003; Stergioulas and Mandilas, 2003; Collins and Comstock, 2008; Tyflidis *et al.*, 2009).

Finally, we found that 57.39% of strains were first degree and the rest second degree. It seems that in the school age population do not occur third degree strains. An explanation for this is the increasing elasticity of the muscle tendon units, that is owed in the positive biomechanical behaviour of collagen. Present results are in line with the other studies (Backx *et al.*, 1991; Damore *et al.*, 2003).

The data of present study collected by PE teachers of the AFC. It is believed that PE teachers are the most appropriate authorities to record injuries, since in our country there are no school nurses or school doctors. The PE teachers are with student-athletes every day throughout the entire academic year and they know them very well. All PE teachers manifest very good responsibility and a high sense of duty.

CONCLUSION AND RECOMMENDATION

Our investigation revealed that the strains were the second type of injuries with male student-athletes to suffer more than female. Also, more strains occurred in the third class, in schools that is functioned in the urban regions and in the winter months, especially the November. The track and field, soccer, basketball, volleyball and handball were the sports in which the students-athletes injured more. The majority of the strains was first and second degree and injured mostly the muscle/tendon units of quadriceps, abductors and hamstring that occurred in the playing surface as the synthetic floor.

The PE teachers of the AFC should be given emphasis in the stretching techniques that might include in the warming up and cooling dawn sessions. Also, the conditions of playing surfaces should be improved in order students/athletes to compete in a safe and healthy environment. Finally, PE teachers should exert better supervision and guidance of students/athletes during training.

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